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The Eurasian Wheat Belt and Food Security

Global and Regional Aspects

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Preface and Acknowledgements

This book is a comprehensive compilation of the principal issues and outcomes of the Joint Research Centre of the European Commission workshop on 'The role of the Eurasian wheat belt to regional and global food security' held in Istanbul, Turkey, between 20 and 22 May 2014.

Following the workshop analysis and discussion, this book gives a particular and comprehensive technical overview of the wheat production and the main factors for achieving full production potential across the Eurasian wheat belt with regard to national, regional and global issues of cereal supply and food security in evolving global markets. It reviews key horizontal issues, such as land policy, credit and finance, privatisation, farm structures, social consequences of transition and environmental challenges, against the backdrop of agrarian reforms implemented during the transition period from central planning to a market economy. In addition, the report explores production potential and corresponding institutional and policy restrictions in a series of Eurasian countries. The special emphasis of the book is on the RUK countries (Russia, Ukraine and Kazakhstan), although it also discusses the emergence and potential importance of new production regions covering other Eurasian countries such as Belarus, Turkmenistan, Uzbekistan and Caucasian countries. The report covers current and potential future market developments in the Eurasian region as well as in a wider global context, in particular with respect to the emergence of China and India and their respective needs, challenges and lessons. Finally, the book closes with expert opinions on policy-relevant conclusions as a basis for policy suggestions and recommendations. It is envisaged that this book can provide a valuable source of technical and conceptual information for ongoing policy considerations, at both the Eurasian and the wider global level with respect to international concerted efforts to secure reliable sources of cereal production. It is stressed that the views and opinions expressed in this book are those of the authors and do not in any way represent a view or opinion of the European Commission or of any other institution with which they are associated.

We would like to thank all participants who readily gave their expertise in regional and global food security, the challenges of wheat production from across the Eurasian wheat belt region and complex issues associated with national, regional and global economic and market drivers, presented and discussed at the workshop: Janetta Azarieva (Hebrew University of Jerusalem, Israel), Jacques Delince (Joint Research Centre, Spain), Thomas Fellmann (Joint Research Centre, Spain), Andrew Fieldsend (Research Institute of Agricultural Economics, Hungary), Giampiero Genovese (Directorate-General for Agriculture and Rural Development, Belgium), Michiel Keyzer (Centre for World Food Studies, The Netherlands), Nina Ladonina (Space Research Institute, Russia), Zvi Lerman (Hebrew University of Jerusalem, Israel), Bill Liefert (US Department of Agriculture, USA), William Meyers (University of Missouri, USA), Ashok K. Mishra (Arizona State University, USA), Alexander Nikulin (Centre for Agrarian Studies, Russia), Dauren Oshakbaev (private consultant, Kazakhstan), Nikolay Pugachov (National Science Centre Institute for Agrarian Economics, Ukraine), Dmitry Rylko (Institute for Agricultural Market Studies, Russia), Valery Saraykin (Russian Institute for Agrarian Issues and Informatics, Russia), David Sedik (Food and Agriculture Organization of the United Nations, Hungary), Natalia Shagaida (Academy of National Economy and Public Administration, Russia), Alexander Shpak (Institute for System Research of Agrofood Sector, Belarus), Ivan Stanchin (Voronezh Economic-Legal Institute, Russia), Vassily Uzun (Academy of National Economy and Public Administration, Russia), Peter Voigt (Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Germany), Renata Yanbykh (Russian Institute for Agrarian Issues and Informatics, Russia) and Holly Wang (Purdue University, USA).

Last but not least, we would like to thank John Bensted Smith, director of JRC.B - Growth and Innovation, who encouraged us to engage in the analysis of the farming sector in the Eurasian cereal belt, which ultimately led to the organisation of the workshop whose major results are reported in this book.

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List of Abbreviations

ACC	Agrarian Credit Corporation
AGLINK-COSIMO	Worldwide Agribusiness Linkage Program + Commodity Simulation Model
AI	Aridity index
AMS	Aggregate measure of support
BGREI	Bringing Green Revolution in Eastern India
CAP	Common Agricultural Policy
CCI-RISE	Center for Citizens' Initiatives
CEE	Central and Eastern Europe
CIS	Commonwealth of Independent States
CPI	Consumer Price Index
CV	Coefficient of variation
DCFTA	Deep and Comprehensive Free Trade Area
DDGS	Distillers dried grains with solubles
EDB	Eurasian Development Bank
ERS	Economic Research Service
ETo	Evapotranspiration
EU	European Union
FADN	Farm Accountancy Data Network
FAO	Food and Agriculture Organization of the United Nations
FI	Fournier index
FINCA	Foundation for International Community Assistance
FDI	Foreign direct investment
FTA	Free trade agreement
GAEZ	Global Agro-ecological Zone
GAO	Gross agricultural output
GDP	Gross domestic product
GDPD	Gross Domestic Product Deflator
GOST	Gosudarstvennyy Standart (State Standard)
GSP	Generalized System of Preferences

GVA	Gross value added
IAMO	Leibniz Institute of Agricultural Development in Transition Economies
IIASA-FAO	International Institute for Applied Systems Analysis–Food and Agricultural Organization
MFN	Most favoured nation
MSP	Minimum support price
NFSM	National Food Security Mission (India)
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
PSE	Producer support estimate
R&D	Research and development
RANEPA	Russian Presidential Academy of National Economy and Public Administration
RCA	Revealed Comparative Advantage
RKVY	Rashtriya Krishi Vikas Yojana
RUK	Russia, Ukraine, Kazakhstan
RWMN	Russian Women's Microfinance Network
SI	Soil suitability index
SMPs	Small and medium-sized agricultural producers
TFP	Total factor productivity
TPDS	Targeted Public Distribution System
TRQ	Tariff rate quota
UAH	Ukrainian hryvnia
UGS	United Grain Company
USD	United States dollar
USDA	United States Department of Agriculture
USSR	Union of Soviet Socialist Republics
VAT	Value-added tax
WWF	World Wildlife Fund
WTO	World Trade Organization

Contents

Part I
The Commercial and Institutional Framework of the Eurasian Wheat Belt Region

Introduction

Pavel Ciaian, Sergio Gomez y Paloma, Sébastien Mary, and Stephen Langrell

Food security—at regional, national and global levels—is a major societal concern. In the light of an increasing population, which is expected to be almost 10 billion in 2050 compared with about 7 billion currently, it is a fact that world food production has to be massively increased. Estimates vary on how much; the actual figure depends on the extent that growth in the 'emergent' economies triggers a switch to a more animal-product-oriented diet. Basically, there are only two ways to achieve such a growth in food production: (1) expanding the amount of land used for agriculture and/or (2) increasing crop yields and total factor productivity. Whereas agricultural productivity was rising during recent decades in the USA, Europe and also some developing countries, the growth rates have lately appeared to be slowing down, and the potential to increase the amount of land use for food production in these regions is quite limited. In fact, the only region of the world with a significant amount of arable land that currently is not under cultivation and that at the same time is experiencing rising productivity figures, is the so-called 'Eurasian wheat belt', comprising Russia, Ukraine, Kazakhstan (RUK) and the other Central Asian countries, namely Uzbekistan, Tajikistan, Turkmenistan and Kyrgyzstan. This makes this region a hot spot for investigating the future perspectives in terms of food production and food security.

In the light of this, the Joint Research Centre of the European Commission organised a thematic workshop, held during 20–22 May 2014 in Istanbul/Turkey, to bring experts on the matter together and to discuss to what extent these countries could play a role in regional and international food security. A particular emphasis was

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on the potential of wheat production and its contribution to regional and global food security. In this context, the current stage and the persistence of the transition processes as well as the reliability and quality of the implemented institutional framework were discussed, remaining challenges and policy/reform agendas were outlined and, moreover, relevant aspects of changing natural conditions were taken into account (such as impact of climate change, water availability and land degradation).

This book summarises the main findings from the workshop, which include both comparative analyses across the Eurasian countries and an in-depth analysis of key issues determining the development of the wheat sector and the agricultural sector in general. The book also highlights the main factors affecting the future potential development of the wheat sector in the Eurasian region. Additionally, to provide a comprehensive analysis of the wheat sector, the book covers policy and structural development of the agricultural sector in Eurasia. The analysis is relevant for understanding structural drivers underpinning the general agricultural developments of which the wheat sector is an inseparable component. For this purpose the book reviews key horizontal issues, such as land policy, agricultural credit and finance, privatisation, farm structures, social consequences of transition and environmental challenges, against the backdrop of agrarian reforms implemented during the transition period from central planning to a market economy.

The special emphasis of the book is the RUK countries and Central Asia. However, Belarus and Caucasian countries (Armenia, Azerbaijan, Georgia) are also considered when relevant for comparison purposes. All these countries were formerly part of the USSR and are also referred to in this book as the Commonwealth of Independent States (CIS).

The CIS countries share a common history as part of the USSR prior to its dissolution in 1991. During this period the agricultural sector was organised in large collective and state farms, the allocation of resources was centrally planned and means of production were state owned. The transition process initiated in the early 1990s led to the abolition of the centrally planned economic system with the aim of creating a market-driven economy. However, this process diverged considerably across the CIS countries, resulting in differences in the organisation and performance of the agricultural sector. These structural differences largely determined the wheat-sector developments over the last two decades, define its current state and determine its potential future growth.

The Eurasian region is a key player in the world agricultural markets in general and in wheat market in particular. Sizeable land resources relative to total population give the CIS a strong predisposition to contribute to the regional and global food security. CIS countries account for 11 % of the world's agricultural area and 13 % of the world's arable area (Fig. 1). Low population density allows the CIS to employ the available land resources to supply food to world regions with lower agricultural production potential. Agricultural area per capita is almost three times higher in the CIS than the world average −2 ha per capita in CIS versus 0.7 ha per capita in the world—whereas for the European Union (EU), China and India the area per capita is much lower at 0.36, 0.36 and 0.14, respectively.

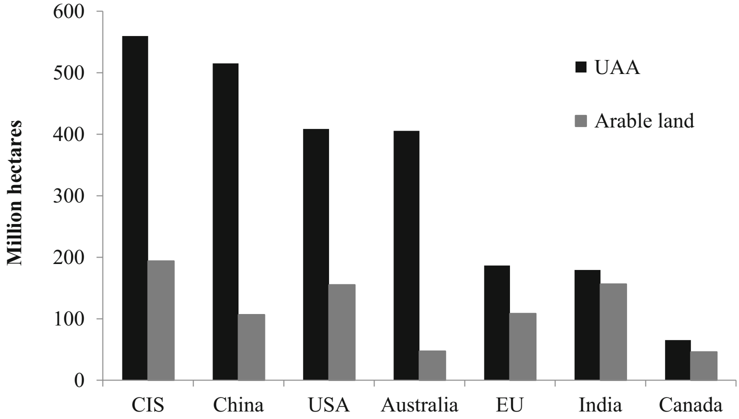

Fig. 1 Global comparison of total agricultural area and arable area, 2012. UAA, utilised agricultural area. Source: FAO

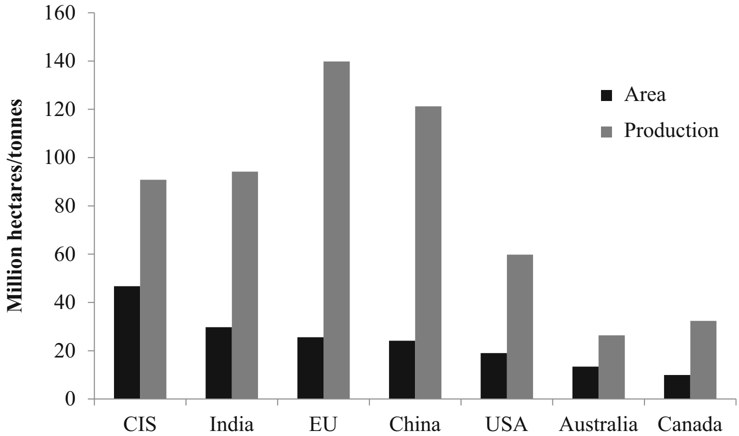

Fig. 2 Global comparison of wheat area and wheat production, average 2012–2013. Source: FAO

The CIS is the largest world producer of wheat in terms of cultivated area and fourth in terms of attained production level (Fig. 2). However, yields are low by international standards and in comparison with other developing countries such as India and China (Fig. 3). The yield gaps between the CIS countries and the EU, China, the world average and India are 65 %, 61 %, 40 % and 39 %, respectively. If the CIS becomes as productive as other wheat-producing regions, it may generate a substantial additional supply of wheat to world markets and contribute to future global food security. The CIS already contributes to global food security by supplying a large share of its production to world markets. The CIS is the third-largest wheat exporter in the world (Fig. 4).

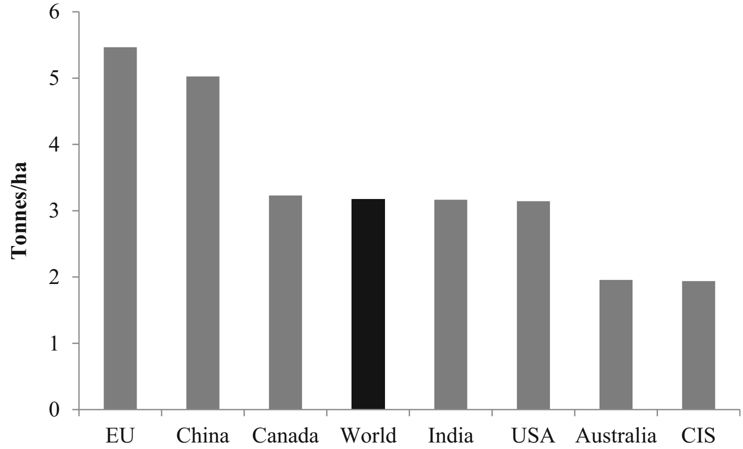

Fig. 3 Global comparison of wheat yields, average 2012–2013. Source: FAO

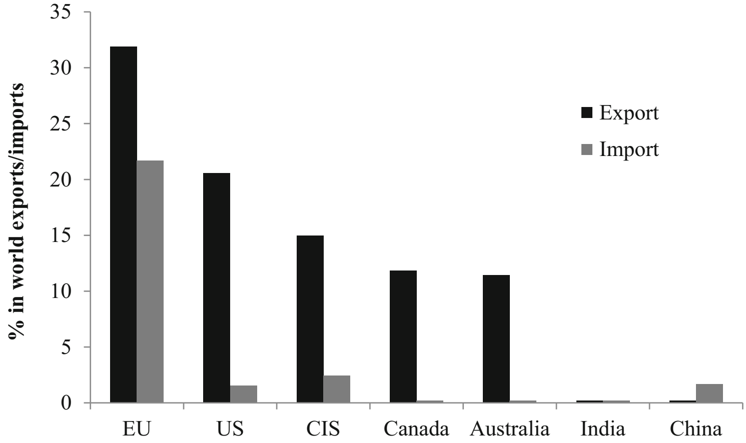

Fig. 4 Share of wheat exports and imports in world exports and imports, respectively: a global comparison (%, average 2010–2011). Source: FAO

The main players among the CIS countries are Kazakhstan, Russia and Ukraine. These three countries together account for more than 90 % of agricultural area and arable area, 90 % of wheat area, 85 % of wheat production and more than 95 % of wheat exports in the CIS.

The insights summarised in this book will, we hope, contribute to a better understanding of the fundamental economic factors affecting the Eurasian wheat sector and its potential growth and implications for the regional and global food security. This may help to identify challenges and design policies about land, agriculture, the environment, etc., with the ultimate aim of improving the competitiveness and sustainability of the wheat sector in Eurasia.

The book is organised in four parts. The first part presents agrarian reforms by taking a historical overview of institutional changes during the transition period. The second part presents agricultural policies and their developments and implications for agriculture in general and the wheat sector in particular. The third part discusses the future potential of wheat production and its contribution to regional and global food security. The fourth part provides global perspectives, horizontal drivers and uncertainties affecting wheat-sector development in the Eurasian region. Alongside these four parts, a concluding section is also included, which provides summary analysis and policy recommendations.

In Chapter "Privatization and changing farm structure in the Commonwealth of Independent States", *Zvi Lerman* explains the agrarian reforms implemented in the CIS during the transition period. The chapter also discusses impacts of the reforms on the rural economy and draws out some policy implications relevant to enhancing the agricultural sector's development. As highlighted in the chapter, the most striking feature of land reform in the post-Soviet space has been the overall shift from collective to individual land tenure in agriculture, generally accompanied by privatisation of legal landownership. Individualisation of farming has been among the main factors that acted to arrest the initial decline in production during the transitional period and to bring about agricultural recovery in the region. The recovery point for agricultural growth is closely linked with the observed watershed dates for individualisation of farming. Furthermore, the rate and the attained level of recovery are higher in countries that pursued decisive individualisation policies (Caucasian countries, Central Asia), while in countries with less sweeping individualisation reforms (European CIS) the recovery has been sluggish. Land reform and individualisation have also led to significant improvements in agricultural productivity due to the higher incentives in family farming. Greater production and higher productivity have contributed to significant poverty reduction. The chapter highlights that, to ensure continued improvement of rural family incomes and poverty mitigation, policy measures should be implemented that facilitate enlargement of very small family farms and encourage the access of small farms to market channels and services.

In Chapter "Land Policy in Russia: New Challenges", *Natalya Shagaida* and *Zvi Lerman* examine in more detail the outcomes of 20 years of land reform in Russia's agriculture. They focus the analysis specifically on landownership structure development and corresponding future challenges in the context of the risks voiced at the beginning of the reform process. Russia's land policy has gone through several stages since the beginning of reform: from clearly formulated policies and procedures in the early 1990s to a set of administrative activities entrusted to disjointed land authorities at the present time. Despite institutional difficulties, the land market appears to be emerging in Russia: land has become transferable, it is actively redistributed between individual farms and corporate farms and it is reallocated to new users. The chapter also points out that, in the absence of an institution that would control and manage the land resources, the land policy is unable to respond to new challenges that arise in the course of the ongoing land market developments.

Availability of financial resources is critical to the growth and development of productivity in agriculture and this has been identified as one of the constraints on realising the agricultural potential of the Eurasian wheat belt region. In this context, in Chapter “Credit and Finance Issues in the Eurasian Wheat Belt”, *Kateryna G. Schroeder* and *William H. Meyers* use examples from Kazakhstan, Russia and Ukraine, as well as other countries in central and eastern Europe, to identify key constraints on well-functioning credit and finance markets and discuss issues and potential remedies for the future. The scope of the chapter includes short-term operating capital, medium-term credit for durable assets and long-term credit for investment, and it addresses bank credit as well as various other alternatives. It is recognised that the basic conditions for well-functioning market institutions, including for commodities, land and finance, take a long time to achieve, so innovations are needed to bridge these gaps. The chapter explores successes and failures in the past experiences of transition in countries in Europe and Central Asia to assess future strategies and alternatives for the CIS.

In Chapter “Agrarian reforms in Ukraine”, *Volodymyr Pugachov* and *Nikolay Pugachov* examine the outcomes of agrarian reform in Ukraine. Ukraine went through a substantial reform process between 1991 and 2010. The key priority of the reform was the adoption of a market-based institutional framework. Establishing a market-based agricultural sector in Ukraine required deep agrarian reforms, whose main components were land privatisation and farm restructuring. Other elements of the reforms included establishing a market infrastructure for trading farm products as well as reforming the tax, agricultural support and credit systems. Besides discussing the outcomes of the agrarian reform in Ukraine, the chapter also reflects on successes and failures of the reform process and highlights the potential future directions of a successful completion of agricultural reform.

In Chapter “Outcomes of Agrarian Reform in Russia”, *Vasiliy Uzun* and *Zvi Lerman* analyse the outcomes of agrarian reform in Russia. The reform has led to a clear change in the agrarian system in Russia, but not all the population, especially not all rural people, have come out as winners. The observed increase in agricultural labour productivity has been accompanied by shedding of labour in agriculture and increasing rural unemployment; the higher productivity of livestock has been accompanied by herd contraction; improved input efficiency has been accompanied by reduction of input use; improved financial stability of agricultural producers has been accompanied by more frequent bankruptcies; and increase of total support to agriculture has been accompanied by reduced efficiency of the support. So far, Russia has not reached the pre-reform production level, and food self-sufficiency is below 90 %. A new middle class has not emerged in rural areas: most rural people are the new ‘proletariat’; they earn their livelihoods as hired workers and many of them have lost their land. It is observed that agricultural production is increasingly concentrated in large vertically integrated structures with a multiplicity of agricultural subsidiaries that are without analogues in developed economies. The chapter shows that the evaluation of Russia’s reform requires a multi-faceted analysis of the entire range of outcomes, accounting for all effects including the adverse impacts.

In Chapter “More than pouring money into an ailing sector? Farm-level financial constraints and Kazakhstan’s “Agribusiness 2020” strategy”, *Martin Petrick*, *Dauren Oshakbaev* and *Jürgen Wandel* analyse agricultural credit and capital subsidies in Kazakhstan. Kazakhstan’s agricultural development strategy relies on capital subsidies as a main engine for boosting competitiveness. The authors argue that this approach under-estimates the knowledge and incentive problems inherent in state-guided management of sector development. Based on unique farm-level data, they examine the financial constraints actually perceived by farmers. According to their results, most farm managers doubt that agricultural investments deliver a sufficiently reliable return for credit funding, so they avoid taking out loans. They conclude that, rather than pouring money into the sector, the government should improve the local institutional environment and invest in public services relevant to agriculture.

It is often argued that the CIS countries are an important source of price volatility in international commodity markets. In Chapter “The New Wheat Exporters of Eurasia and Volatility”, *David Sedik* explores in detail the role the CIS countries have in contributing to the volatility of international wheat prices. The chapter argues that studies of the connection between the CIS wheat trade and international price volatility have predominantly focused on export restraints imposed by these countries. The chapter also goes beyond export restraints as a source of international price instability, pointing to two further potential sources of price volatility: production volatility and growing state intervention in grain markets in the wheat-producing CIS countries. Production volatility is caused mostly by weather variation and other agronomic factors. Such volatility has an understandable scientific basis, and can be controlled by the use of more inputs and better agronomic practices. Political border interventions aimed at limiting grain exports are of a different nature, since they are highly unpredictable. In this respect they are akin to the increased state measures, aimed at ‘stabilising’ and exerting state control over grain markets, observed in the CIS wheat sector since 2001. Taken together, these policies do not bode well for the stability of grain prices.

In Chapter “Unlocking Ukraine’s production potential”, *Michiel A. Keyzer*, *Max D. Merbis*, *Alex N. Halsema*, *Valeriy Heyets*, *Olena Borodina* and *Igor Prokopa* review conditions and constraints that inhibit the sustainable development of the rural economy in general and how to unlock the potential for wheat production and exports in Ukraine more specifically. Rural areas in Ukraine are facing a strong dualisation between large corporate farms often belonging to even larger agro-holdings, the modern successors of kolkhozes, on the one hand, and private farms on the other hand, the latter of which comprise a smaller number of relatively dynamic commercial farms and a multitude of small household farms that largely produce for subsistence. This dualization is a reality that cannot be reversed but there is an urgent need to halt the further concentration as well as the continued fragmentation of holdings, to make export licences available more freely and openly and to stop the persistent loss of soil fertility resulting from intensive cultivation without adequate replenishment of nutrients. These are only some of the steps required to unlock Ukraine’s production potential, to enable its dualised system to operate more effectively and sustainably. Policies will also have to take into consideration the fact that agro-holdings currently appear to be far more vulnerable financially than they seemed to be a few years ago. At any rate, from 2014 onward the conflict in the eastern part of the country overshadowed much of all this; the chapter ends with a number of observations on how a less ambitious agenda for trade agreements might help reduce some of the tensions.

In Chapter “Assessing the potential for Russian grain export: A special focus on the prospective cultivation of abandoned land”, *Valery Saraykin*, *Renata Yanbykh* and *Vassily Uzun* develop a simple methodological approach with the aim of assessing Russia’s potential to expand its grain area and its impact on grain exports under different scenarios of how export prices may develop. The post-Soviet period has been characterised by the abandonment of land across Russia. Today, Russia has regained a prominent role in wheat markets. The results of this chapter show that, with improved market conditions (such as higher grain prices), the recultivation of these areas may increase grain exports in the medium term and thus further increase Russia’s contribution to global food security.

In Chapter “Kazakhstan’s production potential”, *István Fehér*, *József Lehota*, *Zoltán Lakner*, *Zoltán Kende*, *Csaba Bálint*, *Szergej Vinogradov* and *Andrew Fieldsend* analyse the potential future development trajectories of wheat production in Kazakhstan by (1) predicting the probable climatic and weather conditions and (2) modelling the future perspectives of wheat production and exports based on a system-dynamic approach. The simulation results show that, over the long term, the agro-ecological status of wheat production in Kazakhstan will deteriorate. The climate will become warmer and dryer, and the numbers of drought periods and extreme weather events will increase. If inputs are not used more intensively and management practices are not adapted, wheat yields in Kazakhstan may decline. The simulation results indicate that, despite the expected deterioration in growing conditions, wheat production in Kazakhstan has the potential to increase by up to 33 % over the next two decades. Finally, the chapter points out that the country’s export potential is likely to reduce as a result of an expected expansion in the domestic consumption of wheat for food and feed.

Central Asian CIS countries are perceived as potential new exporters of wheat. Uzbekistan and Turkmenistan are seen as emerging players in the region. In Chapter “Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan”, *Ihtiyor Bobojonov*, *Nodir Djanibekov* and *Peter Voigt* illustrate trends in wheat production and consumption in Uzbekistan, and outline the potential for further increases in wheat production, corresponding scenarios for export dynamics and the role of policy in this regard. The chapter suggests that Uzbekistan has the potential to emerge as an important supplier of (low-quality) wheat to neighbouring countries. In fact, Uzbekistan has turned from a wheat importer into an exporting country during the last two decades. However it is difficult to assess potential future export development, because the state procurement mechanism has a strong role and intervenes in the supply chains. Improving the existing procurement mechanisms and introducing market-based incentives could help to overcome remaining production inefficiencies, thus ensuring the sustainability of wheat supply chains and that excess production is available for export.

In Chapter "Wheat production in Turkmenistan: Reality and expectations", *Ivan Stanchin* and *Zvi Lerman* investigate wheat production potential in Turkmenistan. In the Soviet period, Turkmenistan specialised in cotton production. When the dissolution of the USSR in 1991 led to a breakdown of agricultural trade links between the former Soviet republics, Turkmenistan could no longer rely on assured supplies of wheat in exchange for its cotton, and the food security situation deteriorated. The government launched the Zerno (Grain) Programme in 1991 to resolve emerging difficulties with wheat supply. The measures undertaken between 1991 and 2013 within the framework of this programme included the reorganisation of the government control system for agriculture, the transformation of the farming structure and the implementation of land and water reform. Massive investments were made in opening up virgin lands for cultivation, developing new infrastructure for grain processing and purchasing new farm machinery. The special attention given to the grain sector led to the rapid expansion of wheat production. Traditionally a wheat importer, Turkmenistan started exporting wheat in 2010. Projections by local experts suggest that, despite the expected population increase of about 30 % during the next 15 years, Turkmenistan will be able to maintain wheat exports at the current level.

As discussed in other chapters, the major agricultural countries of Eurasia—Russia, Ukraine and Kazakhstan—have become increasingly important for world agriculture, as important grain-exporting regions. However, these countries, especially Russia, are also large agricultural and food importers, especially of livestock products. The rise in grain exports marks a reversal of the region's status during the Soviet period as a major grain importer. In Chapter "The Development of the Eurasian Livestock and Grain Economies", *William M. Liefert* and *Olga Liefert* interconnect these two markets—grain and livestock—and investigate how their development codetermined the grain export potential of Eurasia. They examine the development of the Eurasian livestock and grain sectors since these countries began their transition from planned to market economies, and also provide an outlook. The key element in the relationship between the two sectors is livestock producers' demand for animal feed, which reduces the grain surpluses available for export. The major changes in the region's agricultural trade since the Soviet period appear to be consistent with its underlying cost-competitiveness, or comparative advantage, vis-à-vis world agricultural markets.

During the last decade the availability of grain exports from the CIS countries displayed high variability and was repeatedly diminished by severe harvest failures. In Chapter "Eurasian grain markets in an uncertain world: A focus on harvest failures in Russia, Ukraine and Kazakhstan and their impact on global food security", *Sergio René Araujo-Enciso*, *Thomas Fellmann*, *Fabien Santini* and *Robert M'barek* present an outlook for RUK grain production and exports up to 2024, taking into account yield variability and possible harvest failures and their impact on national and international food security. They use the stochastic version of the AGLINK-COSIMO model. Their simulation results show that grain yields in

RUK are a major source of uncertainty for international grain markets, especially as regards wheat. In particular by inducing substantial increases in world market prices owing to limited grain exports from RUK, the results highlight the importance of RUK's grain production for world markets and global food security.

The next two chapters investigate the wheat sector in neighbouring countries from the east and southeast of the Eurasian region—China and India—and their potential implications for Eurasian trade. As they are the most and second-most populous countries in the world, prices and availability of food grain and other agricultural products are of the greatest importance for China and India. Consequently, food security for a large population is of paramount concern for national governments and policymakers and has an important impact on international grain markets.

In Chapter "China's Role in World Food Security", *Holly Wang* and *Kim Ha* discuss China's role in global wheat markets. As the world's most populous country, China is facing great challenges in providing sufficient quantity and good quality of food from its domestic supply. The fast-growing demand for grains, stemming from growth in population, the increasing calories consumed per capita and the growing share of animal protein are the main challenges. China is also faced with limitations to production as a result of water scarcity and a decrease in arable land resulting from urbanisation and desertification. China has steadily increased its food-grain and oilseed imports from the world market, while trying to intensify its domestic production of food grains with strong policy support.

In Chapter "Wheat Sector in India: Production, Policies and Food Security", *Amarnath Tripathi* and *Ashok K. Mishra* analyse the Indian wheat sector. Over the past two decades India has experienced a dramatic turnaround in its economic conditions and has achieved unprecedented levels of prosperity. The agricultural sector in India has undergone significant reforms that have moved India from being a net importer of food grains to being self-sufficient. In this context, the authors discuss the current production and consumption of wheat in India. They discuss wheat productivity by location (states), export capacity and the agricultural policies that support wheat production. They also investigate the impact of climate change on wheat production. Finally, they present food and nutrition security issues in India. They conclude that, although India may be self-sufficient in food, the hunger problem in the country has shifted from malnutrition to undernutrition.

Overall, these two chapters highlight that China and India have an important role in the world grain market. Both countries are (or will be) very important with regard to demand. China and India are limited in both resources (such as arable land) and agricultural productivity. The rising number of middle-income households in both countries will potentially boost demand for grains and food products. Demand for wheat will probably increase in China and India in the coming years. In addition, demand in China is expected to also increase as a result of increased demand for feedstock.

In the final section, *Pavel Ciaian, Sergio Gomez y Paloma* and *Sébastien Mary* and *Stephen Langrell* draw main conclusions and provide policy recommendations. They highlight that, given the availability of large land resources and low level of current yields, Eurasia is a strong player in global wheat markets and has great potential to further increase wheat production and exports, thus strengthening its contribution to global food security. Production growth can be achieved primarily by bringing more land into cultivation, increasing current yields and incorporating modern technologies into its farming practices. However, the authors stress that the production potential of Eurasia can be realised fully only if the agricultural sector is supported by structural changes including (1) enhancing market institutions and property rights, (2) developing land markets, (3) improving access to credit, (4) creating a reliable and transparent policy support framework, (5) addressing climate and environmental challenges and (6) developing infrastructure.

Privatisation and Changing Farm Structure in the Commonwealth of Independent States

Zvi Lerman

1 Introduction

The rural sector in nearly all the 12 original countries of the Commonwealth of Independent States (CIS)[1] has undergone a shift from predominantly collective to more individualised agriculture. At the same time, most of the land in the region has shifted from state to private ownership. These two shifts—a shift in tenure and a shift in ownership—were part of the transition from a centrally planned economy to a more market-oriented economy that began around 1990 in the huge post-Soviet space stretching from the Baltic Sea to the Pacific Ocean. The transition reforms in the region were unprecedented in their scope and pace. Some 120 million ha of agricultural land transferred ownership in these countries in just one decade of reform (1990–2000), compared with 100 million ha in Mexico during 75 years (1917–1992) and 11 million ha in Brazil during 30 years (1964–1994) (Deininger 2003). The basis of this shift from collective to individual agriculture lay in two interrelated aspects of agricultural policy reform: *land reform*, which concerns issues of land use rights and landownership; and *farm reform*, which deals with issues of restructuring of farms into individual landholdings. Land reform, together with farm restructuring, set an agenda for the transformation of socialist farms in

[1]There were 15 republics in the USSR, or the former Soviet Union. The three Baltic republics (Estonia, Latvia and Lithuania) adopted a European orientation immediately on the dissolution of the Soviet Union in 1990. The remaining 12 republics formed the CIS. Of these 12 republics, 10 are full members (Armenia, Azerbaijan, Belarus, Moldova, Russia, Kazakhstan, Kyrgyzstan, Tajikistan, Ukraine and Uzbekistan), one (Turkmenistan) is an associate member and Georgia withdrew from the CIS in 2008 in the wake of the South Ossetia conflict. For the purposes of this chapter Georgia is included as one of the 12 original countries of the CIS.

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CIS into what is hoped to be a more efficient farm structure with a clear market orientation.

2 Starting Conditions and Transition Desiderata

Catching up with market economies (and perhaps even overtaking them) was always an important consideration for Soviet planners. It is enough to recall Khrushchev's outbursts in the 1950s and the 1960s in which he threatened to 'bury' the West—economically if not militarily. The transition to a market-oriented system, emulating the economic order of the more successful capitalist countries, was regarded in the early 1990s as a new strategy to cure the chronic inefficiency of the socialist economic system in general, and socialist agriculture in particular. Because of the broadly common organisational and institutional heritage in agriculture, efficiency considerations suggested a fairly uniform conceptual framework for agricultural reform in all CIS countries (Lerman et al. 2004).

A strategy of agricultural transition aiming to improve the efficiency and productivity of agriculture in the CIS required the replacement of institutional and organisational features of the former command economy with attributes borrowed from the practice of market economies. The ideal transition desiderata for key areas of economic activity can be summarised as follows:

- production: eliminate centrally prescribed targets and allow free decisions;
- prices: eliminate central controls and liberalise prices;
- finance: eliminate state support and debt write-offs, institute hard budget constraints;
- inputs, sales, processing: eliminate state-owned monopolies, privatise and demonopolise;
- ownership of resources: go from state and collective ownership to private ownership of land and other productive resources;
- farming structure:
  - downsize large-scale farms
  - individualise farming structure
  - eliminate the sharply dual land concentration inherited from the Soviet Union, with a small number of large-scale farms controlling most of the land and a huge number of smallholders cultivating but a minor share of the land
  - ensure a level playing field for farms of all organisational types.

The conceptual framework for transition in agriculture envisaged a transformation from collective to individual or family farming as the ultimate goal, because both theory and world experience suggested that individual responsibility and direct accountability would cure the free riding, shirking and moral hazard that make collective organisations generally inefficient. Property rights associated with private ownership of land (or with secure tenure) would induce farmers to put greater effort into production. Individual farmers, once established as independent entities, would engage in land-market transactions to optimise the size of the holdings given their management skills and availability of resources. Transferability of use rights would facilitate the redistribution of land from less efficient to more efficient producers, or more concretely from passive landowners (such as pensioners in an ageing population) to energetic active operators.

Change in the ownership of resources (land reform proper) and change of farming structure (restructuring of traditional collective farms) encompass the main components of agricultural transformation. Land reform in the context of transition implies establishment of private property rights in land in all CIS countries (as well as the Baltic states), where land was nationalised at various times since the Bolshevik Revolution in 1917. Farm restructuring implies transformation of large-scale collective and state farms to operations based on market-oriented principles, including emergence and proliferation of individual farms alongside corporate organisational forms.

3 Land Reform in the Commonwealth of Independent States

In the CIS countries, agricultural land had belonged to the state since 1917 and the first step was to legalise private ownership of agricultural land. The necessary legislation has been passed in most of the countries. Of the 12 original CIS countries, only four still maintain the traditional Soviet policy of exclusive state ownership of agricultural land (Tajikistan, Turkmenistan, Uzbekistan and, to some extent, Belarus). While experts—both Western and local—are heatedly debating the success or failure of land privatisation in the CIS, there can be no doubt that the process so far has achieved at least one major goal: in most countries, it has eliminated the monopoly of the state in landownership and produced a dramatic reduction in the share of agricultural land directly owned or managed by the state (Table 1).

Landownership statistics (as opposed to land use statistics) are notoriously difficult to obtain for CIS countries. Table 1 was laboriously assembled from scattered pieces of information in various sources and it could not be updated beyond 2000. For instance, Georgia, one of the trailblazers of land reform in CIS, has disbanded the established statistical monitoring mechanisms for land and no longer has any aggregate landownership statistics: the land-management organs can only identify a specific cadastral number as state owned or privately owned. The Russian Federation is an exception: the State Cadastre Agency publishes a phenomenally detailed report on status and use of land in Russia (see, for example, Rosreestr 2013), which has been used to calculate the share of privately owned agricultural land shown for selected years in Fig. 1. Landownership data also exist

Table 1 Share of state-owned agricultural land in CIS countries that had recognised private land ownership prior to 2000 (%)

Country	Pre-1990	2000	Legal attitude to private land ownership
Russia	100	35	Potentially all land
Ukraine	100	31	Potentially all land
Moldova	100	17	Potentially all land
Georgia	100	78 (54 excluding pastures)	Potentially all land
Armenia	100	67 (35 excluding pastures)	Potentially all land
Azerbaijan	100	70 (half of this is common municipally owned land)	Potentially all land
Belarus	100	93 (potentially 84)	Household plots only
Turkmenistan	100	100	Constitution recognises private ownership, but land is absolutely non-transferable

Source: Lerman et al. (2004)

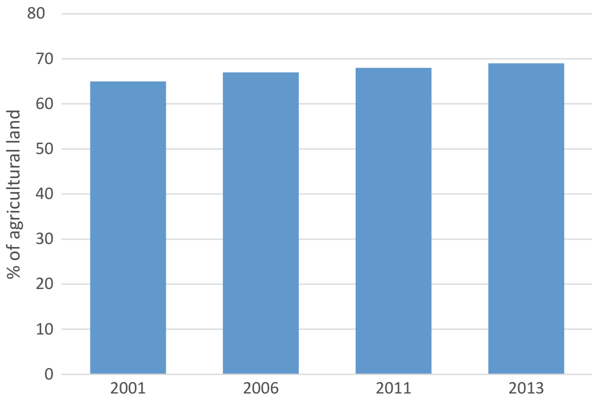

Fig. 1 Russia: share of privately owned agricultural land, 2001–2013. Source: Rosreestr (2006, 2011, 2013)

in Ukraine, but they are not readily accessible: the landownership curve for Ukraine in Fig. 2 is based on information obtained in a private communication. The striking feature is that in both countries the share of privately owned agricultural land in 2011–2013 was about 70 %. The dramatic increase in privately owned land observed in Ukraine after 2000 (Fig. 2) is the outcome of President Leonid Kuchma's 1999 reform, which greatly accelerated the distribution of physical plots to rural residents (Lerman et al. 2007).

Once the land-privatisation legislation had been put in place, collective farms were transformed into corporate farms on private land (joint stock companies, partnerships, etc.) and land shares were distributed within these farms to workers and to local rural populations. This was a kind of 'redistributive land reform' based on paper certificates of entitlement, not on physical plots. The new corporate farms continued to operate on collectively owned ('shared') and collectively farmed land,

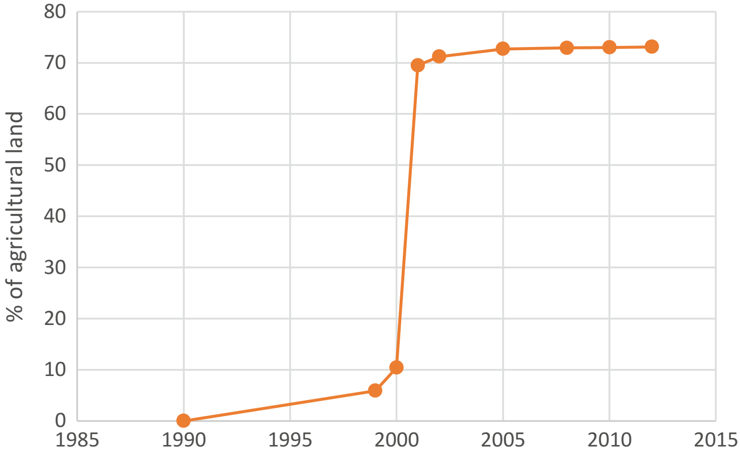

Fig. 2 Ukraine: share of privately owned agricultural land, 2001–2011. Source: N. Pugachev (private communication)

although the share owners had the right to exit with a physical plot of private land for individual farming.

Although this mechanism of land-share assignment was followed in most CIS countries, two exceptions can be noted. The first was in the Transcaucasus, where collective and state farms were physically disbanded and actual plots of land were distributed early on, from 1992 in Armenia and then in Georgia, and from 1996 in Azerbaijan. No land shares were needed. The second exception was in Central Asia, where land formally remained state property long after its redistribution began in 1991–1992 throughout the rest of the CIS. Uzbekistan and Turkmenistan, where agricultural land remains state property to this day, retained collective and state farms and distributed state leaseholds (‘use rights’) rather than land shares. Kazakhstan, Kyrgyzstan and Tajikistan distributed land shares to collective farm workers, though they initially left agricultural land under state ownership. Kyrgyzstan and Kazakhstan subsequently legalised private ownership of land, in 1998 and 2003, respectively; Tajikistan made land shares transferable after 2009 in response to pressure from the World Bank and other international donors (Republic of Tajikistan 2009).

Since the distribution of land shares to corporate farm workers often did not change the farm management, the new ‘private’ corporate farms operated much like the socialist collective farms (with their associated problems). Further changes were needed. Accordingly, Kyrgyzstan, Tajikistan, Moldova and Ukraine had converted land shares into titles to land parcels or to actual land parcels by the end of the 1990s (Lerman and Sedik 2008; Lerman et al. 2007). A similar mechanism for converting land shares into private plots is well established in Russia, but it is plagued by high transaction costs and bureaucratic difficulties (Shagaida and Lerman 2008; see also Chapter “Land Policy in Russia: New Challenges” in this volume). In Kazakhstan, the June 2003 Land Code (Republic of Kazakhstan 2003) annulled the permanent rights associated with land shares and forced the shareholders either to acquire a land plot from the state (by outright purchase or by leasing) or to invest the land share in the equity capital of a corporate farm, thus effectively losing ownership rights.

Landowners do not always cultivate their privatised land. Some land privatised in land shares remains unclaimed or abandoned, mainly for administrative reasons. Some landowners are unable to cultivate their land because of age and health reasons. Some owners are qualified for more profitable jobs elsewhere and leave agriculture. These factors create a supply of land for leasing (if not outright selling) from landowners to other users and producers: a potential for the emergence of land markets. For these reasons, we generally focus on land use rather than landownership: we speak of individualisation of land use, as distinct from land privatisation.

4 Farm Reform

A second component of agricultural policy reform was farm restructuring, in which the individualisation of landholdings—transition from corporate to individual land use—was critical. Clear sub-regional differences are apparent in farm policies in the CIS, as indicated by the depth (percentage of sown land in individual farms) and timing (watershed dates) of the individualisation of landholdings. These differences have resulted in substantially different levels of recovery from the transition recession since the turnaround date (Table 2).

Table 2 Sub-regional differences in farm policies and agricultural recovery in CIS countries

Aspect	Central Asia	Transcaucasus	Russia, western CIS
Farm policies			
Dominant farm organisational form	Individual, corporate	Individual	Corporate, individual
Land sown in individual farms (%, 2007)	71	97	34
Share of gross agricultural output produced on individual farms (%, latest year)	88	97	62
Watershed date for individualisation	1996–1998	1993	None
Agricultural output recovery			
Turnaround year	1998	1993	1999
Production (gross agricultural output) relative to 1991 level (%, latest year available)	105	114	76

Sources: computed from official country statistics

The dramatic shrinking of the corporate farm sector and the strong showing of the individual sector (household plots and peasant farms) in Central Asia is illustrated in Figs. 3 and 4, which present the distribution of arable land by farm type in Tajikistan and Uzbekistan. Although land is state owned in these countries and the political regimes tend to be authoritarian (and thus cannot be regarded as overly open to reform), the individual sector completely displaced the corporate sector (enterprises) as the dominant player in agriculture. In Russia and Ukraine, we also observe a clear pattern of increasing individualisation, but the corporate sector continues to dominate agriculture, especially in Russia (Figs. 5 and 6).

The shift of the main productive resource—arable land—from enterprises (corporate farms) to the individual sector has resulted in a significant increase in the share

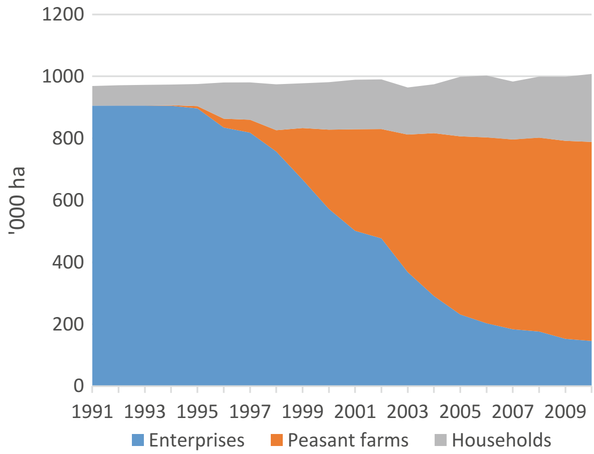

Fig. 3 Tajikistan: shift of arable land from corporate to individual farms, 1991–2010. Source: official country statistics

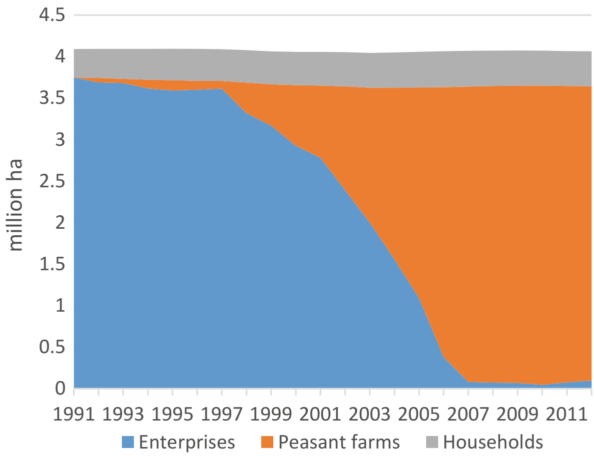

Fig. 4 Uzbekistan: shift of arable land from corporate to individual farms, 1991–2010. Source: official country statistics

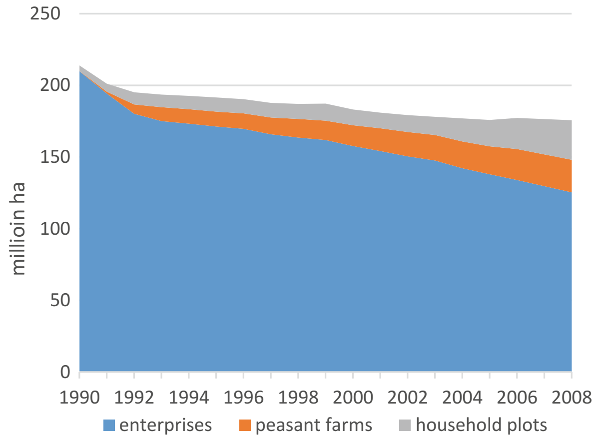

Fig. 5 Russia: corporate farms retain dominant position in land use, 1991–2011. Source: official country statistics

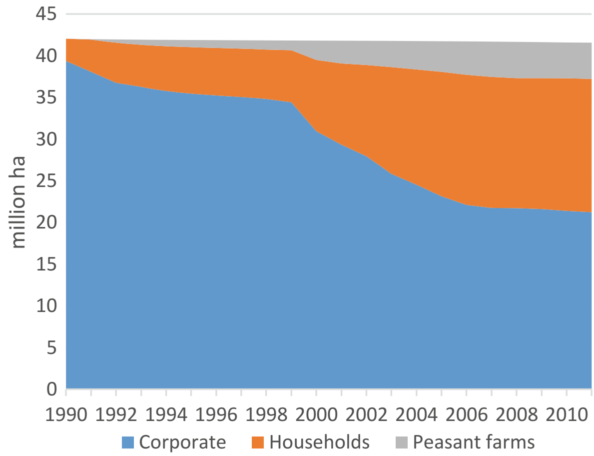

Fig. 6 Ukraine: corporate farms retain dominant position in land use, despite the observed shift in land to individual farms, 1991–2011. Source: official country statistics

of individual farms in agricultural production. At the end of the Soviet era, individual farms (the traditional household plots at that time) contributed one-third of gross agricultural output (GAO) in Central Asia and agricultural enterprises produced the remaining two-thirds; in 2007, individual farms (household plots and peasant farms combined) contributed 88 % of GAO and the share of the enterprises had shrunk to 12 %. Table 3 summarises the data on the dramatic shift of land and production to the individual sector between 1990 and 2007 in the Central Asian states. For comparison it shows Azerbaijan as a representative of the Transcaucasus region, where individualisation has been comparable to that in Central Asia, and also Russia and Ukraine, where individualisation lags far behind both Central Asia and Transcaucasus.

Table 3 Changing role of individual farms, 1991–2010 (%)

	Share of arable land		Share of GAO	
	1991	2010	1991	2010
Kazakhstan	1	39	32	71
Kyrgyzstan	3	76	44	98
Tajikistan	7	86	36	91
Turkmenistan	5	93	n.a.	n.a.
Uzbekistan	8	98	33	98
Average Central Asia	*5*	*78*	*36*	*90*
Russia	2	31	24	56
Ukraine	7	49	27	60
Azerbaijan	4	84	35	95

Source: Lerman et al. (2004), updated from official country statistics

5 Agricultural Recovery and Individualisation in the Commonwealth of Independent States

The transition from central planning to a market-oriented economy involved breaking up an established economic system. This inevitably caused initial disruption and led to sharp declines in the economy as a whole and in agriculture in particular. In the CIS, the steep decline continued until 1998, when the CIS countries as a group bottomed out at 75 % of the 1992 output. Despite the initial decline during the transition, the CIS countries generally persevered in their reform efforts, which eventually produced a turnaround leading to recovery of agricultural growth. Figure 7 takes a disaggregated view of the recovery, showing three separate decline and growth curves for the agricultural output in the three geographical regions from Table 2: Central Asia, Transcaucasus and European (or western) CIS.

There is a traceable link between the beginning of recovery (the turnaround year in Table 2 and the absolute bottom point in Fig. 7) and the implementation of significant individualisation reforms in CIS. The countries in the Transcaucasus individualised land early and decisively, and the turnaround came as soon as 1993 (Transcaucasus in Fig. 7, orange curve). The Central Asian countries began individualisation much later, between 1996 and 1998, and agricultural growth in the region as a whole resumed in 1998 (red curve in Fig. 7). As we see in Figs. 3 and 4 for Tajikistan and Uzbekistan, Central Asian countries achieved remarkable progress with individualisation of farming structure in the past few years (despite continued state ownership of agricultural land in Uzbekistan, Turkmenistan and Tajikistan) and this progress is apparently responsible for the robust growth in the region. The laggards in the date and degree of individualisation have been Russia, Belarus and Ukraine (Figs. 5 and 6). In fact, Russia and Belarus have not yet appreciably individualised landholdings to date, which may account for the sluggish recovery in agricultural production in the European CIS (green curve in Fig. 7).

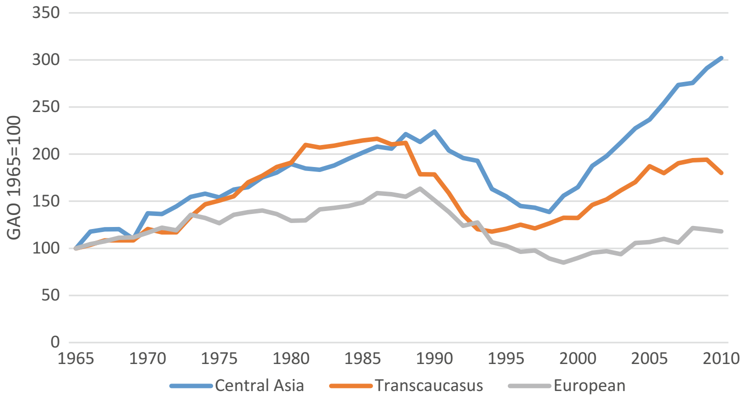

Fig. 7 Regional agricultural growth in CIS, 1965–2010: average GAO index for three regional groupings of CIS countries. Source: based on official statistics

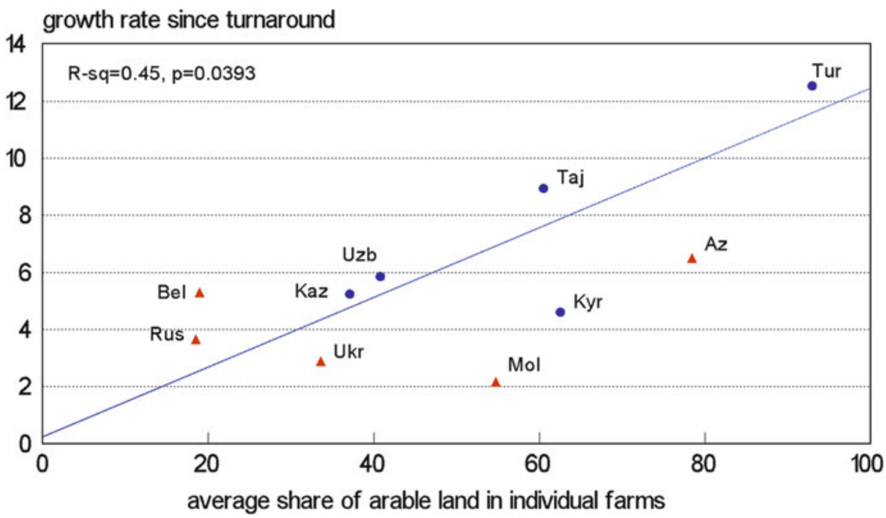

Fig. 8 Growth of agricultural output since turnaround is faster for countries with greater individualisation of arable land. Source: Lerman (2010)

Further direct evidence shows that individualisation has a positive effect on agricultural growth. Among the CIS countries, those with more land in individual use have achieved faster growth since the start of recovery (Fig. 8). In Russia, a similar relationship between agricultural growth and individual land use is observed across the 80 provinces (Fig. 9). This seems to explain why recovery in Russia and the western CIS lags behind the recovery in Central Asia and the Transcaucasus: individual land use in Russia and the western CIS is at a substantially lower level than in the rest of the CIS.

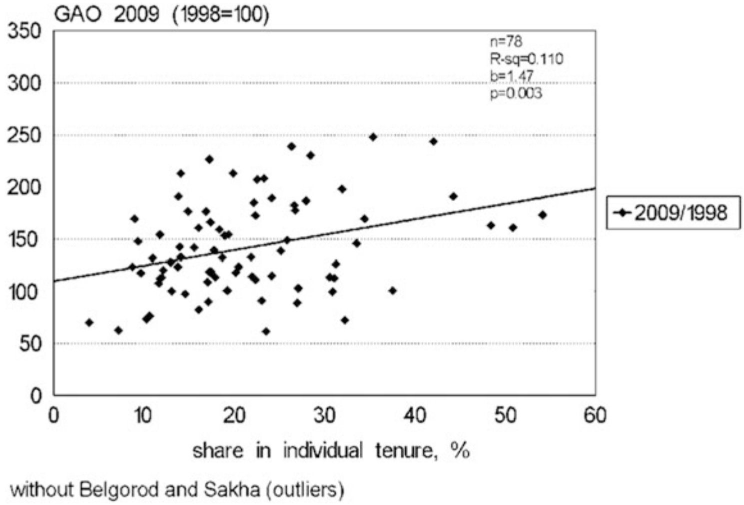

Fig. 9 Growth in agricultural output since 1998 is faster in Russia's regions with greater individualisation of land. Source: Lerman and Sedik (2013)

Individualisation also has a positive effect on agricultural productivity, which measures the value (or aggregate quantity) of agricultural output per unit of land ('land productivity') or per agricultural worker ('labour productivity'). Land productivity in many CIS countries is observed to be highest in household plots—the classical example of an individual farm with most pronounced family-driven incentives and personal accountability (Lerman 2010; Lerman and Sedik 2009, 2010, 2013; Lerman et al. 2007). Labour productivity, like agricultural growth, is observed to increase with the share of agricultural land in individual use across Russia's 80 provinces (Lerman et al. 2004: 186–187; Lerman and Schreinemachers 2005). A straightforward conclusion about higher land productivity in the individual sector emerges from Table 3, where the share of individual farms in GAO across all countries is higher than their share in land.

6 Agricultural Reform and Poverty Mitigation in the Commonwealth of Independent States

It is difficult to establish a rigorous causal relationship between land and farm reform and the reductions in poverty that have been observed in CIS countries since 2000 (Alam et al. 2005), because there are no comparable rural poverty assessments spanning the period of land reform that specifically examine landholdings over time. Studies of the connections between land and farm reform and rural welfare rely on cross-sectional survey evidence on landholdings and farm incomes.

Still, it is clear that land and farm reforms in CIS countries have helped reduce rural poverty in two respects. First, they have increased household assets by means of one-off transfers of land, livestock and farm machinery from corporate farms to households. Farm-survey data from many CIS countries show a positive correlation between family landholdings and incomes—both total family income and, more importantly, income per capita (Lerman et al. 2007; Lerman and Cimpoies 2006; Lerman 2008; Lerman and Sedik 2010). Second, asset transfers from collective and state farms to individual farms increased agricultural productivity (as noted above) and specifically raised crop yields (Dudwick et al. 2007). Higher productivity and higher yields increase farm production and thus improve family welfare both directly, through higher consumption of home-grown products, and indirectly, through additional cash income from sale of surplus products.

This highlights commercialisation, or sale of farm products, as another important factor—alongside landholdings and productivity—that positively affects rural incomes. Survey evidence convincingly shows that farm sales increase family incomes and also improve the subjective perception of family well-being. On the other hand, families with more land tend to be more commercially oriented, selling a greater share of their output. Commercialisation completes the loop between land reform and rural family incomes: land reform shifts land to individual farms and raises their incomes through increased production (part of which is consumed in kind by the family); more land and greater production stimulate rural families to sell more of their output; greater sales contribute additional cash that also raises family incomes.[2] This double effect of more land leading to more production and at the same time to greater commercialisation is demonstrated in the outcomes of the recent World Bank/Food and Agriculture Organization (FAO) land consolidation project in Moldova (2007–2009): consolidation increased the farm sizes and reduced the number of parcels, while the participating farms increased their output and their commercial capacity, achieving higher income, as was evident from higher mean gross margins and more investments (Moldova 2011).

7 Policy Measures to Improve Rural Incomes

Agricultural reform across the region produced tens of millions of small family farms in place of tens of thousands of large-scale collectives and production cooperatives. Table 4 illustrates how small the average farm is in the CIS. However,

[2]Policy measures to increase commercialisation and productivity typically focus on improving the access of small farms to specific market services, such as channels for marketing farm products and purchasing farm inputs, farm machinery services, veterinary and artificial insemination services, extension services and credit services for small farms. These measures are not directly related to land and farm reforms and are not discussed in this chapter. Best-practice experience around the world suggests that farmers' service cooperatives provide the most effective way of improving the access of small farmers to market services (see Lerman and Sedik 2014).

Table 4 Average size of family farms in some CIS countries

Country	Average farm size (ha)
Armenia	1.38
Georgia	0.96
Azerbaijan	1.86
Kyrgyzstan	3.80
Tajikistan	3–5
Turkmenistan	4–5

Source: farm-level surveys, 2000–2010

these small farms are not pure subsistence operations: surveys show that between 60 % and 80 % of small farms in CIS sell some of their output, and farm sales average 30–50 % of the output in these 'semi-commercial' farms. Yet smallholders in the CIS, like small farmers all over the world, face what is sometimes described as the 'curse of smallness': low incomes due to limited asset bases and difficulties with access to market channels for sales and services.

In view of the links between landholdings, commercialisation and family income, it is important to consider what policy measures can be applied to enlarge family landholdings and to encourage smallholder farms to sell more of their output. It is, of course, also important to focus on options for increasing productivity, as higher productivity will improve rural livelihoods by enabling smallholders to produce more with limited resources.

Two main policy measures can be applied to enable enlargement of small individual farms (from 0.5 ha to 5 or even 10 ha, say). The first is to implement another wave of land distribution to smallholder farms, continuing the process of land reform that originally led to dramatic enlargement of household plots and creation of new peasant farms. Additional land can be distributed from the state reserve or from the holdings of the less productive corporate farms (agricultural enterprises). There are large reserves of unused state-owned land in many CIS countries (with the possible exception of Central Asia). In addition, large areas of agricultural land (in some countries more than 50 % of total agricultural area) are managed inefficiently by large corporate farms, which achieve productivity levels that are substantially lower than the productivity of individual farms. Governments should channel the unused land from the state reserve and the under-utilised land from large agricultural enterprises to more productive use by distributing these lands to small family farms. It is therefore sad to note that Georgia has opted for an opposite policy: the government recently cancelled the existing leases of state land to smallholders—one of the proven market mechanisms for enlarging small farms—and began auctioning reserve land to outside investors. Officials are very pleased with the cash revenues from this process and argue in justification that it will raise Georgia's agriculture to higher levels of commercial production. In this way they completely disregard the interests of the large rural population and ignore the hard evidence of the greater productivity of smallholder farms, which make a crucial contribution to both sectoral growth and rural livelihoods.

Table 5 Lease markets work to adjust farm sizes in CIS countries

Country	Average size of farms with own land only (ha)	Average size of farms with leased land (ha)	Farms with leased land (%)
Armenia	1.3	2.6	14
Georgia	0.7	8.7	2
Azerbaijan	1.8	15.7	7
Kazakhstan	160	272	11
Tajikistan	18	144	3
Moldova			
1997	2.8	16.9	6
2003	3.8	11.6	21
2005	3.7	9.5	28
Ukraine	53	227	53

Sources: Lerman et al. (2004, 2007); Lerman and Sedik (2010)

The second policy measure that may lead to enlargement of smallholdings is encouraging the development of land markets. Land markets provide a mechanism that allows land to be transferred from passive or inefficient users to active, efficient users and thus leads to farm size adjustment. The basic prerequisite for land-market development is to allow transferability of landownership and land-use rights: this has been accomplished as part of the reforms in most CIS countries, but it is still not the case in parts of Central Asia. Another prerequisite for the development of land transactions is registration and titling of all privately owned plots. Modern registration and titling systems exist in all CIS countries, but the titling coverage is generally limited, apparently because of complex bureaucratic procedures and high costs. Simple and transparent registration procedures should be instituted, with minimum transaction costs, to encourage rural landowners to register their land and obtain legal titles (Shagaida and Lerman 2008; see also Chap. 2 in this volume).

As another policy measure, governments should guarantee contract enforcement and rule of law. This is crucial for, inter alia, the support of land leasing, which appears to be even more important than buying and selling of land as a mechanism for the enlargement of smallholdings. Table 5 demonstrates that land leasing indeed works to enlarge small farms, and the example of Moldova shows that land leasing becomes more widespread over time.

Land consolidation programmes are often promoted as a vehicle for farm enlargement. Effective consolidation programmes are driven by market mechanisms, i.e. free negotiations and mutual agreements between owners of fragmented plots (FAO 2010). Examples of such market-driven consolidation efforts are provided by the World Bank/FAO project in Moldova (2007–2009) or the latest United States Agency for International Development (USAID) project in Kyrgyzstan, which heavily relies on the Moldova experience. In Moldova, the consolidation project reduced the number of parcels by 23 % (from 7220 initially to 5515 parcels after the completion of the project), thus significantly increasing the average parcel size. The consolidation activity furthermore encouraged elderly and inactive

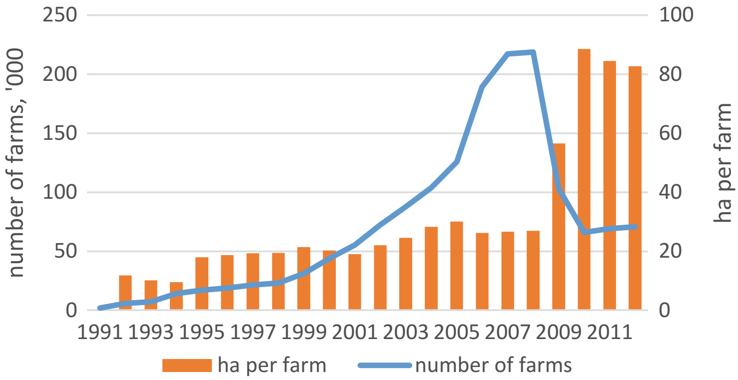

Fig. 10 Development of peasant farms in Uzbekistan, 1991–2012: number and average size. Source: official country statistics

landowners to leave agriculture, leading to an increase of 32 % in the average size of a farm holding (Moldova 2011).

'Spontaneous' enlargement of individual farms, i.e. enlargement without special consolidation programmes, has been observed in recent years in Ukraine, where the shift of land from corporate farms to the individual sector has led to substantial enlargement of both household plots and peasant farms without government intervention. Household plots increased in average size from less than 0.5 ha in the early 1990s to more than 3 ha in 2011, while peasant farms increased in the same period from less than 25 ha to more than 100 ha.

An example of farm enlargement through brute-force government intervention is observed in Uzbekistan. Up to 2007, farm sizes in Uzbekistan followed a 'spontaneous' enlargement pattern, as in Ukraine, with the average size of peasant farms trebling from less than 10 ha in the early 1990s to about 30 ha in 2004–2007 (comparable to the average farm sizes in Ukraine and Russia). This 'spontaneous' enlargement trend was broken in 2008 when the government adopted its 'farm size optimisation' policy, forcing small peasant farms to merge into larger, allegedly more efficient, units by administratively revoking their lease contracts. This phenomenon is illustrated in Fig. 10, which shows that the number of peasant farms in Uzbekistan decreased precipitously after 2008, while the average farm size increased abruptly through mergers from 30 ha in 2007 to more than 80 ha in 2012.

An opposite trend is observed in Tajikistan, where joint efforts by the World Bank and the government of Tajikistan have led to the breaking up of relatively large 'collective' (multi-family) peasant farms after 2007. The 'collective' peasant farms were judged to be too close to corporate farms in their organisational profile and were encouraged to split into smaller single-family farms. This was accomplished by issuing land titles to individuals. The number of farms increased sharply after 2007, while the average farm size naturally decreased, after an initial phase of

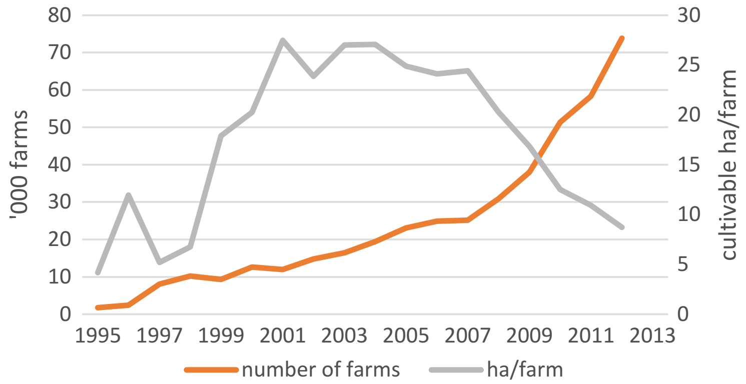

Fig. 11 Development of peasant farms in Tajikistan, 1991–2012: number and average size. Source: official country statistics

'spontaneous' growth and stabilisation between 1995 and 2007 (Fig. 11). There does not seem to be a coherent policy of farm enlargement across the CIS, and the changes in farm sizes are determined by local interests and conditions in each country.

The main issue in designing policies to improve rural incomes is the attitude of the government towards small farms. It has to undergo a radical change from the prevailing neglect and disdain to full recognition of the huge role that small farms play in agriculture and in rural well-being. Government officials and decision makers have to acknowledge the contribution and importance of small farms, abandon the traditional preference for large farms, and focus on policies that ensure a supportive market environment for the successful operation of the small-farm sector instead of continuing the unsuccessful attempts to guide production decisions. This change of attitude requires a strong political will at all levels of government, starting with clear direction from the very top.

8 Conclusion

Small family farms have become the backbone of post-transition agriculture in both Central and Eastern Europe and the CIS. They may not control most of the land, but they nevertheless dominate agricultural production because of their higher productivity. Recovery of agricultural growth is clearly seen to be associated with individualisation of farming: the transition from the exclusive dominance of large corporate farms to the prevalence of substantially smaller family farms in a wide range of sizes. The new farming structure requires the development of a new market infrastructure for farm services: marketing, input supply, machinery, agricultural extension. Government policies should be designed to meet this challenge: the government's new role is to create a supportive service environment for family farms.

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Land Policy in Russia: New Challenges

Natalya Shagaida and Zvi Lerman

1 Introduction

Twenty years since the beginning of land reform in the Russian Federation, we are still far from the originally declared goal: mobility of land resources and their redistribution in response to market signals in agriculture. It seems appropriate to review the process and draw some intermediate conclusions. The policy of removing agricultural land from the traditional users (collective and state farms—*kolkhozes* and *sovkhozes*) implemented in the early 1990s was expected to be conducive to conflict-free restructuring of agricultural assets. In practice, however, the responsiveness of Russia's agriculture to change was significantly reduced by a combination of factors: galloping inflation, political uncertainty, breakdown of established supply and marketing channels in agriculture, and low attractiveness of agribusiness to investors. Beyond all that, local authorities tried to keep individuals from withdrawing with their share of collective property and establishing new farms during the early years of reform (when the asset base in rural areas was still intact), and this pervasive resistance severely slowed the rate of change. Therefore, all through the 1990s agricultural land largely continued to be managed by successors of collective and state farms.

The 1998 crisis created new options for agricultural producers and awakened an interest in land among entrepreneurs from other sectors of the economy. The new

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developments were stimulated by the expansion of existing investment channels and the substantial reduction of administrative pressure from local authorities. In parallel, however, new constraints emerged: new regulations governing partition and distribution of land plots and creation of land users (both corporate and individual) substantially increased the transaction costs by requiring detailed surveying of land plots, preparation of official cadastral documents, and registration of land rights and transactions in land.

At the time of writing, the new land transaction mechanisms are too costly, too unwieldy or simply beyond the capacity of individual landowners and conventional agricultural producers.[1] Mobility of landownership has increased primarily through the activity of entrepreneurs who invest in agricultural land, although they are not necessarily willing to engage in agriculture or agribusiness. These investors are non-conventional producers: the investor-owned agro-holdings can cover the high transaction costs with income from non-agricultural sectors and they have the professional and legal capacity to tackle the complex registration procedures.

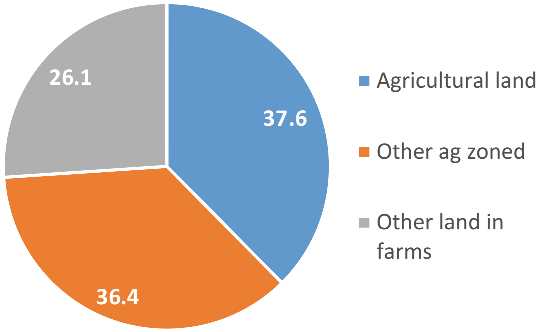
2 Agricultural Land: Contraction and Redistribution

To understand the Russian land statistics, we have to start with a brief description of the terminology. Agricultural land (*sel'skokhozyaistvennye ugod'ya* in Russian) designates land that is used or can potentially be used for agriculture. It is typically subdivided into arable land (the most fertile component of agricultural land), land in perennials (orchards and vineyards), hay meadows and pastures (Land Code 2014: art. 79). Agricultural land is a component of agriculturally zoned land[2] (*zemli sel'skokhozyaistvennogo naznacheniya* in Russian), which is defined (Land Code 2014: art. 77) as land outside settlements earmarked for the needs of agriculture (or more precisely the needs of farms or agricultural producers). 'Needs' are not restricted to agricultural production. In addition to agricultural land, this land category includes intra-farm roads, communications, forest belts planted as protection from harmful natural and anthropogenic effects, water bodies (rivers, ponds, swamps, lakes) and land under farm buildings used

[1]By conventional producers we mean individual and corporate farms created in the process of restructuring of former *kolkhozes* and *sovkhozes* without capital inflow from investors in other sectors. Capital inflows from other sectors typically create agro-holdings, non-conventional farming structures also called 'new agricultural operators'.

[2]This is an ad hoc term that we use in the absence of an accepted equivalent in English. The concept of zoning in the sense of specifying the allowed uses for a particular region has not been implemented so far in Russia. An alternative translation could be 'agriculturally targeted land'. The unofficial English translation of the Land Code uses the term 'agricultural-purpose land' (Land Code English 2001, Chap. XIV).

Fig. 1 Structure of land use in farms, 2013 (percentage of total land in use, 522.2 million ha)



for storage and primary processing of agricultural products. In effect, this is land allocated to farms for their use, and not necessarily for primary agricultural production. The structure of land in Russia's farms in 2013 is shown in Fig. 1: agriculturally zoned land represents 74 % of total land in farms, which is divided roughly half and half between agricultural land (blue segment) and other (non-agricultural) agriculturally zoned land (orange segment); the remaining 26 % of land in farms is other land, neither agricultural nor even agriculturally zoned.

Contraction of agricultural areas is often highlighted as one of the negative outcomes of reform. Between 1991 and 2013 agriculturally zoned land decreased by 37 % (Table 1). However, much of agriculturally zoned land is not agricultural land and is not used for primary agricultural production. The contraction of agricultural land as the main resource in agriculture is not so dramatic. Agricultural land as a component of agriculturally zoned land remained constant at about 196 million ha between 1991 and 2011 (Table 1); agricultural land in use by farms (including agricultural land from other land categories) decreased by less than 13 % between 1991 and 2013 (Table 1).

The main outcome of agricultural reform was the dramatic change in farm structure. In 1990, corporate farms (*kolkhozes* and *sovkhozes* at that time) dominated agriculture: they controlled 97 % of agricultural land in use by producers. By 2013, the situation had changed radically: the share of corporate farms in agricultural land used by producers had dropped to 63 %, while the share of the individual sector (the traditional household plots and the peasant farms that began to be created in 1992) had increased from 3 % in 1991 to 37 % in 2013. Thus, at the time of writing, individual producers (household plots and peasant farms combined) control more than one-third of agricultural land, and the corporate farms, although still the largest category of land users, no longer dominate agriculture in quite the same way as in 1991.

The distribution of agricultural land among different categories of agricultural producers is shown in Table 2. The largest category of producers today is private

Table 1 Changes in agriculturally zoned and agricultural land, 1991–2011 (million ha)

A	Land in agriculture[a]	1991	2006	2013	2013/1991 (%)
1	Agriculturally zoned land	621.0	401.6	386.1	62.2
2	Land in use by corporate agricultural producers	637.5	458.7	422.0	66.2
3	Land in use by individual agricultural producers	6.1	79.3	100.2	1 642.6
4	Land in use by all agricultural producers	643.6	538.0	522.2	81.1
5	Of which: agricultural land in use by agricultural producers	219.0	191.6	191.1	87.3
B	Agricultural land	1991	2006	2013	2013/1991 (%)
1	Total agricultural land in all land categories[b]	222.4	220.7	220.2	99.0
2	Agricultural land in agriculturally zoned land	196.1	194.4	196.2	100.1
3	Agricultural land in use by corporate agricultural producers	212.9	137.9	119.8	56.3
4	Agricultural land in use by individual agricultural producers	6.1	53.7	71.3	1 168.9
5	Agricultural land in use by all agricultural producers	219.0	191.6	191.1	87.3

[a]'Land in agriculture' is all land used in or intended for the agriculture sector. It is broader than agriculturally zoned land: not all agriculturally zoned land is used by producers and producers are not restricted to using only agriculturally zoned land (see, for example, lines 4 and 1)

[b]The seven land categories are agriculturally zoned land, land in settlements, land for industry and other special uses, protected territories, forest lands, water fund lands and state land reserve. There is some agricultural land in each of the seven categories, which explains why total agricultural land (220.2 million ha in 2013) is greater than agricultural land in agriculturally zoned land (196.2 million ha)

Source: Rosreestr (2013: 349–350, 485–486)

Table 2 Distribution of agricultural land among agricultural producers, 1990–2013

	1990		2013	
Agricultural producers	Area (million ha)	% of total	Area (million ha)	% of total
Peasant farms	0	0	22.5	11.8
Household plots	3.8	1.8	48.7	25.5
Private corporate farms	84.9	39.7	109.2	57.1
State and municipal corporate farms	117.3	54.9	6.6	3.5
Other users	7.8	3.6	4.1	2.1
Total	213.8	100	191.1	100

Source: Rosreestr (2013)

corporate farms, i.e. farms created through restructuring of former *kolkhozes* and *sovkhozes*. They control 57 % of all agricultural land. The second largest category is the household plots (24 % of all agricultural land)—physical bodies who engage in agricultural production without being registered as a legal entity.[3] Peasant farmers increased their holdings from zero in 1990 to 12 % in 2013, while state and municipal farms control less than 5 % of agricultural land (down from 55 % in 1990).

Agricultural land 'managed' or 'controlled' by farms does not necessarily mean land 'used' by farms. Statistical organs do not monitor actual land use by agricultural producers. The share of land actually used by producers can be determined only from agricultural censuses, the last of which was conducted in 2006 (the next agricultural census is planned for 2016). Based on the 2006 agricultural census, the share of actually used agricultural land did not exceed 50 % in 10 of Russia's 87 administrative divisions (Table 3).

Agricultural land is underutilised even in regions with favourable agro-climatic conditions, such as Kaluga and Ivanovo oblasts (50 % and 49 % of land use, respectively) and Chechnya (36 %).[4] In some cases, even neighbouring regions with similar agro-climatic conditions fall in different land-use groups: agricultural land use in Altai Territory is 86 %, whereas in the Altai Republic it is as high as 93 %; in Tambov and Voronezh oblasts the land use rates are 76 % and 86 %, respectively; in Tula and Orel oblasts they are 57 % and 81 %, respectively; and in Kabardino-Balkaria and North Ossetia they are 95 % and 76 %, respectively.

Theory suggests that production shifts to regions that yield greater returns, i.e. regions where conditions are more favourable for agriculture (for empirical evidence see Uzun 2012). This, however, hardly explains the widely differing shares of land in actual use (or, equivalently, abandoned land) between regions in Russia with similar agro-climatic conditions. This issue clearly requires further research.

Despite the varying and uncertain reasons for abandonment of agricultural land, government policy in Russia has chosen one corrective measure for all: expropriation of unused land. This measure ignores the widely differing natural, socio-economic and demographic conditions in different regions, not to say differences in demand for agricultural land across Russia.

[3]We use the term 'household plots' to designate an aggregate of 11 groups of individual land users according to the Rosreestr classification, all of which are physical bodies. This aggregate does not include the so-called individual entrepreneurs (about 3 % of agricultural land in the individual sector), which are physical bodies but are nevertheless combined with peasant farms for statistical purposes.

[4]Political unrest limits the use of agricultural land in Chechnya. In Kaluga Oblast, some agricultural land in the southern districts is partly unusable as a result of radioactive contamination due to the Chernobyl nuclear accident (Kaluga 1987).

Table 3 Grouping of Russia's administrative divisions by share of agricultural land in actual use

Percentage of land used	Number of divisions	Administrative divisions
>90	9	Republics: Kabardino-Balkaria, Bashkorostan, Altai, Tatarstan, Udmurtia Oblast: Rostov Territories: Stavropol, Krasnodar Autonomous oblast: Chukotka
80.1–90	11	Republics: Kalmykia Autonomous oblast: Nenets Oblasts: Belgorod, Lipetsk, Voronezh, Kemerovo, Novosibirsk, Amur, Omsk, Orel Territory: Altai
70.1–80	19	Republics: Sakha (Yakutia), Mordovia, Mariy El, Chuvashia, Karelia, Adygea, North Ossetia-Alania, Tyva Oblasts: Birobidjan, Tyumen, Kursk, Orenburg, Samara, Volgograd, Tambov, Chelyabinsk, Saratov, Moscow Territory: Perm
60.1–70	18	Republics: Dagestan, Ingushetia, Karachaevo-Cherkesskaya Autonomous oblast: Yamalo-Nenets Oblasts: Astrakhan, Penza, Tomsk, Sverdlovsk, Ryazan', Nizhnii Novgorod, Kurgan, Vladimir, Vologda, Leningrad, Yaroslavl' Territory: Trans-Baikal, Khabarovsk, Krasnoyarsk
50.1–60	14	Republics: Komi, Khakassia Autonomous territory: Khanty-Mansiisk–Yugra Oblasts: Kostroma, Kaliningrad, Sakhalin, Tula, Irkutsk, Kirov, Ulyanovsk, Bryansk, Pskov, Kamchatka Territory: Primorskii
40–50	8	Republic: Buryatia Oblasts: Kaluga, Ivanovo, Tver, Arkhangelsk, Novgorod, Murmansk, Smolensk
<40	2	Republic: Chechnya Oblast: Magadan

Source: Agricultural Census (2006)

3 Main Landowners in Russia

One of the goals of land reform was to privatise agricultural land and transfer it to individual users. As part of the interim outcomes of reforms, let us consider the structure of agricultural landownership, focusing on the share of agricultural land that remains in state ownership. Unfortunately, statistical organs do not track the changes in ownership structure of agricultural land, while the Unified Rights and Transactions Register (EGRP) does not identify the type of land (agricultural or other) being registered or undergoing a transaction. The structure can be accurately computed only if we have detailed documentation of the privatisation processes from the early 1990s and all the subsequent changes in rural land. Some calculations carried out by the authors are presented in Table 4.

Table 4 Ownership structure of agricultural land in use of various groups of agricultural producers as of 1 January 2013 (%)

Agricultural producers	Owned by				Total
	User	Collective of individuals	State, municipality	Other	
1. Partnerships, companies, cooperatives	10.7	68.6	19.5	1.2	100
2. State corporate farms	0.3	7.9	91.2	0.6	100
3. Other corporate farms	11.3	16.9	70.7	1.2	100
4. Total corporate farms	10.2	62.2	26.4	1.2	100
5. Peasant farms	21.3	29.4	41.9	7.4	100
6. Household plots	39.0	0.9	59.9	0.2	100

Source: Rosreestr (2013)

The list of agricultural producers in Table 4 reflects the restructuring of the farm sector since 1991. Former collective and state farms (*kolkhozes* and *sovkhozes*) were restructured into a range of corporate entities (partnerships, companies, cooperatives), some newly constituted and some acting as successors of former agricultural enterprises. Most corporate farms today are private entities, but some remain state owned. The agricultural land of private corporate farms was divided into land shares and these were assigned to most rural residents, who became land-share owners. Individuals could withdraw from the collective with their land share, creating an independent peasant farm, or they could choose to keep their land in collective, joint ownership. The last group of agricultural producers are household plots, which are basically small individual producers continuing the tradition of Soviet semi-subsistence agriculture in the post-reform market environment.

In 2012, collectives of individuals (i.e. recipients of land shares in former collective farms who continue to hold them in joint ownership) were still the main holders of agricultural land used by corporate farms (Table 4, line 4) and especially private corporate farms created through restructuring of former *kolkhozes* and *sovkhozes* (Table 4, line 1). The vision of partitioning collective property into land plots in individual ownership through consolidation of land shares in various transactions has not materialised, although the required mechanisms were laid down at the very beginning of reform.

The partitioning was constrained first by administrative restrictions and later by high transaction costs (the cost of reconfirming previously endowed land rights, transactions concerning land shares, surveying costs, meeting requirements for cadastral registration of individual plots created from partition of joint property, etc.).[5] This has led to abandonment of land plots (if no outsiders showed any

[5]For a detailed estimate of transaction costs and their causes see Shagaida (2010). Despite recent efforts to streamline the registration procedure (World Bank 2016), the transaction costs—including the time spent dealing with bureaucratic requirements—remain high for rural residents.

Table 5 Redistribution of agricultural land between main groups of agricultural producers, 2001–2013

Types of landownership	2001		2006		2013	
	Million ha	%	Million ha	%	Million ha	%
1. Privately owned agricultural land	128.7	65	128.1	67	132.9	70
1.1. Land in joint ownership	113.7	58	111.3	58	96	50
Successors of collective and state farms ('share ownership')	107.8	55	93.4	49	69.7	37
Other corporate farms	1.7	1	4.2	2	5.6	3
Peasant farms	2.8	1	5.4	3	7	4
Other individuals	0	0	0	0	0.5	0
Land-share owners	1.4	1	8.3	4	13.2	7
1.2. Other forms of private landownership:	15.0	**7**	16.9	9	36.9	19
Peasant farms	6.3	3	6.3	3	7.6	4
Corporate farms	3.6	2	3.0	2	11.4	6
Household plots	5.1	2	7.6	4	15.9	8
Unclassified users	0	0	0	0	2	1
2. State-owned land in use of agricultural producers	68.3	35	63.5	33	58.2	31
Total in use of agricultural producers	197.0	100	191.6	100	191.1	100

Source: Rosreestr (2006, 2013)

interest in acquiring these plots), on the one hand, and to large-scale sale of land shares or even expropriation of land rights, on the other.

In addition to drawing on collectively owned land shares, corporate farms are large landowners in their own right. In 2012, corporate farms owned more than 10 % of the land in their use (Table 4, line 4), up from 8 % in 2010. The share of agricultural land directly owned by corporate farms markedly increases from year to year, especially in certain regions. Land owned by corporate farms increased from 3.6 million ha in 2001 to 11.4 million ha in 2013, trebling in share from 2 % to 6 % of all agricultural land (see Table 5).

The state and municipalities are currently the owners of only 26 % of agricultural land managed by corporate farms (Table 4, line 4); if state and municipal unitary enterprises[6] are excluded, the share drops to 18 %. We do not know below what limit the state might run into risks associated with loss of control in land markets when increases in land prices and lease rates make land unaffordable to agricultural producers. This problem may become particularly acute if there are no limits on concentration of land by a single owner and producers may be faced with monopolistic land prices in their regions. In the absence of a monopoly on land plots, the risk of high prices is reduced.

[6]A unitary enterprise, according to the Russian Civil Code, is a legal body that does not have ownership rights to the assets that it controls.

However it may be, the privatisation of land to individuals, reinforced by the need to reorganise land use in successors of restructured agricultural enterprises and in newly created farms, has created the necessary conditions for mobility of landownership. Despite the high transaction costs, land is slowly but steadily being redistributed between different groups of users: between peasant farms and corporate farms, between corporate farms and household plots, and between corporate successors of traditional land users and their neighbours (Table 5).

The data in Table 5 demonstrate the following outcomes of land reform.

1. Agricultural land in private ownership increased by 4.2 million ha between 2001 and 2013, an increase of 350,000 ha each year on average (line 1 in Table 5). Annually, this works out at less than 0.2 % of agricultural land used by agricultural producers (bottom line in Table 5). In the same period, the state lost 10 million ha of agricultural land (line 2 in Table 5), but only 40 % of this went to increase private holdings while the remainder was abandoned, as the total land in use by agricultural producers shrank by 6 million ha (bottom line in Table 5).
2. The main redistribution occurs not between the state and private landowners, however, but between different groups of private landowners. Successors of collective and state farms lost 38 million ha between 2001 and 2013, while land-share owners gained nearly 12 million ha and other private landowners (line 1.2 in Table 5) gained 22 million ha during this period.
3. Between 2001 and 2013 agricultural land in joint ownership decreased by 17.7 million ha (line 1.1 in Table 5). Some of this land shifted to private ownership by corporate farms, peasant farms and household plots, which in total increased their holdings by 22 million ha (line 1.2 in Table 5). Of this, 11 million ha of agricultural land shifted to corporate and peasant farms. This can be regarded as a positive development because the land remains in agricultural production. The remaining 11 million ha went to increase household plots, where agriculture is not a fully commercial activity. This shift to household plots may be a signal that agricultural land is being withdrawn from active farming with the intention of using it for construction.
4. Some of the land assigned in land shares (plots in shared ownership, a sub-category of joint ownership) shifted from the successors of reorganised collective and state farms to neighbouring farms (both corporate and peasant farms, which gained 4.9 million ha and 4.2 million ha respectively). Yet most of the land lost by successor farms came under the direct control of land-share owners (who gained nearly 12 million ha) and is not formally used for commercial production. In total, about one-third of all shared land in successor farms (38 million ha out of 108 million ha in 2001) shifted to other private users.

Shifts of agricultural land among users of different types between 2001 and 2013 are summarised in Table 6.

Agricultural land in use of agricultural producers decreased by about 6 million ha over 12 years (bottom line in Tables 5 and 6). Our analysis of withdrawal of land shares and their conversion to construction plots (dacha or residential construction),

Table 6 Shifts of agricultural land across users between 2001 and 2013

User	Loss/gain of agricultural land, million ha	
	Main category	Sub-category
State and municipal	−10.1	
Joint ownership	−17.7	
Successor farms		−38.1
Land-share owners		11.8
Other joint-ownership farms		8.6
Other private ownership	21.9	
Household plots		10.8
Other private farms (peasant and corporate)		11.1
Total loss of land use	−5.9	

Source: Table 5

combined with the ongoing activity of the Fund for Support of Development of Residential Construction,[7] highlights processes of irrevocable and chaotic loss of a non-replenishable natural resource: land for the development of agriculture.

4 Risks Imaginary and Real

Most of the risks envisaged by the opponents of land reform in Russia have not materialised.

This applies to the **risk of destruction of large farms** due to fragmentation of holdings and mass transfer of agricultural land to peasant farms. To this day two-thirds of agricultural land is still controlled by agricultural enterprises (corporate farms) created from former collective and state farms (see Table 5). The main land users are still large corporate farms (see Table 2). This is associated, in particular, with large barriers to redistribution of joint shared property.

The risk of **decline of agricultural production** due to land fragmentation and creation of a multitude of small farms has not materialised either. In regions where a market in agricultural land emerged as early as the mid-1990s (primarily a market for land leasing), we observe that land has remained in the hands of the primary owners and agriculture has developed vigorously. Thus, Krasnodar territory and Rostov oblast, where more than 90 % of land shares were in the hands of the primary owners at the time of the 2006 Agricultural Census, have remained the largest agricultural producers in Russia since 1990. Overall, analysis of census data

[7] A state organisation created to oversee transfer of agricultural land to construction uses (Russian Federation 2008). The law stipulates (art. 15) that the right of permanent use in state-owned agricultural land can be revoked at the discretion of the state, without any of the causes specified in the Land Code (art. 45, part 2) for such action. The law makes no mention of compensation of the affected user (for lost investments or lost income) or provision of an alternative plot.

shows that agricultural output per hectare and per person employed in agriculture steadily increases with the increase of the proportion of land shares retained by the original owners.

Concerns regarding the **exit of pensioners from agriculture** have proved unfounded. It was originally claimed that transfer of land to the ownership of collective farms, where 50 % of the population were pensioners and rural administrative staff, would lead to large-scale land abandonment, as there would be no one to cultivate the pensioners' plots. The age structure of former collective and state farms is approximately the same over all of Russia, and yet the proportions of cultivated and abandoned land differ widely. The conclusion is clear: the composition of beneficiaries does not determine the share of cultivated land.

The risk that rural people would **readily sell their land 'for a bottle of vodka'** has not materialised. On the whole, agricultural land in Russia has largely remained in the hands of primary owners who originally received their land shares in the process of farm restructuring. The exceptions observed in some regions are easily explained by local circumstances.

Thus, in Moscow oblast, very few corporate farms leased land shares and made lease payments to individuals between 1991 and 2002. The absence of any benefits from owning land led to a general feeling that land was worthless. On the other hand, at the end of the 1990s, individuals often lost their privately owned land as a result of unclear records in the original reorganisation documents of corporate farms from the early years of reform (this trend was supported by land registration organs). For instance, in Moscow oblast, the registration organs and courts enforced a curious practice: whenever the statutes of corporate farms that were registered in 1992–1994 mentioned the option of investing land shares in the farm's equity capital, this option was interpreted after 1998 as an obligation, and land shares were transferred from individual to corporate ownership. Attempts to extend this interpretation to other regions have generally been unsuccessful.

In these circumstances, land-share owners in large numbers would gladly sell their land shares whenever a willing buyer appeared. The registration system was not adapted to rapid processing of a large number of simultaneous transactions, and the majority of transactions were completed through 'power of attorney' granted by hundreds of co-owners to a single physical body. The transparency of such transactions left much to be desired.

The selling prices were initially very low. For instance, in Mozhaisk raion, Moscow oblast, a 4-ha land share was sold for RUB 3 000 in 2002 (about USD 100 at the time). By 2005, increasing demand had pushed up the prices in the same raion by a factor of 20, and then 30. As of 2013, only 39 % of agricultural land in Mozhaisk raion was still owned by land-share holders, and this land was used by large corporate farms. For comparison, in Krasnodar territory—the most agriculturally productive region in Russia—fully 67 % of agricultural land is owned by land-share holders. On the whole, land-share owners are still the main holders of private agricultural land in Russia (Rosreestr 2013).

The risk that **foreigners would take over Russia's agricultural land** remains a topical issue. However, even if foreigners do buy land in Russia, they cannot take it out of the country; they will use it for agricultural production, operating within Russian legislation, introducing new technologies and creating jobs for rural people. The constraints on foreign landownership imposed in Russian legislation[8] are easily overcome and foreigners can acquire ownership of agricultural land. We often read in the news that a foreign company has so much land and would like to buy even more, and there is no mention of proceedings initiated by the state attorney to investigate any suspicion of illegal ownership.

Many non-Russian experts highlight the well-founded risk of **reduced investment activity** in agriculture. Privatisation of land in favour of the rural poor inevitably makes agriculture less attractive to investors. This difficulty was partially resolved only in the middle of the first decade of this century, when economic conditions in Russia were normalised, state programmes for the support of agriculture were developed and outside investors began showing interest in the assets of corporate farms.

Of all the risks frequently voiced at the beginning of reform, **land concentration** remains the only real danger. This danger exists in many countries, and rich experience has been accumulated throughout the world on how to combat land concentration. Yet Russia has again followed a unique path.

The decision on the maximum permitted concentration of land in the hands of a single owner (physical or legal body) is not centralised: it is left to Russia's administrative divisions (Russian Federation 1998). If a region decides to impose such a restriction, then the allowed concentration should be 'not less than 10 % of the total area of agricultural land in an administrative district'. In other words, the maximum allowed concentration may be 10 %, 20 % or even 50 % of total agricultural land in the district, but by law it may not be limited to 5 %, 7 % or 9 %.

On the other hand, the law does not consider the possibility of land concentration in several corporate farms owned by one person or a group of persons. Thus, today a single person may register ten limited-liability companies and each of these companies may hold up to 10 % of agricultural land in the district. In this way, that person will be the sole owner of 100 % of agricultural land in the district, without contravening the letter of the law. Nor is there any restriction of land concentration in a single family, as long as each family member stays within the obligatory 10 % limit.

In today's Russia, only peasant farmers are restricted in their ability to buy land and redistribute it among relatives. Table 5 shows that agricultural land in the ownership of peasant farms increased by 800,000 ha in 10 years (on average 3 ha per peasant farm).

There are ways to counteract land concentration, but nobody seems interested. Although Ukraine still has a moratorium on selling and buying of agricultural land, draft legislation proposed over the years in preparation for the lifting of the moratorium always included a clear upper limit on land that may be owned by a single individual (100 ha in recent drafts); no landownership by legal persons is

[8]Foreign physical and legal bodies may not own agriculturally zoned land.

envisaged (Kalyuzhnyi 2012; Lerman 2014). Other measures are also possible, but their implementation, as always, requires political will, which seems to be lacking in Russia.

Today we face a number of additional risks that were not apparent in the early 1990s and only surfaced in the process of reform:

- the danger of land shifting to entities not engaged in agriculture or agribusiness, who may accumulate large tracts of land for resale or leasing (this is a convergence of risks associated with land concentration and the absence of effective restrictions on landholders);
- the danger of uncontrolled loss of fertile agricultural land, open spaces and agro-landscapes due to unregulated rezoning of land for construction (which is much more profitable than agriculture);
- the danger of creating or preserving inappropriate land-market institutions (more on this below).

5 State Policy Guidelines

The multiple risks and dangers discussed above could be eliminated by the adoption of a long-term state policy regarding agricultural land. The policy should be embedded in a programme that articulates the long-term state objectives, sets out tasks and mechanisms to achieve these objectives, assesses risks and dangers, and provides options for experience-based adjustment of tasks and mechanisms. The absence of such a long-term policy prevents normal development of agriculture, because at any instant we may unexpectedly face a new phenomenon that requires fire-fighting measures: such measures may involve breaking existing laws and coming up with strictly ad hoc rulings that violate the interests of agricultural producers.

A vivid illustration of such a situation is the creation of the Fund for Support of Development of Residential Construction (Russian Federation 2008). The very name of this fund grants a licence to withdraw land from normally functioning unitary agricultural producers (recall that a unitary enterprise does not own the assets it operates). In 2006, article 45 of the Land Code was amended to allow the right of permanent land use to be terminated even if the land user has not violated the law. In 2008, the law ‘On support of development of residential construction’ (art. 15) stipulated that federally owned land can be alienated from a lawful user if such land is required by the fund. In this case, unlike alienation of land for state or municipal needs and requisition, the user loses the land to the fund without any compensation: ‘In cases when permanent use rights in federally owned land plots are given to organisations, these rights may be terminated without the consent of these organisations and independently of the reasons set out in the Land Code’ (art. 45, part 2).

The unconstitutionality of this provision was argued before the Constitutional Court, but the appeal was rejected. The court decided that the user could protect his or her rights in a different manner, without annulling the allegedly unconstitutional provision.[9] As a result of the court's decision, the provision continues to apply.[10] It is quite likely that the new provision may be annulled in the future—as unexpectedly as it appeared—but by then much land will have been alienated and many rights will have been violated.

Without a long-term policy on land resources, many sub-issues—continued privatisation of state-owned land, development of construction, large-scale leasing of agricultural land to Chinese firms and other unexpected events—often clash with the need to maintain agricultural production and ensure access to land for Russian agricultural producers. In extreme cases, the contradictions require the application of micro-management tools.

Without a long-term policy, it is impossible to decide on a comprehensive list of information items that the land register and the register of immovable-property rights should include. In such a situation, something will always come up as missing. For instance, there are discussions of passing from classification of land by category (see note to Table 1 for list of land categories) to zoning, which specifies the allowed uses for each region. Yet the Unified Register of Rights and Transactions contains only a field for land category, and no field for zoning. If in the future the government seeks to prohibit the use of fertile agricultural land for construction, we will suddenly discover that the Unified Register of Rights and Transactions contains only the category of land, and no information about type of land (arable, pasture, etc.) or its quality, while the land register shows only the cadastral price of land.

The government is starting to privatise the last group of federal unitary farms. Unqualified privatisation, allowing sale to the highest bidder, will inevitably lead to concentration of land in private hands and increase the danger of land being withdrawn from agricultural production. In either case, the access of agricultural producers to land will become more difficult: either lease rates will become monopolistically high (assuming that the new owner will lease out the land) or producers will face a shortage of land in some well-endowed agricultural territories.

By ignoring these dangers, privatisation will continue unchecked without preserving at least a portion of land in state ownership (which can be released for leasing if lease prices become prohibitive), without restricting the range of buyers of agricultural land, without creating demarcated plots that could be bought by peasant farmers and corporate farms with no need for costly zoning of rural areas, and finally without putting a stop to chaotic construction on agricultural land. All this is happening in reality, because no objective has been set and no paths have

[9]Judgment of the Constitutional Court of the Russian Federation No 1911-O, 4 October 2012.

[10]Justice M. I. Kleandrov, in a dissenting opinion, argued that experience shows that in such cases the user has no chance to protect his or her interest and that the provision should be recognised as contradicting international law and declared unconstitutional.

been charted for achieving the (unspecified) objective. The emergence of legal norms is often a sporadic process, driven by lobbyists' efforts.

Thus, in 2008, the Government Commission on Development of Residential Construction was created with the aim of deciding on the release of federal property, e.g. experimental and teaching farms, for construction. The commission adopted its own statute, which decreed that the commission will determine its own decision-making rules. There is no reference to the Land Code or the future law to determine how land changes from one category to another (e.g. from agriculturally designated land to land in settlements). Initially it was assumed that unused agricultural land would be released for construction. However, as a rule there is no unused agricultural land in experimental and teaching farms. Someone on the commission came up with the idea that inefficiently used land should be alienated for construction. To avoid delving into the full complexity of efficiency assessment, the commission simply changed its name: as of 18 December 2012 it is called the Government Commission on Development of Residential Construction and Assessment of the Efficiency of Use of Federally Owned Land Plots. It is hard to see how efficiency assessment will be done if the commission members are ministers, deputy ministers and directors of ministries. The intention to encourage residential construction is inconsistent with an objective assessment of land use in experimental and teaching farms, but nobody appears to be bothered by this inconsistency.

Russia acutely needs a coherent state policy on land resources. The use of land resources to satisfy the needs of the population assumes at least two tasks: production of food and agricultural raw materials for industry, and development of rural territories and housing. Agricultural land is unavoidably an important resource for construction. In the absence of a government policy, these two tasks clash with each other.

6 Priority Measures

In the first stage, it is necessary to carry out a full classification of land plots by quality, identifying the plots of highest and lowest value for agriculture. The withdrawal of the highest-quality plots from agriculture should be prohibited outright; for the lowest-quality plots, several options are possible. In the USA, farms with the most valuable land are listed by name on the websites of agricultural departments in various municipalities. A similar option exists in Russia. Agrochemical mapping carried out as part of the fertility monitoring of agricultural land (Federal Targeted Programme 2005) already provides sufficient data for identifying low-quality plots in parts of Russian territory.

In the second stage, wealthy land buyers should be made to realise that they cannot withdraw just any land plot from agricultural use; only the lowest-quality land may be withdrawn. This will immediately reduce the pressure on the highest-quality land plots from those who do not intend to engage in agriculture or agribusiness, and it will segment the land market into market for agricultural plots and market for plots that may be potentially released for construction. Because of different returns on these different activities, the corresponding plots will have different prices.

Then low-quality agricultural land may be marked on territorial planning maps as land for potential construction. It is advisable to develop a procedure (and reflect it in legislation) for the sale of building rights in such plots through auctions. The sale proceeds can be used to augment local budgets and to develop amenities and recreation zones. The building rights for such plots should be sold with building plans and permits attached. In this way, the authorities will be able to monitor the process of land alienation and ensure that the proceeds from the loss of agricultural resources are channelled directly to the local budget, and not to the pockets of various officials. This will also ensure development of territory with prescribed building density and building quality.

Once developers are kept from valuable agricultural land, it will become more accessible to agricultural producers. To further rein in the appetites of land speculators, we can discuss size limits on agricultural land plots that can be bought or otherwise acquired by a single person, persons affiliated with that person or a person who is the owner of an organisation with agricultural land in its asset portfolio. Before embarking on sale of state-owned land, the government should make sure that the plots have been duly surveyed and demarcated; these tasks should not be transferred by the state to potential buyers. This approach will reduce the barriers to access to agricultural land for corporate and peasant farms.

It is advisable to abandon punitive measures and stop threatening all landowners that they will lose their land unless it is cultivated. In developed countries, local authorities intervene only when there is a candidate willing to take over the land, and the owner, in the expectation of driving the price up above market value, is neither cultivating the plot nor leasing it out. In such cases, the authorities conclude a lease contract on behalf of the owner at the going market price. A similar mechanism is needed in Russia.

The last question concerns the adequacy of institutions. This term in our context covers the level of transaction costs that enable a Russian citizen to register land rights in the new registers.[11] The process involves completing a transaction concerning a land plot or a land share, withdrawing a demarcated land plot corresponding to a land share from joint property, preparing the necessary documents for cadastral registration of the land plot, entering the plot in the register and registering the land rights independently, without resorting to a lawyer, within a reasonable time and at reasonable cost. During the entire existence of the EGRP since 1998, the information on rights to land plots has been entered in the register for not more than 20 % of land plots. This clearly suggests that the existing institutions are inadequate, requiring unreasonable investment of time and money.

[11]The government created a new unified rights and transactions register—the EGRP—in 1998 without transferring the relevant information from previous registers.

Finally, another observation does not engender optimism: at the beginning of land reform there was a single organ responsible for land policy, implementation of land reform and adequacy of institutions—the State Committee of the Russian Federal Socialist Republic on State Reform (Goskomzem). Since its establishment in November 1990, the committee has undergone repeated reorganisations: legal and normative acts contain no fewer than eight names of successor bodies that replaced one another in the course of these reorganisations.

In the process of reorganisation, the land-reform function was lost by the wayside, experts familiar with the fine features of land transformations were dismissed and new experts were taken on board without any understanding of what it means to demarcate a specific land plot arising during land privatisation in collective and state farms. At the raion level, a single raion land committee was replaced with three organisations—cadastral chamber, land committee and registration chamber; at the federal level, Goskomzem was replaced with two organisations—Roskomzem (the Federal Land Committee) and the Registration Chamber.

Each organisation, through laws and normative acts, secured its specific interests without aiming at the larger common goal. New rights registers were introduced without ensuring orderly transfer of existing data from old registers; the burden of populating the new registers fell on the users. New specialists in these organisations invented new rules without checking their feasibility in Russian practice.

In 2004, during the next reorganisation of the organ entrusted with management of land resources, the strategic function of managing land resources simply disappeared. Today we again have a single organ—Rosreestr—but it is entrusted with purely technical functions. How can we hope to achieve rational management of land resources without a duly empowered institution?

7 Conclusion

Russia has made huge progress on the path of land reform since the early 1990s. Nearly 70 % of agricultural land has been privatised, and land-leasing transactions are widespread, demonstrating the rapid development of land markets. Many of the risks of land reform that had been raised since the beginning of the process have proved groundless and imaginary. Agriculture continues to prosper and grow in regions that are suitable for farming, while declining and shrinking in unprofitable regions—as in all market economies. Despite tremendous achievements on the ground, Russia still lacks a coherent land policy with a clear statement of objectives and definition of an adequate set of institutions. New challenges arise every day, and the existing policies are unable to cope with these challenges. Main policy measures should include implementation of binding limits on land concentration, decisive reduction of transaction costs for access to land by farmers, and enforcement of effective legal protection of land-use rights. Furthermore, land policy should aim to preserve the most fertile lands for agricultural uses by effectively restricting construction on such land. So far, these measures have not been implemented. Their introduction requires long, tedious work that focuses on socially meaningful objectives, instead of administrative interests. Such an effort is impossible without strong political will.

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Credit and Finance Issues in the Eurasian Wheat Belt

Kateryna G. Schroeder and William H. Meyers

1 Introduction

Currently, rural areas in the Russian Federation, Ukraine and Kazakhstan (RUK) lack reliable and accessible financial means, which slows growth and development of agricultural production and productivity. For example, according to the Organisation for Economic Co-operation and Development (OECD 2013a), limited access to finance for agribusiness firms is one of the main barriers to the competitiveness of agribusiness in the RUK countries. As many as 75 % of agribusiness firms surveyed by the International Finance Corporation (IFC) in Ukraine identified lack of access to finance as a key barrier to further expansion and investment (European Fund for Southeast Europe 2012). A study by Homans et al. (2011) on regulatory and institutional barriers affecting Ukrainian small and medium-sized agricultural producers (SMPs) estimated that the annual unmet demand for credit for SMPs was more than USD 7.2 billion.

The reasons behind low levels of finance and credit in RUK are numerous. Lack of overall macro-economic stability undermines existing financial institutions and their ability to issue credit to the market players. After the financial crisis of 2008, levels of financing obtained by the agricultural producers through bank credit, government programmes and micro-finance institutions has been on the decline.

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Although it has started to recover in recent years, new economic turmoil in both Russia and Ukraine will no doubt negatively affect credit flows into agriculture in all three countries, although to a lesser extent for Kazakhstan. According to the World Bank (2014), since the beginning of 2014, Ukrainian banks have witnessed an aggregate deposit outflow of about 20 %. In addition, depreciation of the hryvnia is putting a strain on the banks' capital adequacy ratios. The decline in oil prices will most likely result in Russian and Kazakh agricultural producers receiving less support from their governments through various programmes.

In this situation, agricultural producers are at a disadvantage. They need to compete with everybody else in the market for these limited resources, yet, because of the inherent risks that are traditionally associated with agricultural production, such as high price volatility on commodity markets and weather disruptions, banks are forced to compensate for these risks with high collateral and/or high nominal interest rates for lending.

The policy and regulatory environment is also a significant constraint on improved access to agricultural finance in the RUK countries, as it further exacerbates the uncertainty associated with agricultural production and its profitability. Agricultural policy in all three countries is often inconsistent and unpredictable. Even though RUK have formally established government objectives and state programmes, the implementation of these policies on the ground often appears to be ad hoc. As an example of such an ad hoc approach to policy implementation, during the financial crisis in 2006–2008 and later in 2010–2011, both Russia and Ukraine introduced a variety of grain export restrictions that took the form of bans, quotas and tariffs. As well as being disruptive to the markets by themselves, these trade policy interventions were also accompanied by a dramatic increase in market uncertainty. Furthermore, in Ukraine, there is uncertainty about the terms of the Draft Law "On Land Markets" (Parliament of Ukraine 2011), which governs the lifting of the moratorium on land sales that is in place, as well as uncertainty about the ability of farmers to obtain clear and marketable titles to their property once the moratorium is lifted. These doubts are also not favourable for attracting additional funds to agriculture in the country.

Finally, at the farm level, weak farm management and accounting reduce the creditworthiness of agricultural producers, and limit their ability to obtain additional financing. Homans et al. (2011) assessed agri-lending to SMPs and their main conclusion was that 'the major barrier to SMPs obtaining additional credit is the inability of most SMPs to generate documented cash flow sufficient to repay a borrowing, regardless of the type of credit supplier extending that borrowing.' Many SMPs that have sufficient cash flow often operate in the cash market and do not have any financial records that could be used to assess their financial status. An OECD study (2013b) shows that a similar situation is prevalent among Kazakh producers.

As a result, in all three countries, commercial credit to agriculture is low compared with credit provided in other sectors of the economy. For example, in

2009–2011 the amount of commercial credit to agriculture in Kazakhstan accounted for only 3.5 % of total bank credit in the country. In Ukraine in 2013, only 5.9 % of all loans went to the agricultural sector (National Bank of Ukraine 2013).

In this chapter we examine different factors determining the availability of finance and credit for the agricultural producers in RUK: the agricultural policy environment, the availability and accessibility of financing for farmers from private players, and the role of farm management. Successes and failures in past experience of transition countries in Europe and Central Asia are used in assessing alternative future development strategies.

2 Access to Agricultural Finance in Russia, Ukraine and Kazakhstan

2.1 Policy Measures

Kazakhstan, Russia and Ukraine use similar policy instruments in their support of agricultural producers: area and output payments, input subsidies, border protection measures and simplified taxation, among others. Following droughts in 2010 and 2012, subsidies to insurance premiums have also become one of the more important spending items in both Ukraine and Russia.

Implicit support through concessional credit is another traditional component of agricultural support in all three countries. It provides interest subsidies for short-, medium- and long-term loans. In Ukraine, the amount of support that comes in the form of concessional credit is modest (only 5 % of all input subsidies in 2010–2012). Compensation to agricultural producers for their interest payments should be no less than 1.5 times the National Bank of Ukraine's refinance rate in national currency.

In the Russian government's proposed aggregate spending for the development of agriculture, interest rate subsidies play a central role, with a 23 % share of total spending for agriculture in 2013–2020. Overall, the role of concessional credit has been on the rise since 2006, and its beneficiaries are predominantly large farms and downstream borrowers. Small farms, households and cooperatives have been receiving only a small fraction of the subsidised credit amount (Fig. 1). Concessions take form of subsidies on interest payments, which are co-financed from federal and regional budgets. The subsidy is set as a fraction of the central bank refinancing rate, with the fraction varying by type of beneficiary and type of loan.

Out of the total amount of subsidised credit (both short- and long-term), 56 % supports the livestock sector and 26 % supports the crop sector. Similarly, long-term credit is mostly used to support poultry, swine and cattle, while crop production receives 32.3 % (Fig. 2).

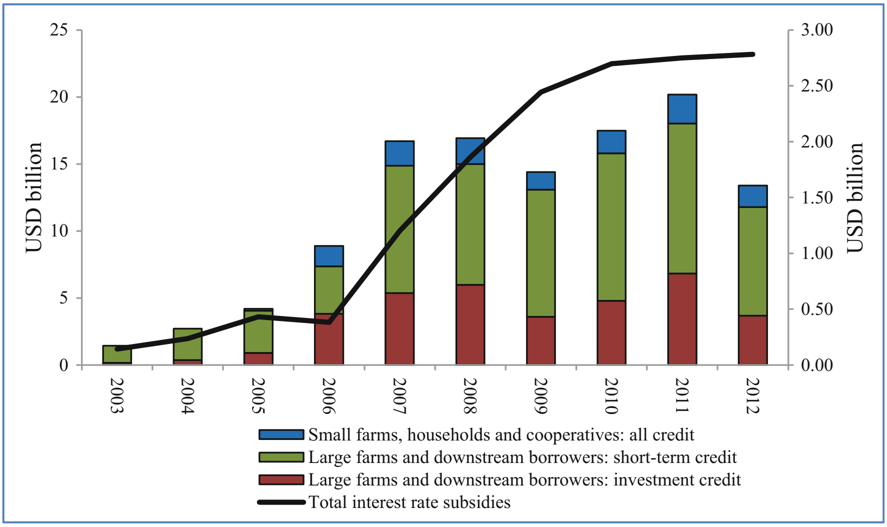

Fig. 1 Concessional credit allocations in Russia in 2003–2012. Source: figure adapted from OECD (2013a)

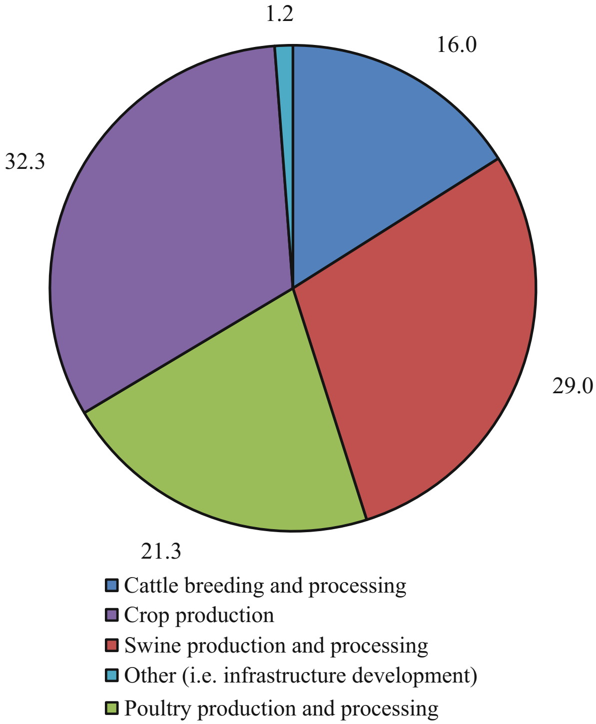

Fig. 2 Distribution of subsidised investment (long-term) credit by use in Russia (percentage of total). Source: Ministry of Agriculture of the Russian Federation (2013)

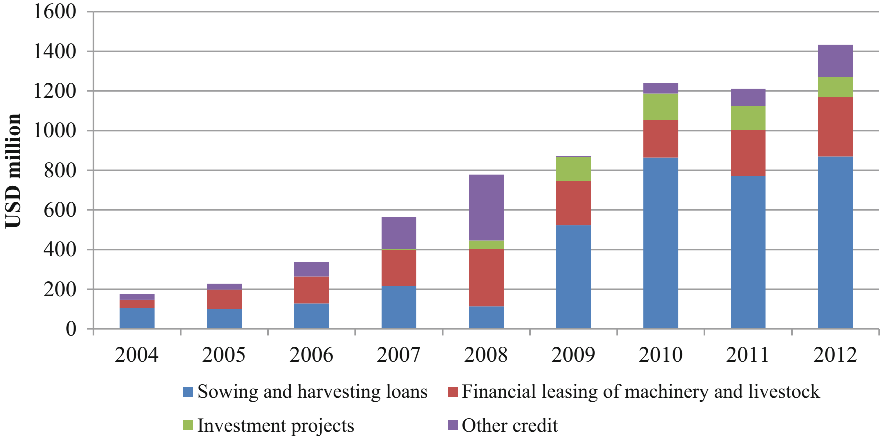

Fig. 3 Concessional credit allocations in Kazakhstan in 2004–2012 (million USD). Source: OECD (2013a)

In Kazakhstan, concessional credit is also an important component of agricultural support. It constitutes 7 % of the OECD producer support estimate (PSE), which is similar to the output payments share (note: two-thirds of PSE comes from market price support, largely as a result of border protection). Concessional credit is implemented through administratively fixed interest rates, and state agencies—KazAgroFinance, Agrarian Credit Corporation, Fund of Financial Support of Agriculture—serve as the sole providers of such credit. Rates depend on the term and purpose of the loan. For example, in 2012, short-term loans for sowing and harvesting were provided at interest rates varying from 4 % to 11 % per annum. Longer-term loans for 3–7 years were given at interest rates ranging between 4 % and 9.5 %, which were lower than commercial interest rates of 10–11.7 % (OECD 2013a). As in Russia, the use of concessional credit started increasing steadily after 2006. The dominant share of the credit is used for sowing and harvesting loans (Fig. 3).

2.2 *Role of Commercial Banks*

Banks, the traditional source of funding for various market players, are usually less eager to provide loans to agricultural producers, particularly small and medium-sized ones. This stems from the inherent risks that are traditionally associated with agricultural production, such as volatile commodity prices, variable weather and lack of relevant credit information on SMPs. As Homans et al. (2011) show, Ukrainian bank lending officers often have a very limited understanding of how farms operate, which makes it difficult for them to underwrite SMP credits effectively. As a result, when it comes to agriculture, banks hedge their risks with higher

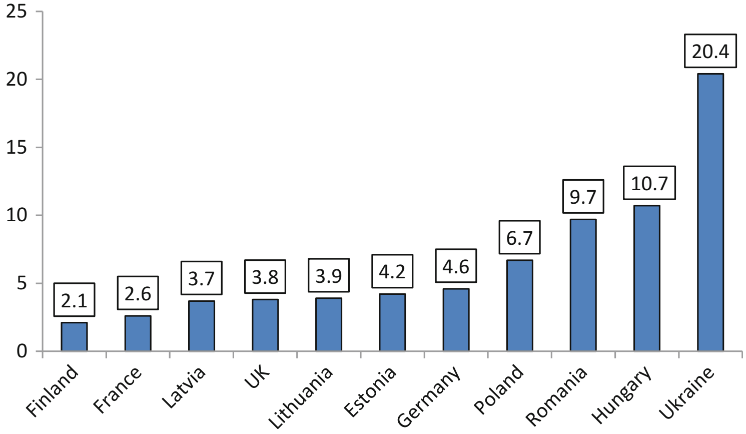

Fig. 4 Average interest rates for bank loans in selected European countries, 2013 (% p.a.). Source: Yatsenko (2013)

interest rates and more stringent collateral requirements. Most of the commercial credit that is extended to agricultural producers is seasonal, making it more difficult for SMPs to make longer-term investments in their operations.

Although it is an issue in all three countries, high interest rates on bank loans is a more restrictive factor for credit expansion in Ukraine's agricultural sector. As is seen in Fig. 4, Ukrainian agricultural enterprises have been faced with significantly higher interest rates than their western and central European neighbours. Furthermore, as the OECD (2013a) report shows, the interest rates charged to agricultural producers are almost twice as high as interest rates for companies in other sectors. In Kazakhstan the nominal rates for loans to legal entities ranged between 10 % and 13 % for loans in national currency in 2011 (Petrick et al. 2014).

Bank requirements for collateral are also particularly high for agricultural producers in Ukraine and its neighbouring countries. Figure 5 shows that the average collateral rate in Ukraine is equal to 137.5 % of loan value, almost 50 % higher than the equivalent rate in Kazakhstan. Given that Ukrainian agricultural producers cannot use land as collateral, because of the moratorium on land sales in the country, access to bank credit is significantly restricted. Not surprisingly, a report from the National Bank of Ukraine (2013) shows that during the previous 5 years there was no trend among Ukrainian banks to increase their lending to SMPs. With the current political and economic turmoil, the amount of available bank credit for Ukrainian agricultural producers is expected to decrease further.

All three countries have adopted a system of warehouse receipts that allows agricultural credit to be secured by pledging a warehouse receipt. Kazakhstan is the most successful of the three in its introduction of such receipts. The country was able to build initial consensus among key stakeholders on the development of a warehouse receipt system, adopt a proper legal framework, institutionalise all the important elements of the system and involve the financial system in its utilisation

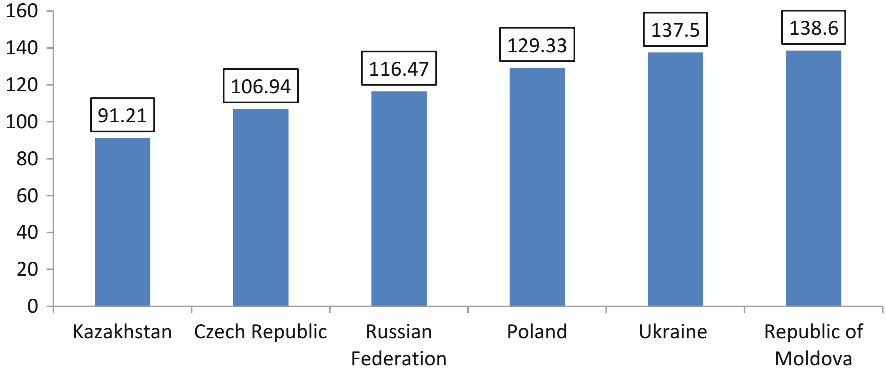

Fig. 5 Collateral rates in various countries of the Europe and Central Asia region (percentage of loan value). Source: OECD (2013a)

from the early stages of development (European Bank for Reconstruction and Development 2004; Hollinger et al. 2009). As a result, a well-functioning system of warehouse receipts has proven to be rather successful in securing agricultural financing in the country: in 2010 over 30 % of the loans issued to agriculture were guaranteed by grain receipts (OECD 2013b).

Ukraine has only been partially successful in developing a warehouse receipt system. While both proper legislation and the requisite institutional framework for the licensing and inspection of public warehouses are in place, some links are still missing, which is preventing the widespread use of warehouse receipts. The major bottleneck is that there is no indemnity fund covering losses at the warehouse. On the positive side, the government has recently established an automated registration system as a next step in improving the system's efficiency.

2.3 *Non-bank Lending*

While bank lending remains a predominant source of financing for the agricultural producers in all three countries, other, non-bank, sources also exist, including credit unions, leasing and value chain financing. For example, in Kazakhstan, agricultural producers can obtain financing from rural credit cooperatives and micro-credit finance institutions, as well as from banks. However, their share in total agricultural financing is rather low: together they supply about 5.5 % of total agricultural lending.

In Ukraine, commercial banks are also dominant when it comes to agricultural lending. However, agricultural producers can enjoy other financing options as well. For example, as access to finance is much easier for larger players, there is an opportunity for a number of value-chain financing schemes, where primary processors, wholesalers and traders provide finance to farmers, and in return receive raw material. Thus, input suppliers are placed particularly well to provide short-term financing to agricultural producers in the country. They can get credit from the banks, and then use it to finance SMPs. Since input suppliers are not regulated and supervised by the National Bank of Ukraine, they are more flexible in their requirements of their borrowers. For example, they do not have collateral restrictions, one of the constraints SMPs face when applying for credit with commercial banks (Homans et al. 2011). However, for financing through input suppliers to become widespread in Ukraine, improvements to judicial and regulatory systems need to be implemented.

Another form of value chain financing, the use of forward contracting, is used by both the Government of Ukraine and large traders. However, its use is not widespread due to low enforcement levels (European Fund for Southeast Europe 2012).

The role of the agricultural credit unions remains marginal in Ukraine, just like in Kazakhstan, and has been declining over time (European Fund for Southeast Europe 2012). The key barrier for more active participation of the credit unions in agricultural financing is regulatory: credit unions are allowed to lend only to individuals and only in local currency. As a result, their customers are predominantly the smallest SMPs (under 100 ha), which apply for short-term credit (Homans et al. 2011).

Agricultural insurance is another way for producers to hedge against the risks associated with variable weather. However, producers lack trust in the insurance sector, resulting in low participation rates. Given this, the crop area insured between 2005 and 2009 constituted less than 3 % of the total seeding area (European Fund for Southeast Europe 2012).

Finally, agricultural leasing in Ukraine constitutes a small but steadily growing share of total investment in the economy. At the end of 2010, agricultural leasing accounted for 13 % of all leasing operations in the country, exceeded only by the transport sector (59 %), and has been growing since. Leasing companies offer a wide range of agricultural machinery and equipment for Ukrainian producers. The down payment is on average 20–30 %, with lease duration of up to 7 years (European Fund for Southeast Europe 2012).[1]

An important aspect of agricultural financing in the RUK countries is that the amount of credit that agricultural producers in RUK can obtain largely depends on their size. SMPs have significantly less access to finance than the large ones. Since early 2000s all three countries have seen an emergence of agro-holdings, large farms (sometimes larger than 100,000 ha) that are often vertically integrated with processors or exporters. Given their size, not only can agro-holdings obtain credit from commercial banks more easily, but larger ones have also been able to strengthen their capital base with foreign venture capital through initial public offerings and private placements (European Fund for Southeast Europe 2012). As an example, a study by Petrick et al. (2014) showed that only 11 % of individual farms took out a bank loan in 2011, compared with 50 % of agro-holdings.

[1]The state-owned UkrAgroLeasing company is a leader in the agricultural lease market.

Ukraine has a funding gap for farms between 100 and 1000 ha in size. Homans et al. (2011) showed that smaller farms (less than 100 ha) can often obtain credit from credit unions. Farms over 1000 ha enjoy various sources of agri-lending: value-chain financing, both before and after harvesting, leasing opportunities and credit from national and regional banks. The farms between 100 and 1000 ha are, however, too large to access financing from credit unions and too small to easily take advantage of other sources of financing available for larger farms.

2.4 Demand-side Constraints

When it comes to agricultural financing in RUK, constraints on the demand side can often be as limiting as the ones on the supply side. For example, for many Ukrainian and Kazakh SMPs a major barrier to obtaining additional financing is their inability to generate documented cash flow sufficient to repay a loan. Many SMPs that have sufficient cash flow often operate in the cash market and do not have any financial records that could be used to assess their financial status (Homans et al. 2011; OECD 2013b). Additionally, the system of extension services is not well developed in these countries, even though farmers would greatly benefit from such services. As they are not frequent borrowers, developing a sophisticated business plan or properly documenting cash flow is a challenge for a number of them.

Ukrainian agricultural producers also often remain reluctant to borrow money from the banks because they distrust the banking system or lack knowledge about the benefits of credit for their business (Homans et al. 2011). As a result, informal borrowing is widespread in the country through family, friends and self-help groups. A survey conducted by the IFC in Ukraine found that, if in need of a loan, 56 % of respondents (among household farmers and smallholders) would first approach family and friends, and only 41 % would go to the banks (European Fund for Southeast Europe 2012).

3 Lessons from Central and Eastern European Countries

Just like agricultural producers in RUK, farmers in central and eastern European (CEE) countries found that access to external financial resources was largely constrained during the transition period. The underdeveloped regulatory framework, low enterprise profitability, high interest rates and lack of collateral were among the major factors that hampered the development of agro-financing in these countries. As they went through these market development stages earlier and faster, their successful practices aimed at the improvement of agricultural financing could be used by the RUK countries. Part of the reason for the faster speed of transition in these countries was political will and the earlier emergence of farm and market restructuring and reform, and part was that the process of preparing for European Union (EU) accession became an external as well as internal pressure for change.

At the early stages of transition, governments of the CEE countries facilitated access of agricultural producers to finance through credit subsidies, loan guarantees and support of special agricultural lending institutions (Swinnen and Gow 1999). Loan-guarantee funds proved to be particularly helpful in overcoming collateral deficiencies. Such programmes resulted in increased credit supply and high repayment rates (European Bank Coordination Initiative 2014; Meyers et al. 2004).

However, a key achievement of the CEE countries in overcoming the constraints that they faced related to agri-lending was implementation of regulatory frameworks and long-term policy programmes conducive to the development of the agricultural sector. For example, post-Soviet CEE countries were relatively efficient and successful in implementing land reforms during the transition (Goychuk and Meyers 2013). One of the results was consolidation of land ownership in the hands of agricultural producers, which allowed them to use land as collateral when applying for bank loans.

Moreover, just like Kazakhstan, CEE countries (including Bulgaria, the Czech Republic, Hungary, Lithuania, Poland and Slovakia) were the first ones among the transition economies to introduce legislation for the warehouse receipt system. In all these countries, warehouse receipts are actively used by agricultural producers.

A proper regulatory framework also allowed more innovative instruments to be used to finance agricultural production activity. Thus, value-chain financing was critical during transition in the CEE countries, as it was particularly suitable for addressing the financial needs of agricultural producers in the short and medium terms. As these can take different forms—leasing of equipment, forward contracting of outputs, producer loan guarantees backed by processing companies—they are well positioned to link together those who are in need of additional financing and those who can provide it in return for raw materials (Meyers et al. 2004). However, as was mentioned in the case of Ukraine, such financial instruments are hard to implement if enforcement mechanisms are lacking, the market players have limited trust in the judicial system, or excessive regulations are in place.

4 Conclusions and Recommendations

Credit and finance are the life-blood of any successful agricultural and agribusiness system, so there are severe constraints on progress without a well-functioning credit and finance system. The entire marketing system as well as the underlying credit and finance infrastructure is still at an early stage of development in this region. It may be more accurate to say that it is fairly well developed in certain sub-sectors or sub-regions of these countries, while other sub-regions or sub-sectors are left behind. It is also clear that the political instability in the Ukraine–Russia border region, along with the steep decline in petroleum prices, has exacerbated an already precarious financial situation for agriculture across the region.

The current constraints that we have identified in the Eurasian wheat belt vary somewhat by country but are present to a greater or lesser extent in all of them. We summarise these constraints in terms of credit-supply issues, credit-demand issues and policy and regulatory issues.

Credit-supply issues originate because lenders are not interested in the national market. They consider it too risky, have insufficient knowledge of the sector or lack personnel trained in the sector's operations to effectively assess the risk, so they prefer to avoid it. Before the financial crisis of 2008, for example, much of Ukraine's agricultural credit from banks came from branches of banks in the EU that were often lending in euros. After the financial crisis, not only did repayment become constrained by depreciated currencies, but also the banks mostly withdrew financial services. Domestic financial institutions were not able to fill that void either. Similar situations obtained elsewhere in the region. In most cases, land cannot be used as collateral, which is another constraint.

The remedies for such constraints, as seen in CEE countries, have been value-chain credit from input suppliers or output buyers, settling land ownership issues to collateralise land, and creation of loan-guarantee funds (especially for investment credit) so the government can share the lending risk and thereby encourage more supply of credit from commercial banks. In some cases, credit unions have also been an important substitute for bank credit. Very large enterprises have tapped into global financial markets for lower interest rates, but that also has become constrained recently by the growing conflict and oil-price conditions.

Credit-demand issues relate to financial management by farms and improved financial conditions of farms. It is not unique to this region but traditional farmers, even in the United States and Europe, frequently operate with poor financial management skill and experience. During the US farm financial crisis in the mid-1980s, the extension services launched emergency financial consulting teams that combined extension agents and experienced farmers with financial skills to assist less expert farmers with financial management advice. So there is a key role for private and public advisory services to help create the basic building blocks for credit demand by farmers.

Naturally the financial conditions and value of collateral of farms and the farming sector also have an impact on demand. This is what the financial officers of the banks want to see. In current conditions the financial stress, political instability and at least temporarily depressed commodity prices all put a damper on demand for credit. Here is where risk-management tools provided by governments could play a role. For short-term credit, this could be revenue-, price- or yield-insurance products; for longer-term credit, such as for investment, the loan-guarantee fund has already been mentioned.

Policy and regulatory issues, finally, are also important. One of the most important is a stable and predictable macro-economic and agricultural policy environment. The state of the national economy has a direct impact on agriculture through, inter alia, interest rates, inflation rates, income-growth rates and exchange rates, which all influence agricultural and food supply and demand. For many CEE countries the process of joining the EU and adopting the common regulations in the *acquis communautaire* and the Common Agricultural Policy provided a much more predictable policy environment for both the general economy and the agricultural economy. Before that, countries were gradually moving towards those policies, so even before accession there was a general improvement in the stability and predictability of policies. Of course, countries can adopt consistent and stable policies without joining the EU or any other regional arrangement. Joining the World Trade Organization and its disciplines or establishing stable domestic policies, for example, is another contributor to policy convergence and predictability.

A corollary to these policy forces is market institutions such as a well-functioning land market. Even a well-functioning land-rental market is helpful, but, for finance and credit to operate normally, there has to be collateral upon which to base many lending decisions, especially for investment funding. A tool that has been useful for short-term financing is a system of warehouse receipts, which provides the lender with assurance that a harvested product is stored securely and can be a short-term loan collateral. We have seen that the RUK countries have used this to varying degrees. Another risk-reducing measure is insurance against price, yield or revenue risk. With a well-functioning insurance system, lenders may insist that farmers buy such insurance as a condition for financing. The experience in the USA is that such insurance is not widely used unless it is subsidised and perhaps also required for access to loans or government-programme support.

Therefore, the path to a well-functioning credit and finance system for agriculture and agribusiness is not one easy step. It involves an accumulation of policies and institutions and learning by doing in the industry itself to form such a modern financial system that will serve the needs of the agriculture industry. The experiences of many CEE countries that have progressed far along this path should be carefully observed as examples for countries in this region, which are 10–15 years behind in terms of these policies and institutions.

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Part II
The Role of Agricultural Policies

Agrarian Reform in Ukraine

Volodymyr Pugachov and Nikolay Pugachov

1 Introduction

The transition to the market economy after the collapse of the communist regime in 1991 required adopting a sustained reform process. The progress of agrarian reforms in Ukraine can be split into two phases. The first phase involved the privatisation of agricultural land and farm restructuring. The second phase attempted to complete the restructuring of agricultural enterprises.

However, the reform progress was sluggish and led to adverse developments in the sector. One of the main reasons why the agrarian reform implemented in the first phase did not succeed was the failure of agricultural enterprises (former collective and state farms) to adapt to economic market conditions, namely the availability of surplus labour in agricultural enterprises, leading to low efficiency and productivity, and thus low competitiveness. The laggard reform process was reflected in a continuous decline in agricultural enterprises' profitability, observed until 1999 (Fig. 1). The adoption of subsequent reform steps was a key prerequisite to address the deficiencies in the functioning of the agricultural market and thus to promote growth of the sector.

The main objective of this chapter is to highlight the main features of the agricultural reform process in Ukraine. The chapter gives an overview of the main elements of the reform as well as its impact on the agricultural sector in general and farming sector in particular. The chapter also attempts to reflects on successes and failures of the reform process and highlights potential future directions of a successful completion of agricultural reform in Ukraine.

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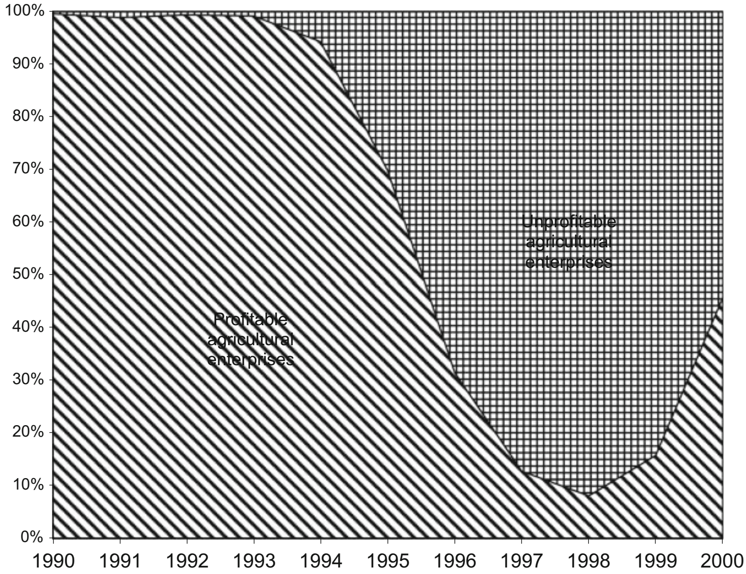

Fig. 1 The proportion of profitable and unprofitable agricultural enterprises in Ukraine. Source: State Statistics Committee of Ukraine

2 The First Phase of the Agrarian Reforms: 1991–2000

The need for agrarian reform in Ukraine was recognised by state authorities in the early 1990s. The primary aim of the reform process was to create a market-driven agricultural sector. As a result, a series of legislative acts were adopted aimed at land privatisation and farm restructuring. In 1990 the Parliament of Ukraine adopted the Resolution on Land Reform (No 563-XII), which established the general strategy for the agrarian reform. The corresponding implementing law was adopted in 1991 (the Law on Farming, No 2009-XII). Under this reform package all land became subject to the reform, and private farms came into existence. In 1991–1993 a set of acts were adopted aimed at transforming state and collective farms into market-type enterprises. The main legal acts included the Law on Entrepreneurship adopted in 1991 (No 698-XII), the Law on Property adopted in 1991 (No 697-XII), the Law on Enterprises adopted in 1991 (No 887-XII) and the Law on Business Associations from 1991 (No 1576-XII) (Pugachov et al. 2007).

The main priorities of the newly created legal framework focused on the following main key areas:

- Privatisation of agricultural land (transfer to agrarian workers)
- Transformation of former collective and state farms into market enterprises on the basis of private property (e.g. private farms, limited liability companies)
- Creation of market infrastructure (e.g. commodity exchanges, trading houses)

- Formation of new tax codes, financial system and credit system in agriculture.

The first phase of the agrarian reform was characterised by emphasis on the first and second areas. It involved establishing market-oriented private farms or agricultural enterprises (such as limited liability companies and joint stock companies) by replacing the collective and state farms. The land reform included deregulation and privatisation of agricultural land by distributing landownership shares (certificates) to agricultural labourers but without physically delimiting the plots. In practice this meant the transfer of land from state ownership to the collective ownership of agricultural workers. The new owners had the option to request to withdraw their share and instead receive a physically delimited plot with private property status. The withdrawal of land from agricultural enterprises by private individuals created the basis for the emergence of privatised farming (i.e. including individual farms). Although the legislation adopted in this phase of reforms recognised private ownership of land, it imposed a moratorium on sales, which significantly inhabited the development of land markets in Ukraine.

The process of land privatisation was accelerated by the presidential decree on urgent measures to accelerate land reform in agricultural production adopted in 1994 (No 66/94). The decree introduced uniform legal documents (certificates), which confirmed the right of citizens—that is, employees of state enterprises—to private property. Each worker was eligible to receive a proportional share of the total amount of land belonging to the enterprise. In some regions, particularly Poltava, the right to receive land was also given to workers in village social enterprises (ex. kindergartens, schools, public utilities enterprises etc.). According to this law, the transfer of land to the collective ownership of the enterprise's workers was considered an intermediate stage of the land-reform process in Ukraine. This measure aimed at gradually and non-disruptively transferring the ownership of agricultural land from the state to private hands. It should be noted that private individuals–the holders of land certificates—were allowed a free exit from agricultural enterprises including conversion of their land certificates into physical plots (Pugachov et al. 2007).

One of the direct and visible effect of reform implemented in the first phase was the transfer of property rights in land to rural residents. By 1999 more than 6 million private individuals received land certificates that gave them the right either to receive physical plots or to rent the corresponding land out to farms. As a result of the privatisation, the landownership structure changed significantly. Prior to 1993 all agricultural land was state owned. From 1993 on, the land in private ownership started to increase. For comparison, in 1993, private individuals owned only 13,800 ha of agricultural land (0.02 % of the total area), whereas, by 1996, 22,119,000 ha (37 %) had passed into the ownership of private farms and 1,925,400 ha (3.2 %) was owned by private individuals. By 2000 the private ownership of agricultural land had further increased to 30,888,000 ha (74 %) for agricultural enterprises and to 7,422,000 ha (18 %) for private individuals (Table 1). Thus, the reform succeeded in transferring most agricultural land to private hands. However, contrary to initial expectations, most agricultural land in Ukraine ended

Table 1 Landownership distribution (000 ha)

Indicators	Total land area	Total agricultural area[a]	Of which Arable area	Meadows	Pastures
Total land	60,354.8	41,829.5	32,669.9	2336.4	5501.6
Including:					
State enterprises	2391.5	1997.7	1601.6	62.4	221.6
Non-state agricultural enterprises	35,989.7	30,888.5	25,094.1	1583.9	3504.6
Private individuals	7851.1	7421.6	5439.7	481.9	1039.3

[a]Arable land, orchards, vineyards, meadows and pastures
Source: State Statistics Committee of Ukraine

up under the control of agricultural enterprises. Note that agricultural enterprises do not own the land directly. The land was owned collectively by private individuals, who rented their share to agricultural enterprises.

By the end of 1999, the first phase of the agrarian reform was largely completed. This was a complex undertaking: it was a lengthy process, during which political priorities and ideology changed and the socio-economic structure and behaviour of the rural economy were fundamentally altered. The complexity of this phase was also exacerbated by the lack of an adequate implementation strategy and by the non-enforcement of the reform, and at the same time industrial and agricultural production declined significantly, established economic ties were destroyed and inflation was high, among other developments.

3 The Second Phase of the Agrarian Reforms: 2000–

A successful land reform needs to result in transformation of collective ownership into private ownership and to create a more efficient socio-economic system of relations with an effective incentive mechanism and a strict system of accountability for results. Most agricultural workers received land certificates, which was expected to result in their conversion into physical plots. The lack of real land-plot conversion inhibited the formation of a land market in Ukraine and the growth of agricultural production efficiency. The development of land markets was also constrained by the moratorium imposed on land sales.

To address some of the deficiencies remaining in the sector, a new stage of agrarian reform in Ukraine started with the Presidential Decree on the Urgent Measures to Accelerate the Reform in Agricultural Sector (No 1529/99) adopted in 1999. The law provided the legal framework for reforming collective farms that did not meet market-economy requirements into structures based on private property and management, i.e. into private farms, private companies, business partnerships and agricultural cooperatives.

Table 2 The structure of agricultural enterprises according to type of business forms

Organisational and legal form of enterprises	December 1999		December 2000	
	Number of farms	%	Number of farms	%
Collective farms	8102	63.8	–	–
Business partnerships	1803	14.2	6761	50.0
Agricultural cooperatives	284	2.2	3325	24.7
Private enterprises	470	3.7	2901	21.5
Others	2041	16.1	500	3.8

Source: data from the Ministry of Agrarian Policy of Ukraine

Like laws adopted prior to 1999, it guaranteed all members of agricultural enterprises the right of free exit from the enterprise including the right to withdraw their land. The decree established that this right of land withdrawal cannot be restricted by any decision of an enterprise's general meeting or in any other way. Further, it made it mandatory for lease contracts to be concluded between the enterprises that use land for agricultural purposes and the landowners. The minimum rental price was fixed at 1 % of land costs.

The presidential decree had a substantial impact on the structure of agricultural enterprises. Most of them changed legal status by transforming from collectives to other legal forms. For example, prior to the adoption of the degree in 1999, the most common form of agricultural enterprise was collective (64 % of total agricultural enterprises), whereas in 2000, after the adoption of the degree, collective farms almost ceased to exist.

Table 2 provides a more detailed picture of agricultural enterprises before and after the adoption of the degree. The share of business partnerships in the total number of agricultural enterprises increased from 14 % in 1999 to 50 % in 2000, agricultural cooperatives increased from 2.2 % to 25 %, and private (one-owner) enterprises increased from 3.7 % to 21.5 %.

The structure of agricultural enterprises varies considerably across regions, for economic, historical and other reasons. Studies tend to suggest that local authorities significantly influenced what kind of land reform was chosen and the legal forms of the agricultural enterprises (Pugachov et al. 2007). They used various methods to prevent land from being withdrawn from agricultural enterprises and to steer their restructuring. Among other strategies, they distributed prepared recommendations on the method of restructuring as well as interacting with employees of enterprises and pressuring them to take a particular decision.

In total, the newly established agricultural enterprises (i.e. business partnerships, agricultural cooperatives, private enterprises, etc.) used 24.9 million ha of agricultural land, of which they owned 2.3 million ha and leased the remaining 22.6 million ha. Some 55 % of the enterprises (7434) kept the land area of their predecessor collective farms, while 77 % (10,378) kept all or some of their predecessor collective farms' capital assets (e.g. tractors, harvesters, buildings). Further, 8617 newly created agriculture enterprises took over in full the rights and obligations of their predecessors. Whereas 10,881 newly created enterprises agreed to pay debt wages to employees of their predecessors, another 3010 refused to take over any obligations from their predecessors.

The largest number of agricultural enterprises (48 %) were founded by 2–10 persons (owners), a quarter of the enterprises were founded by one person, and the rest have more than ten founders. Typically, the founders were of working age and only 3 % of them were over 60 years old. Of the total number of founders of agricultural enterprises, 227 were women (8 %). The newly established enterprises after 1999 had on average 2164 employees, 9 % of whom had specialised education in agriculture (e.g. agronomists, engineers, livestock specialists, veterinary doctors, economists).

The presidential decree also affected individual farms. According to data from the State Statistics Committee of Ukraine, the number of individual farms increased by 2500 because of the adoption of the decree, reaching 38,400 farms in 2001. Individual farms used 2,158,000 ha of agricultural land in 2001, of which 1,994,000 ha was arable land. Consolidation of individual farms also took place. The average size of individual farms was 56 ha of agricultural area (52 ha of arable land) in 2001, an increase from 32 ha (30 ha of arable land) prior to the adoption of the degree. The average size of individual farms ranged from 8.12 ha in the Transcarpathia and Chernivtsi regions to 109–111 ha in the Rivne and Lugansk regions. Of the total area used by individual farmers, 46 % is leased whereas the rest is owned by the farmers themselves.

4 Impacts of the Agrarian Reforms

The reform process resulted in fundamental change in the agricultural sector in Ukraine. Two of the key changes introduced were land privatisation and farm restructuring. The distribution of the land certificates empowered rural individuals by allowing them to obtain title to land. Although by 2000 the majority of agricultural land was transferred to the ownership of rural residents (Fig. 2), farm restructuring was more challenging and had mixed effects on the agricultural sector.

Overall, around 31 million ha of agricultural land was distributed to agricultural labourers in Ukraine. The average amount of land distributed (in the form of certificates) was 4.2 ha per person. The land was transferred into private ownership free of charge, but the cost of implementing the reform was USD 10 per hectare. The process of titling distributed landownership is necessary to create secure property rights, which are critical for stimulating the development of the land market. The main problems of landownership titling in Ukraine are insufficient funding, poor technical equipment of the land registration centres and regional offices, and the lack of appropriate land documentation of the newly created farms.

The transfer of landownership to private hands was a long and complicated process that stirred up the greatest ideological and political resistance. Still, land

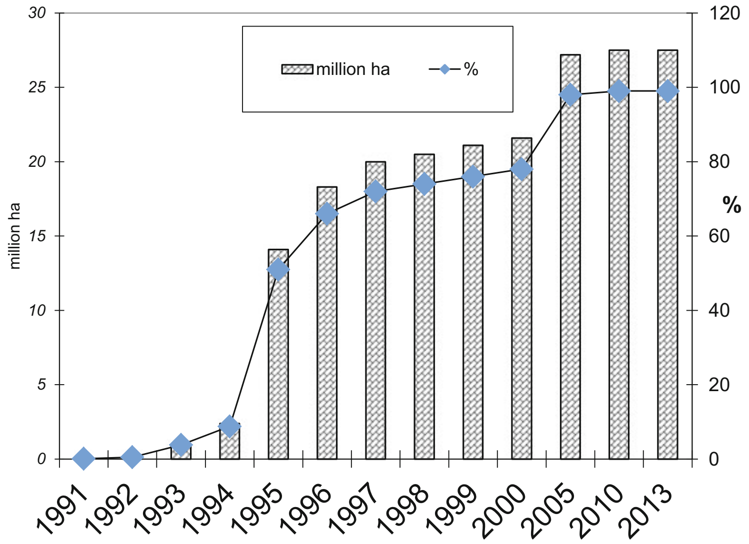

Fig. 2 The development of privatised agricultural land in Ukraine. Source: Ministry of Agrarian Policy of Ukraine

reform ensured a gradual and relatively undisputed transfer of farmland from state to private ownership. Nearly seven million Ukrainians became owners of land, with 31 million ha of agricultural land today being in private hands. Of this, 17.5 million ha was leased out to agricultural enterprises in return for rental payments, which gradually improved material conditions for rural Ukrainians. Based on contracts signed in 2013, the total sum of rental payments was UAH 9.8 billion (USD 1225 million), of which over UAH 4 billion (USD 500 million) went to rural pensioners. It is important to note that during the privatisation land rights could be vested not only in those who directly worked on farms, but also in those who were closely associated with the life of rural communities (e.g. rural school teachers, doctors, village social workers).

The agrarian reform has stimulated production growth in agriculture since the second phase of the reform was implemented in 2000. In 2000 the value of agricultural production was UAH 151 billion (USD 18.9 billion); this value had increased by 67.5% in 2013 and by 69.1 % in 2014 (measured in constant 2010 prices) (Table 3). Crop production predominates, representing 60 % of total agricultural production, increasing to 70 % in 2014.

The production growth in the reformed agricultural enterprises has also boosted profitability. In 1995–2000 most agricultural enterprises experienced losses (about UAH 500 million); in 2008–2014 production efficiency increased and as a result profitability improved. In general, the aggregate profits of agricultural enterprises in Ukraine represented UAH 19.9 billion in 2011, UAH 20.2 billion in 2012, UAH 11.9 billion in 2013 and UAH 16.9 billion in 2014 (Pugachov 2012).

Table 3 Dynamics of gross agricultural production in Ukraine (billion UAH, constant 2010 prices)

Year	Crop production	Livestock production	All production	% of 2000 value
2000	92.8	58.2	151.0	100.0
2005	114.5	65.1	179.6	118.9
2008	136.3	65.3	201.6	133.5
2009	129.9	68.0	197.9	131.1
2010	124.6	70.3	194.9	129.1
2011	162.4	71.3	233.7	154.7
2012	149.2	74.1	223.3	147.9
2013	175.9	77.0	252.9	167.5
2014	178.7	76.6	255.3	169.1

Source: statistics from State Statistics Committee of Ukraine

An area where reforms are crucial is transforming the institutional framework into one that can create a market-driven farming sector rather than maintaining the old centrally planned system for distributing products and allocating resources. This requires not only establishing a market infrastructure, but also teaching and stimulating millions of agricultural workers, specialists and managers to switch to market-based methods for running a farm business. The general outlines of an agricultural market infrastructure were put in place during the reform process; however, its overall effectiveness of implementation and enforcement remained poor.

One area relevant to stimulating productivity growth is development of a credit market. Developing a financing and crediting infrastructure has been set in motion in parallel with the adoption of a series of regulatory acts reforming taxation and state support for the farm sector. Among others, the law on a fixed agricultural tax, which later became a component of the tax code of Ukraine, and the law on state support for agriculture in Ukraine were adopted. These regulatory acts put in place the current tax system and financing and crediting system in Ukraine's farm sector. They provided specific loan repayment breaks and credit support to agricultural-sector enterprises.

However, access to financial resources remains an unresolved issue. The fact that farmland cannot be legally bought and sold represents an obstacle for investors interested in the agricultural sector and restricts the development of credit markets. This is particularly true of small farms, which have constraints on access to external capital. Further, agricultural policies remain biased mainly towards supporting middle-sized and large agricultural enterprises.

An important area where further reforms are desirable is linked to the socio-economic development of rural areas, rural families and quality of life in rural areas. This type of reform needs to provide a global solution for the problem of rural communities—to transform the current strong dependency of villages on collective and state farms into self-sufficient and self-governing territorial communities and create normal conditions for economic activities and quality of life. However, this important dimension of agricultural and rural development was practically not carried out and was absent from the reform process.

5 Agricultural Support Policies in Ukraine

The main instruments for supporting agricultural producers in Ukraine are tax based (indirect government support). They include compensation for value-added tax (VAT) and the fixed agricultural profit tax. The provisions in tax legislation regarding the reimbursement of VAT in the agricultural sector are temporary, expected to be in place until 2018. This policy uncertainty may create an unstable environment in the sector, with a potential adverse effect on attracting investment. Direct state support for the farm sector is relatively low in Ukraine and current trends indicate that it will reduce further. Direct state support decreased significantly from UAH 7.2 billion in 2008 to UAH 1.2 billion in 2012, and almost to zero in 2013. Indirect government support was UAH 7–9 billion (USD 0.9–1.1 billion) in 2011–2013 (see Fig. 3).

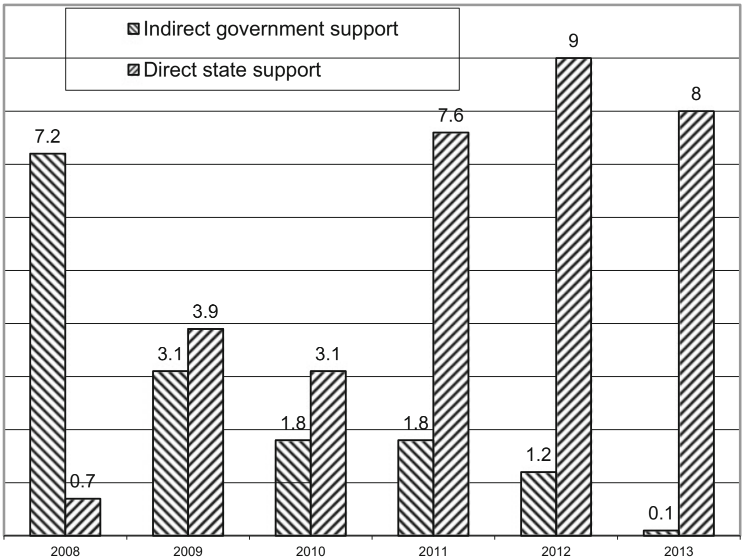

Fig. 3 Direct state support for the farm sector (billion UAH). Source: data from Ministry of Agrarian Policy of Ukraine

6 External Dimension of Agricultural Policies

Important changes in agricultural policies were induced by the accession of Ukraine to the World Trade Organization (WTO) in 2008. In fact, the measures Ukraine had to undertake to join the WTO gave agricultural reform a big push. These mostly concerned liberalising foreign economic relations, the reduction of state interference in commercial activities, reforming the sectoral state support systems and reforming the state procurements system. WTO membership was an important political stimulus to promote a market orientation in developing the farming sector in Ukraine. More precisely, the changes induced by the Ukraine's accession to the WTO include:

- Harmonisation of legislation
- Modification of the state support to agriculture
- Elimination of export restrictions
- Liberalisation of customs tariffs on imports
- Reduction of export tariffs
- Reform of the food safety and sanitary standards.

Another important stimulus for the reform process in Ukraine was EU cooperation. In 1994 a partnership and cooperation agreement was signed with the EU. The general goals of the partnership established for the agricultural sector and the agro-industrial complex were:

1. Carrying out agricultural reforms;
2. Modernising, restructuring and privatising the farm, agro-industrial and service sectors;
3. Developing both domestic and foreign markets for Ukrainian goods under conditions that ensure the protection of the environment and the promotion of food safety standards.

More precisely, to foster the process of economic reforms in Ukraine, the partnership focused on ensuring policy harmonisation of food standards in the agro-industrial complex and the farm sector. The main requirements of the EU were to gradually bring Ukrainian standards closer to EU technical regulations regarding industrial and agricultural food production, including health and phytosanitary standards, and to reduce trade barriers. These provisions were repeated and concretised in the text of the association agreement between Ukraine and the EU signed in 2014. Ukraine committed itself to gradually adapt its domestic legislation to the *acquis communautaire* of the EU, and to approximate its laws and regulatory standards to and harmonise them with those of the EU.

Having declared European integration a priority, Ukraine is supposed to steadily adapt its legislation to European laws and to reform the institutions of sectoral public administration based on generally accepted EU principles and approaches. These commitments are not specifically legal in nature, but they establish the external dimension of agricultural reform. Thus, among the general provisions of

Ukraine's agricultural policy is its approximation to EU agricultural policy: 'State agricultural policy is based on national priorities and reflects the need for Ukraine to integrate into the European Union and the world economic sphere'(Pugachov and Melnyk 2014).

7 The Current Priorities and Developments of Agricultural Policies

The main regulations establishing priorities of the current agricultural policies are the Law on the Main Principles for State Agricultural Policy for 2015 (No 982-IV) adopted in 2005 and Cabinet Resolution No 1158 on the State Targeted Programme for the Development of the Ukrainian Countryside for 2015 adopted in 2007. The main strategic goals of these regulations are as follows:

- Guaranteeing the food security of the country
- Ensuring a highly efficient and competitive farm sector on both the domestic and international markets
- Ensuring the social and cultural development of rural populations.

The Presidential Economic Reform Programme 'Well-Off People, a Competitive Economy, Effective Government' adopted in 2014 also established priorities for the systemic reform of the agricultural sector. These reform priorities aim at stimulating adoption of new technologies in the sector, making the sector competitive on domestic and international markets and creating simulative conditions for investment growth that can boost the efficiency of agricultural production.

Overall, the ideology of farm reform is based on establishing a highly efficient, competitive agricultural sector that is attractive to investors and can produce a large volume of good-quality foodstuffs for both the domestic and international markets. The social component of farm reforms—the development of rural areas—was moved to the background with no specific priorities established in this area.

8 Current Developments and Future Prospects of Ukrainian Agriculture

Ukraine has been undergoing agricultural reforms for more than two decades. The most successful achievement in the organisation of the farming sector is the setting up of privately owned commercial entities that can ensure increasing volumes of agricultural production. Although the reform path was sluggish and exhibited several deficiencies, a certain stability is nevertheless evident in the sector. This is particularly true of the organisational form of agricultural enterprises and the tax and support systems, which allowed the sector to develop somewhat. Over

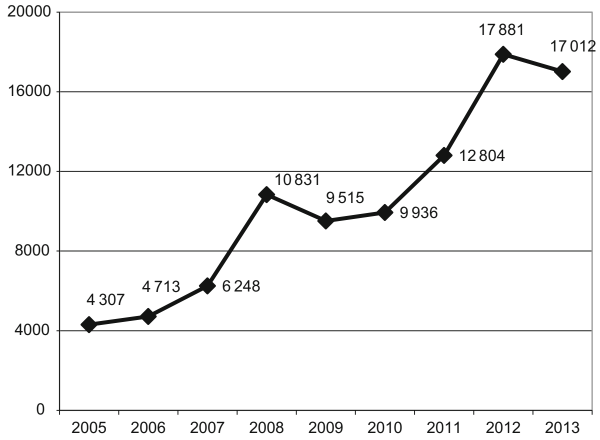

Fig. 4 Ukraine's export of agricultural products (l ionUSD). Source: State Statistics Committee of Ukraine

2010–2013, the average annual growth in investment in Ukraine's farm sector remained high, more than 10 %. This, in turn, has led to production growth. In 2012, Ukraine's farm sector produced the largest amount in its history (even when compared with the production levels attained during the Soviet period) (Pugachov 2014). These developments were reflected in the growth of Ukrainian agricultural exports (particularly of grains). Exports of agricultural products have risen sharply in recent years. Ukraine's farm sector has strengthened its position on external markets and has become one of the main sources of foreign currency. In 2011, exports of food products were worth USD 12.8 billion, and in 2013 they rose to USD 17 billon (see Fig. 4). Projections show that exports will continue to increase in future.

However, it cannot be argued that the reform process is complete. The current structure of farms and production is the result of incomplete and unsystematic reforms implemented since 1991. Typical features of the reform deficiencies are:

- The polarisation of farm structure into small-scale family farms averaging less than 2 ha in size and large agribusinesses with tracts of land going up to tens and hundreds of thousands of hectares
- The concentration of land use and the growth of the illegal (shadow) market for land sales and lease
- The polarisation of incomes in rural areas and the squeezing out of small and middle-sized farms
- The growth of political influence in the sector through corruption, red tape and government interference in the commercial activities of producers.

A particular problem is the concentration of land use by large enterprises. Recent trends show that control over farmland is quickly being concentrated in the hands of a small number of entities. In contrast to the EU, Ukraine's farm sector is dominated by giant agribusinesses, each of which control tens or even hundreds of thousands of hectares of farmland.

A large deficiency in the past reforms is implementation and enforcement of ownership rights to land. In practice, the owners of land parcels have no right to dispose of their own property. As a result, a shadow market for the sale and leasing of land has developed and rural residents are increasingly losing access to their land and are becoming landless.

The incomplete state of infrastructural reform related to land can be also seen in:

- The immature state of the institution of private property, which lacks a system for registering deeds to land and property and has little institutional responsibility for the state of the environment
- Highly centralised government decisions and the lack of inter-institutional coordination
- Weak civil society institutions, which have little ability to induce collective action.

Although the initial intentions of the reform may have been right in intending to address a wide range of issues relevant to developing a market-driven agricultural sector, in practice not a single objective has been achieved at the time of writing, and no critical mass of success has been attained. The lack of decent information, the high level of corruption and the red tape have allowed interest groups to limit the adoption of reforms and to express negative attitudes towards their continuation, despite all the problems that they acknowledge exist in the sector.

The future growth of the agricultural sector can be sustained only by stimulating investments. The basic prerequisite for attracting investors is a functioning land market. A particular constraint on this is the moratorium imposed on land-sale transactions. It is expected that lifting the ban will bring land-sale and lease transactions out of the shadows of (il) legality. The legalisation of the land market will foster rental price increases and will stimulate the emergence of land-sale markets, which may further promote the development of land-collateralised credit in agriculture.

A functioning land market is fundamental to the development of small farms, including family farms, as it leads to better access to landownership as well as attracting capital necessary for farm development. A well-functioning land market also improves the competitive position of small farms with respect to large agricultural enterprises and agribusinesses. Large agricultural enterprises will find that they have more competition for land resources and on the product markets. Individual family farms will gain greater opportunities and incentives to expand and to switch to operating in more economically sustainable ways.

If, however, further reforms are not pursued and the existing land-market restrictions are maintained, the consequences could prove even worse, both for the interest groups and for Ukrainian society as a whole. The continuing shadowy nature of the land market reduces potential income gains for landowners. Moreover, increasing tracts of farmland will come under the control of large agribusiness. Small farms will have few prospects of expanding their activities and growing. This development will have adverse consequences for productivity growth. Agriculture will continue to specialise in capital-intensive products (e.g. grains), in which large agricultural enterprises have comparative advantage and are competitive on international markets. Meanwhile, the production of labour-intensive products (e.g. meat, vegetables and fruits) is likely to decline. As a consequence, demand for these products will tend to rely on supplies from abroad, leading to expansion of imports.

Instituting a properly functioning land market will be a key factor in continuing and completing agricultural reforms in Ukraine. This should resolve a number of critical issues, including:

- Setting up and ensuring the proper functioning of a system that guarantees property rights to land, such as a land registry, a deed registration system and an enforcement system
- Ensuring full ownership rights: the right to dispose of, lease, use, manage and employ in production one's own land.

In terms of financial markets, agricultural reform needs to focus on implementing fair and effective support programmes and to establish clear performance indicators. The main principle underlying state support for farming should be conditional on reaching concrete goals in the medium term with the objective of maximising the impact of limited public funds.

To support the development of small farms and the rural economy, policies need to focus on promoting a network of transparent clearing houses and storage facilities for proper wholesale distribution and marketing. This will help ensure that the infrastructure component of agricultural reform is properly implemented. It is also important to harmonise the food safety and sanitary standards, which is the prerequisite for creating a competitive domestic agricultural market.

The current political developments indicate that any outcome is possible in future, from the successful implementation of reform to the complete rejection of certain aspects of it. The future strategy for agricultural reform developments is supposed to be established in the government's agricultural sector development programme for 2020. However, the government's strategy does not provide clear answers about how reform might unfold in future.

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Outcomes of Agrarian Reform in Russia

Vasiliy Uzun and Zvi Lerman

1 Introduction

How to assess the outcomes and effects of agrarian reform in the Russian Federation? This question has held the attention of agricultural economists since the early 1990s. The debates predate the start of reforms, but they became particularly acute during the first years of reform, and continue to rage to this very day.

The Russian literature often paints a negative view of reform outcomes. This opinion is vigorously upheld by Shut'kov (2011) and by Miloserdov and Miloserdov (2012), who mainly examine time series of agricultural output, areas of used (and unused) agricultural land, number of tractors, combine harvesters and other farm machinery, and application of fertilisers. Comparing the pre-reform and post-reform series, the authors reach an unambiguous conclusion that the reform has negatively affected the development of agriculture: production declined, a large proportion of agricultural land was abandoned, cropped areas decreased, livestock headcount shrank, the number of machinery reduced and less fertiliser was applied to crops.

These conclusions regarding agriculture's decline, based as they are on statistical data, are indisputable. However, such analysis is strictly one-sided: it ignores the causes that have led to the decline in production and resource use. More precisely, the reform is regarded as the only factor that can be blamed for these

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negative outcomes. The analysis ignores efficiency indicators, although efficiency improvement was one of the main aims of reform.

Serova (2010) also analysed the outcomes of reform, focusing in particular on the reasons for production decline in the early years of reform (price disparity, fall in family incomes and the resulting fall in food demand, low competitiveness of domestic producers in the local market, etc.). Serova also attempted to analyse the efficiency indicators before and after reform, but only crop and livestock yields were examined as measures of agricultural efficiency.

In this chapter, we assess the reform outcomes primarily through the lens of efficiency, although we also consider absolute levels of resources and outputs. The agrarian reform in Russia in the 1990s was a huge endeavour that radically changed property rights and economic mechanisms, leading to multi-faceted outcomes. The country essentially shifted to an entirely new agrarian system. The process affected millions of people. Everybody gained something or lost something through the reform. The reform outcomes are contradictory. On the one hand, the reform has led to huge increases in yields, productivity and efficiency that agricultural economists in the pre-reform era could have hardly imagined possible. On the other hand, agriculture in many regions contracted dramatically and abandonment became widespread.

In this chapter, we consider 12 major outcomes of reform (Sects. 2–13). The evaluations are not single-valued: each of the outcomes receives both a positive and a negative evaluation, which is already clear from the wording we use for most outcomes.

2 Land Privatisation, High Transaction Costs, Latifundialisation

Privatisation of agricultural land was the key element of Yeltsin's agrarian reform in the early 1990s. Land privatisation was carried out according to the rules set in the Law of Land Reform (1990) and the Land Code (1991). Yeltsin's reform transferred 70 % of agricultural land to private ownership, and only 30 % remained state owned (down from 100 % in the Soviet period) (Fig. 1).

The bulk of privatised land was (and still remains after 25 years) in joint shared ownership; that is, peasants did not receive demarcated land plots. Many beneficiaries of the privatisation process were pensioners, rural teachers and doctors, and other individuals who could not farm independently. It was thought at that point that low transaction costs would allow land to be transferred from these passive landowners to efficient users. Yet, in reality, transaction costs often exceed the market price of land.

The Yeltsin agrarian reform created landless peasants, large latifundia and agroholdings, and spurred oligarchic development of Russia's agriculture. In the early 2000s, large investors exploited legal options for land concentration and based their

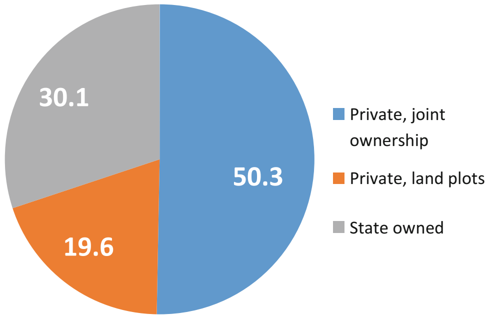


Fig. 1 Ownership structure of agricultural land in use by agricultural producers as of 1 January 2013 (%). Source: Rosreestr (2013)

farms primarily on hired labour, although these trends contradicted the established mode of agricultural development in market economies. The land-concentration option clearly set the Yeltsin reform apart from the Stolypin agrarian reform of the early 1900s, which prohibited concentration of more than 12–18 ha[1] within one administrative district in the hands of one owner (either by purchase or by free gifts). The Stolypin reform aimed to create a large 'middle class' (to use modern terminology), and this required prohibition of land concentration in the hands of a small number of large estate owners. This restriction on landownership in no way limited the allowed size of a single farm: farmers could increase their holdings by leasing land up to the limit of their 'managerial' capacity.

3 Development of Heterogeneous (Multi-form) Agriculture

Yeltsin's reform produced a heterogeneous agriculture with three categories of producers: corporate farms of various organisational forms ('agricultural enterprises'), peasant farms and individual entrepreneurships, and household plots. A different farming structure emerged in each province.

Prior to the 1990 reform, 74 % of gross agricultural output (GAO) was produced in large agricultural enterprises (collective farms or *kolkhozes*, state farms or *sovkhozes*, and agro-firms). Household plots produced the remaining 26 % of GAO (there were no peasant farms at that time). Russia's agrarian structure radically changed during the reform. The share of agricultural enterprises in GAO dropped to 40 % (1998), subsequently rising to 49 % (2013). Family farms (this category aggregates peasant farms, individual entrepreneurships and household plots) produced 51 % of GAO in 2013 and achieved an even higher share of gross value added (GVA) (60 % in 2011), as they use less purchased inputs than agricultural enterprises (National Accounts 2012). Peasant farms began to emerge in the

[1]This is the size of six 'upper per capita allotments' (*vyshii dushevoi nadel* in Russian) as determined in the 1861 reform. The exact area of six allotments varied across provinces. See Stolypin reform (2015).

Fig. 2 Structure of GAO by type of producer, 1990–2013. Source: authors' calculations from Rosstat (2015)

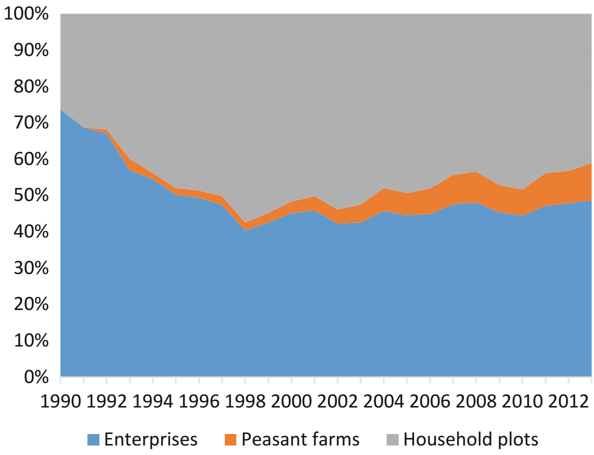
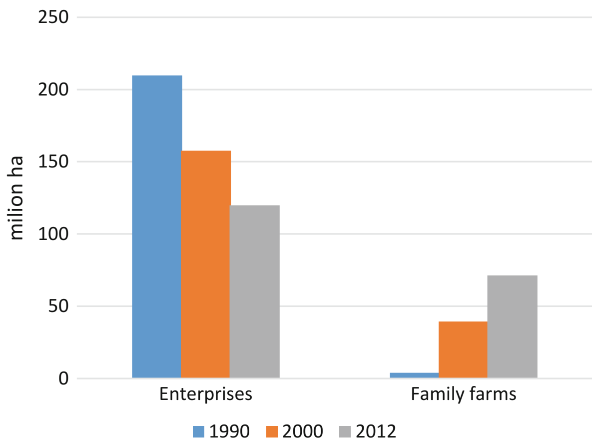


Fig. 3 Use of agricultural land by different types of producers, 1990–2012. Source: Rosreestr (2013)



early 1990s and gradually grew and developed, reaching 10 % of GAO in 2013 (Fig. 2).

Changes in GAO were the result of a significant redistribution of agricultural land between different categories of producers (Fig. 3). Agricultural land in enterprises decreased by 90 million ha between 1990 and 2012 (a drop of more than 40 % from the 1990 holdings), while family farms gained nearly 70 million ha. The remaining 20 million ha, or more than 10 % of agricultural land in all farms in 1990, is no longer used for agricultural production.

In the pre-reform era, the agrarian structure was virtually the same in all regions across Russia. The reform has led to a sharp differentiation of regions by agrarian structure. Some regions preserved a corporate structure with predominance of agricultural enterprises (>50 % of GAO). On the other hand, many regions markedly reduced the share of agricultural enterprises in GAO, while family farms (household plots and peasant farms combined) began to contribute more than

Table 1 Grouping of Russia's regions by farming structure, 2000 and 2010 (%)

Indicators	Russia total	Farming structure		
		Corporate	Mixed	Family
2000				
Share of 77 regions	100	23.4	54.5	22.1
GAO in farms of all types (total RUB 742 billion in current roubles)	100	35.3	54.5	10.2
Structure of GAO by farm type				
Enterprises	45.2	56.1	42.3	23.2
Family farms	54.8	43.9	57.7	76.8
2010				
Share of 78 regions	100	29.5	42.3	28.2
GAO in farms of all types (total RUB 2 618 billion in current roubles)	100	36.1	44.2	19.7
Structure of GAO by farm type				
Enterprises	44.5	60.5	41.9	21.1
Family farms	55.5	39.5	58.1	78.9

Source: Uzun et al. (2014), based on Rosstat (2015)

70 % of GAO; that is, individual or family agriculture emerged to the forefront. In the remaining regions, we observe a mixed farming structure with agricultural enterprises producing between 30 % and 50 % of GAO, while family farms produce between 50 % and 70 % of GAO.

In 2000, the corporate farming structure dominated 23 % of Russia's regions, and 22 % of the regions were characterised by a family farming structure (Table 1). Thus, 55 % of the regions had a mixed farming structure in 2000. By 2010, the share of regions with a mixed farming structure had dropped to 42 %, while both corporate and family farming spread to more regions (30 % of regions with corporate farming and 28 % of regions with family farming). In regions with a corporate farming structure, about 60 % of GAO is produced by agricultural enterprises; in regions with a family farming structure, about 80 % is produced by peasant farms and household plots (Table 1).

Family farming is observed mainly in eastern and northern regions of Russia, and also in non-chernozem regions suffering from depopulation. Corporate farming, on the other hand, is observed in regions where the natural and economic conditions are the best (Belgorod, Lipetsk, Moscow and Leningrad oblasts, Krasnodar and Stavropol' territories).

Family farming also dominates in ethnic republics and is strongly influenced by regional agrarian policies. In Astrakhan, Saratov and Samara oblasts as well as in the ethnic republics of Tatarstan and Bashkirostan, regional policies support small business and it flourishes. In Moscow and Leningrad oblasts, small business is not supported by regional authorities and its share in GAO is very low.

In parallel with these changes, we observe continuous concentration of production in very large agricultural enterprises, agro-firms and agro-holdings.

Concentration also occurs in peasant farms. The average area of a peasant farm increased from about 40 ha in the early 1990s to about 100 ha in 2010. In 2006, there were 285,000 peasant farms and individual entrepreneurships in Russia and the 5000 largest among these accounted for almost half the sales revenue (Uzun et al. 2010).

4 Adaptation of Agricultural Producers to Market Conditions

Agricultural producers have learned to respond to market signals and adjust their production structure accordingly. The bulk of production now is in farms that show a profit. Farms of different types and in different sectors react differently to market signals. Farms have become much more specialised, and there has been a noticeable decrease in the number of more traditional farms that produce a wide variety of commodities. Unprofitable producers eventually drop out.

The location of agricultural production has also changed dramatically. Instead of farm location oriented towards regional self-sufficiency, we begin to observe location based on economic efficiency. The production of each commodity has shifted to regions where it is most profitable.

5 Improved Financial Stability Versus Increased Bankruptcies

The reform has improved the financial stability of agricultural producers: the proportion of overdue debt in agricultural enterprises dropped from 71 % in 1998 to less than 3 % in 2013. The Law on Financial Rehabilitation (2002) has had a decisive influence on the financial health of Russia's agriculture: although the total debt of agricultural enterprises (in current prices) markedly increased between 1998 and 2013, overdue debt has been systematically decreasing since 2002 in both absolute and relative terms. In absolute terms, agricultural debt peaked in 2002 at RUB 177.1 billion (in current roubles). By 2013 it had shrunk to RUB 43 billion, that is, to less than one-quarter of the 2001 level (the decrease in constant prices is even more impressive). Figure 4 shows that the share of overdue loans and bank debt in agricultural enterprises dropped from 44 % in 1998 to less than 2 % in 2013. The reduction of overdue debt was facilitated by the advent of an attractive debt-restructuring mechanism, imposition of harder budget constraints and a stricter evaluation of creditworthiness.

The proportions of profitable and loss-making producers provide another indicator of financial stability. In 1997–1998 more than 80 % of agricultural enterprises were unprofitable, whereas by 2013 the number of loss-making enterprises had

Fig. 4 Percentage of overdue debt in agricultural enterprises, 1998–2013. Source: Rosstat (2015), Statistical Yearbook (2013), Agricultural Statistics (2013)

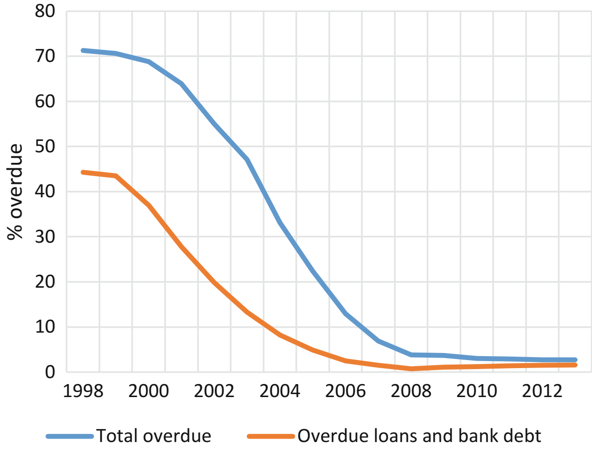
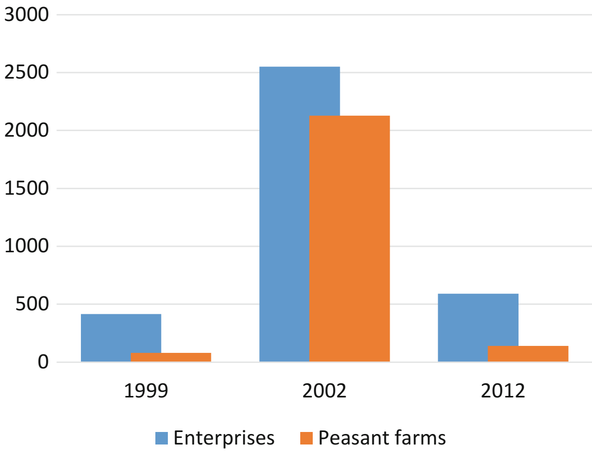


Fig. 5 Number of bankruptcies filed by agricultural producers, 1999–2012. Source: Arbitration Court (various years)



dropped to 22 %. In 1997–1998 loss-making producers accounted for a little over 60 % of total revenue in agriculture, whereas by 2008 this proportion had dropped to 9 %. Both indicators provide evidence of improved financial health.

The financial discipline has improved not only among agricultural producers, but also among their business partners: overdue accounts receivable in agricultural enterprises also decreased (from 57 % in 1998 to less than 4 % in 2013).

Financial rehabilitation did not proceed painlessly. A substantial number of enterprises and peasant farms went bankrupt in the process. Figure 5 shows that the number of bankruptcies was particularly high in the first years of the financial rehabilitation programme (around 2002). In recent years, the frequency of bankruptcies has sharply decreased. The absolute number of bankruptcies among peasant farms is smaller than among enterprises. Since there are more than 200,000 peasant farms and fewer than 20,000 enterprises, the gap in relative terms is much greater: the share of bankruptcies among peasant farms is much smaller than among agricultural enterprises.

6 Improved Labour Productivity Versus Reduced Employment

The transition to a market economy encouraged efficient use of labour resources. In the early years of the reform (up to 1995), the average number of employed in agriculture was increasing. In the subsequent period it contracted markedly, dropping from 9.7 million in 1990 to 6.5 million in 2012. The productivity of agricultural labour decreased until 1998, and then started increasing. By 2012 it had reached 127 % of the level of productivity in 1990 (Table 2).

GAO in agricultural enterprises had dropped by 1998 to 35 % of the 1990 level (in constant prices). In subsequent years agricultural production almost doubled, but even so by 2012 it had reached only 65 % of the 1990 level. The number of employed in agricultural enterprises contracted by an astonishing 82 % between 1990 and 2012. In their attempt to remain competitive in the new market economy, agricultural enterprises kept shedding surplus labour. Up to 1998, production

Table 2 GAO, number of employed, and labour productivity in agriculture 1990–2012

	GAO in constant 2012 prices (billion RUB)	GAO index (1990=100)	Number of employed in agriculture (million)[a]	GAO per worker (thousand RUB)	GAO per worker (1990=100)
All farms					
1990	3 952.5	100.0	9.7	406	100.0
1998	2 177.1	55.1	8.7	250	61.4
2005	2 690.5	68.1	7.4	365	89.7
2012	3 340.5	84.5	6.5	517	127.1
Agricultural enterprises					
1990	2 467.1	100.0	8.3	297	100.0
1998	866.5	35.1	5.3	163	55.0
2005	1 142.3	46.3	2.5	457	153.7
2012	1 600.9	64.9	1.5	1 079	363.0
Family farms					
1990	1 485.4	100.0	1.4	1 041	100.0
1998	1 310.6	88.2	3.4	383	36.8
2005	1 548.2	104.2	4.9	317	30.5
2012	1 739.6	117.1	5.0	349	33.5

[a]Number of employed in agricultural enterprises is given for large and middle-sized farms (up to 2005, data from Statistical Yearbooks (1993, 2013); for 2012, data from the consolidated annual reports of agricultural enterprises). Number of employed in family farms is the number of people engaged in commercial production (including peasant farms, household plots and small agricultural enterprises)

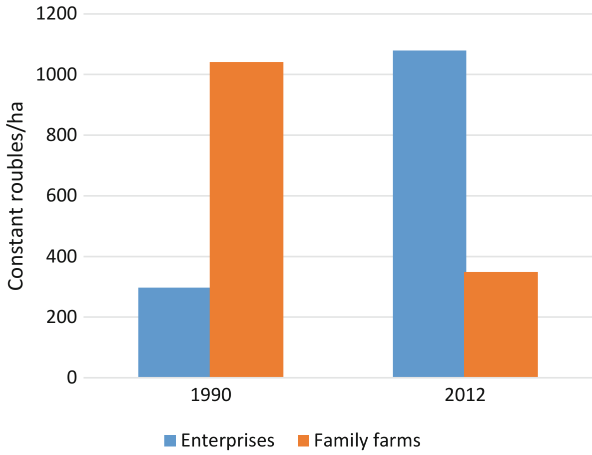


Fig. 6 Comparison of agricultural labour productivity in enterprises and family farms, 1990 and 2012 (constant 2012 roubles per worker). Source: authors' calculations from Rosstat (2015)

volumes (GAO in constant prices) decreased faster than the number of employed; correspondingly, by 1998 the productivity of labour had fallen to 55 % of the productivity in 1990. Starting in 1998, production volumes in enterprises increased while the labour force continued to contract. Increasing production and decreasing labour combined to produce a robust increase in labour productivity, which had risen by 2012 to 363 % of the 1990 productivity.

In family farms, GAO increased by 17 % between 1990 and 2012, while the number of employed increased from 1.4 million to 5 million (i.e. an increase by a factor of 3.6). As a result, GAO per worker in family farms decreased to one-third of the 1990 level. Rapid growth of the labour force combined with relatively slow growth of agricultural production in family farms led to a stabilisation of labour productivity in this sector at 30–33 % of the 1990 productivity. Comparing the performance of enterprises and family farms in 1990 and 2012, we see that, in absolute figures, GAO per worker in family farms was a factor of 3.7 higher than in enterprises in 1990 and a factor of 3 lower than in enterprises in 2012 (Fig. 6).

Data on direct labour inputs per unit output also reveal robust productivity increases in agricultural enterprises in recent years. For all major agricultural products, except beef, direct labour inputs in 2013 were substantially less than in 1990. For sugar beet and pork weight gains, direct labour inputs in 2013 were a factor of 8–10 lower than in 1990; for potatoes, other vegetables and poultry weight gains, direct labour inputs in 2013 were a factor of 3.3–4.5 lower than in 1990. Labour productivity for the production of milk, grain, sunflowers and eggs in agricultural enterprises increased by a factor of 1.6–2 during the same period.

7 Improved Land Productivity Versus Contraction of Land Use

The last decade has witnessed a steady growth of agricultural production in Russia, with GAO in constant prices increasing by 39 % between 2000 and 2012. This growth, however, does not encompass the entire country: it is concentrated only in some farms, districts and provinces. The main share of growth in commercial output is accounted for by a relatively small group of the largest farms. Russia's agriculture no longer exhibits widespread universal coverage: it flourishes in discrete foci across the country. According to the 2006 Agricultural Census, 94 million ha (43 % of all agricultural land in Russia) is abandoned. These unused areas are primarily in regions with a low bio-climatic potential and depopulated villages. They are basically registered to defunct agricultural enterprises and inactive family farms. They are no longer used because of unacceptably low returns, as well as administrative difficulties with demarcation and titling.

The productivity of agricultural land aggregated over all farm types was falling between 1990 and 1998. Then came a turnaround and land productivity in all farms began to increase after 1998 (Table 3). This process, however, followed different trends in agricultural enterprises and in family farms. In agricultural enterprises, the contraction of agricultural land was accompanied by an increase in GAO, resulting in increasing land productivity: the return from land in 2012 (in constant roubles per hectare) was more than double the return in 1998, and by 2011–2012 it had exceeded the pre-reform level (Table 3, Fig. 7). In family farms, on the other hand, the efficiency of land use rapidly dropped in the early years of reform, as GAO could not catch up with the rapid expansion of family holdings (in both household plots and peasant farms). It is only in recent years that the land productivity of family farms has stabilised (Table 3, Fig. 7).

Despite the different trends in the returns from land, family farms use land much more efficiently than agricultural enterprises. Over the entire period 1990–2012, the land productivity of family farms was consistently higher than that of agricultural enterprises, and in recent years the production of family farms per hectare was double that in agricultural enterprises (Table 3).

Table 3 Productivity of land by farm type, 1990–2012

	GAO in constant 2012 prices per ha (RUB/ha)		
Year	All farms	Enterprises	Family farms
1990	18,487	11,759	371,351
1995	12,628	6997	37,733
1998	11,119	5300	40,576
2000	12,182	6166	36,248
2005	14,035	8284	28,830
2010	14,952	10,718	22,476
2012	17,480	13,363	24,398

Source: authors' calculations from Rosstat (2015) and Rosreestr (2013)

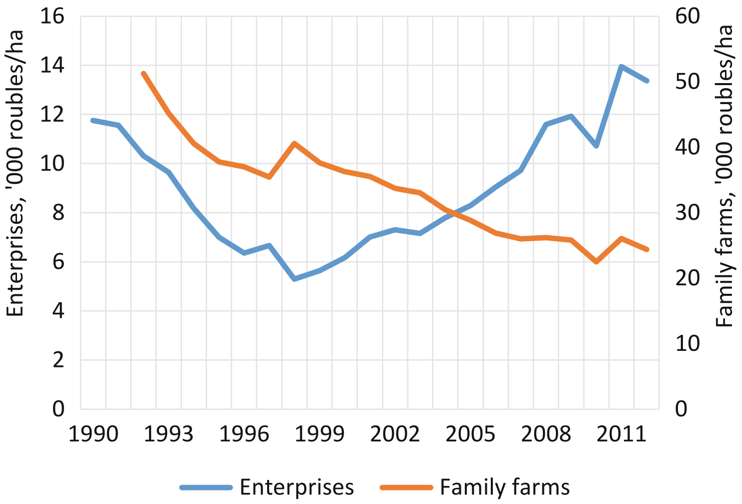


Fig. 7 Land productivity of agricultural enterprises and family farms, 1990–2012 (in thousands constant 2012 roubles per hectare). Source: authors' calculations from Rosstat (2015) and Rosreestr (2013)

The productivity gap is only partially attributable to the better land quality in family farms. Family farms produce more intensive crops (fruits, vegetables, potatoes) and keep more animals per hectare of land. The calculated productivity is also biased upwards because rural residents actually use some of the land registered to enterprises, without any formal contracts, and also have access to animal feed, which is distributed in kind as lease payments for land shares leased by the enterprises.

8 Increasing Crop Yields Versus Contraction of Sown Area

Direct evidence of increasing land productivity is proцevided by the changes in crop yields over time. The yields of all major crops in 2013 were substantially higher than in 1990, the increase ranging from a low of 12 % for grain and legumes to 180 % for fruit orchards (Table 4). The yields continue to fluctuate over time, as is evident from the fairly high coefficients of variation in Table 4 (last row).

Table 4 Crop yields, 1990–2012 (all farms, 100 kg per harvested hectare)

Year	Grain and legumes	Sugar beet (industrial)	Sunflower	Soy	Potatoes	Other vegetables (open ground)	Fruit orchards
1990	19.5	240.1	13.7	11.1	104.2	166.6	27.5
1995	13.1	188.3	10.6	7.5	117.7	147.8	23.5
2000	15.6	188.3	9.0	10.1	104.7	143.3	35.1
2005	18.5	282.3	11.9	10.5	123.8	170.0	40.2
2010	18.3	240.7	9.6	11.8	100.2	180.3	41.5
2013	21.9	431.8	15.6	13.8	144.6	213.9	77.1
2013/1990 (%)	112.3	179.8	113.9	124.3	138.8	128.4	280.4
Coefficient of variation	16.2	33.9	19.1	19.2	13.4	14.9	35.7

Source: Rosstat (2015)

Table 5 Livestock yields in all farms, 1990–2013

Year	Cattle weight gain (kg/head/year)	Hog weight gain (kg/head/year)	Broiler weight gain (g/head/day)	Milk yield (kg/cow/year)	Wool yield (kg/sheep/year)	Laying capacity in enterprises (eggs/layer/year)
1990	119	91	7.5	2731	3.9	236
1995	123	82	5.6	2153	2.9	212
2000	128	100	6.2	2502	3.1	264
2005	149	114	10.6	3176	3.0	301
2010	155	135	17.4	3776	2.6	307
2013	150	147	21.3	3893	2.4	305
2013/1990 (%)	126.1	161.5	284.0	142.5	61.5	129.2

Source: Rosstat (2015)

9 Increasing Livestock Yields Versus Contraction of Animal Headcount

Productivity increases are observed during the reform years for all animal and poultry species. Table 5 presents the changes in livestock productivity between 1990 and 2013. In contrast to crop yields, livestock yields do not fluctuate much from year to year. The time series show an initial decrease in the early years of reform, followed by a turnaround in 1996–1998 and rapid growth in recent years (except for wool yields). Milk yields in 2013 had reached 143 % of the 1990 level, whereas broiler weight gains had nearly trebled by 2013 (Table 5).

Direct evidence of livestock efficiency improvements is provided by the reduction of feed consumption per unit output between 1990 and 2012 (Fig. 8). Feed use

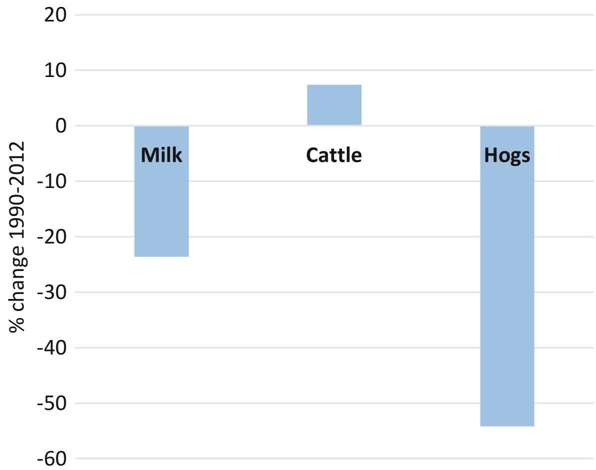


Fig. 8 Change in feed utilisation in feed units per kg of livestock production, 1990–2012. Source: consolidated annual reports of agricultural enterprises

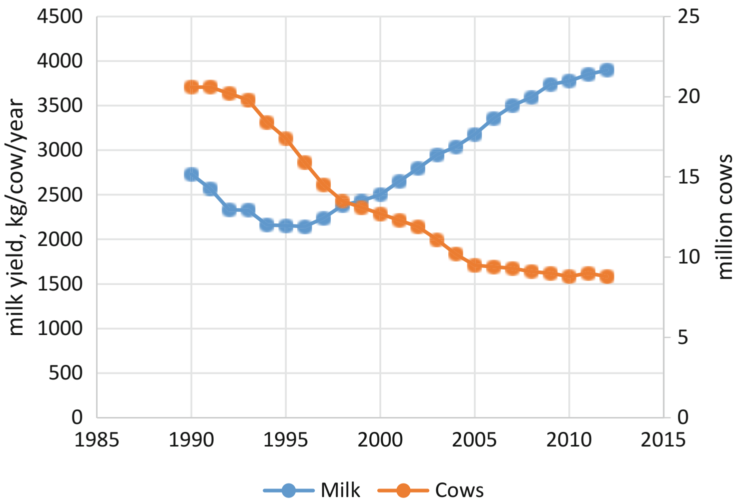


Fig. 9 Increasing milk yields and decreasing cow headcount, 1990–2012. Source: Rosstat (2015)

for hogs dropped from 8.3 kg of feed units per kilogram of weight gain in 1990 to less than half in 2012 (3.8 kg of feed units per kilogram of weight gain). Feed use per kilogram of milk decreased by nearly 25 %. Only beef production continued to use the same high levels of feed per kilogram of weight gain as in Soviet times.

Livestock productivity improvements and increasing feed utilisation efficiency were accompanied by a substantial reduction of the animal and poultry inventories. Figure 9 shows how the rapid increase in milk yields (after 1996) went hand in hand with a steep decrease in the number of cows, which dropped by 60 % between 1990 and 2012. The cattle herd shrank to almost one-third in the same period, the number of sheep also dropped by 60 % and the number of pigs halved. The sheep, hog and poultry inventories appear to have bottomed out and begun increasing after 2002–2004; the cattle herd, on the other hand, continues its decline, with no clear end in sight.

10 Higher Input Efficiency Versus Lower Input Use

In the pre-reform years, Russia's agricultural producers purchased inputs at prices that were fixed by the state below world market prices. Transition from a planned to a market economy led to substantial increases in input prices, which rose at a faster rate than the prices of agricultural commodities. To survive, farms had to increase the cost-efficiency of input use and to achieve higher returns per unit of inputs.

Non-uniform input-price increases led to a substantial change of the cost structure in agricultural enterprises. Thus, the share of fuel and oil in crop production increased from 4.7 % in 1990 to 13.3 % in 2012 and in livestock production from 1.8 % to 3.5 % (Table 6). The share of spare parts, purchased services and electric power also increased.

The increase of input prices was basically offset by reducing the share of labour costs and depreciation expenses. In many farms, however, even the reduced depreciation deductions could not be used for fixed-asset renewal; they went to cover the losses in unprofitable enterprises. Inability to renew the asset base has led to a loss of previously accumulated productive potential.

Agricultural enterprises did not immediately realise the urgent need for strict cost-efficiency. In the early years of reform we even observe an increase in power consumption, which more than doubled per RUB 100 of GAO between 1990 and

Table 6 Cost structure in agricultural enterprises (%)

Cost components	Crops		Livestock	
	1990	2012	1990	2012
Total costs	100	100	100	100
Labour (including social contributions)	28.1	18.1	28	16.3
Seeds and seedlings	17.6	12.6	0.0	0.0
Feed	0.0	0.0	48.6	50.5
Fertilisers	9.9	10.8	0.0	0.0
Electric power	0.7	1.5	1.1	3.0
Fuel	4.7	13.3	1.8	3.5
Spare parts and other materials	3.7	7.8	2.4	3.0
Services from external suppliers	6.5	9.8	3.3	8.4
Depreciation	14.5	10.7	9.3	7.7
Other costs	14.5	15.4	5.5	7.5

Source: consolidated annual reports of agricultural enterprises

1996. By 2012, power costs had been sharply reduced, both in absolute terms (to 25 % of the 1990 level) and per RUB 100 of GAO (to 40 % of the 1990 level).

11 Increase of State Support Versus Reduced Returns to State Support[2]

Total support to agriculture is composed of three components: support to agricultural producers (Producer Support Estimate—PSE), general support to the sector through government funding of infrastructure and services (such as agricultural extension, research, sanitary and phytosanitary inspection, and other services), and budget support to consumers (through food price measures). Table 7 shows the total agricultural support (in US dollars) in Russia, the European Union (EU), and the USA over time (1995–2010).

Nominal support of Russia's agriculture (in US dollars) increased by a factor of nine between 2000 and 2010. The level of total support measured as a percentage of GDP ranged between 0.8 % and 1.4 %. On the other hand, the share of total support as a percentage of agricultural GVA increased from 11.8 % in 2000 to 33.8 % in 2010. In 2010, the level of support as a percentage of GDP was substantially lower in the EU and USA than in Russia, whereas the level of support measured as a percentage of agricultural GVA was substantially higher in the EU and the USA (Fig. 10).

In Russia, agricultural support policies give clear preferences to producer support, which accounted for almost 85 % of total support in 2010. The remainder was channelled to general services support. There has been virtually no consumer support in Russia since 1995, although during the Soviet era consumers enjoyed generous budget transfers. At that time, consumer support accounted for 20–25 % of total budget support to agriculture (RUB 30–50 billion annually between 1986 and 1990).

The support structure in the USA in 2010 was totally different. More than 50 % of total support went to general services support and less than 20 % to producer support. In the EU, on the other hand, the support structure was similar to that in

Table 7 Total agricultural support in different regions, 1995–2010 (billion US dollars)

Region	1995	2000	2005	2010
Russia	6.5	2	7.8	18.3
EU	137.8	97.5	144.3	116.2
USA	64.9	92.4	101	133.4

Source: OECD (2011)

[2]The analysis in this section is based on data from OECD (Organisation for Economic and Cultural Development) for corresponding years (OECD 2011). For more details, see Uzun (2012a, b).

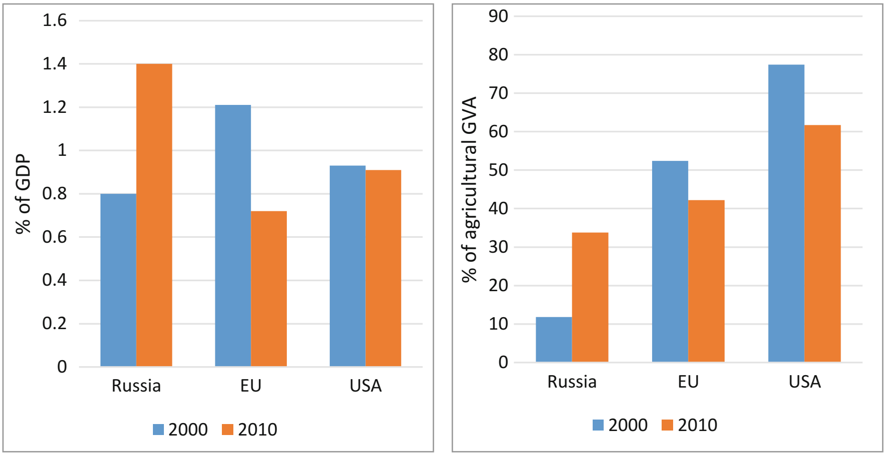


Fig. 10 Total agricultural support in Russia, the EU and the USA in percentage of GDP (*left panel*) and percentage of agricultural GVA (*right panel*), 2000 and 2010. Source: OECD (2011)

Table 8 Sources of total agricultural support (2010)

Source	Russia	EU	USA
Transfers from consumers (EUR billion)	9.5	11.6	2.7
% of total support	68.7	13.2	2
Budget transfers (EUR billion)	4.3	76.2	130.8
% of GDP	0.44	0.62	0.89

Source: OECD (2011)

Russia: the bulk of support went to producers (87 %), general services support received 12 % of the total and consumer support was just 1 %.

The structure of support sources varies depending on agricultural policies. In Russia, consumers of agricultural products were the main source of total support since 2005. Transfers from consumers through price mechanisms represent 69 % of total support and budget transfers contributed only 31 % (Table 8). In contrast to Russia, the share of budget transfers in total support is 98 % in the USA and 87 % in the EU.

The high share of budget transfers in the total support in the USA and the EU indicates that the burden falls on the high-income segments of the population, reducing the share of food expenditure for low-income families. The taxes paid by high-income segments and corporations (even with flat tax rates) generally exceed in total the payments from the low-income segments. Directing part of tax income to agricultural support, the state lowers food costs and thus reduces the share of food expenditure in the family budget, mainly for the poor families, where the share of food expenditure is highest.

Total agricultural support in Russia increased much faster than GAO between 2000 and 2010. Total support rose ten-fold, whereas GAO increased by a factor of 3.5 (in current roubles). As a result, the efficiency of support decreased from RUB 7.4 of GAO per rouble of total support in 2000 to RUB 2.6 of GAO per rouble of total support in 2010. Economists and government officials in Russia focus primarily on the relatively small budget component of total support to assess the effectiveness of government policies. The much larger transfers from consumers—the lion's share of total agricultural support—are largely ignored and remain hidden from the public eye. This lack of monitoring of a major component of support may be responsible for the observed decrease in support efficiency.

12 Changing Import–Export Strategy

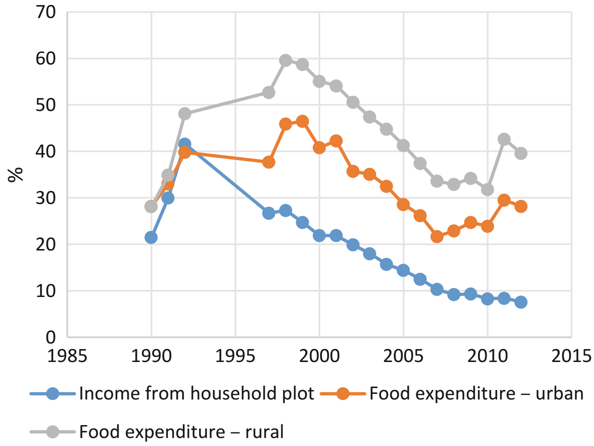
In the last decades of the Soviet planned economy (1960–1990), the USSR imported concentrated feed, and sustained development of the livestock sector by encouraging high levels of consumption of domestically produced meat and milk. The transition to a market economy precipitated a diametrical change in foreign trade strategy: Russia sharply reduced wheat utilisation for animal feed and boosted grain exports to volumes that roughly matched Soviet-era imports (about 20 million tonnes). At the same time, meat and milk imports markedly increased. Money invested in purchase and resale of meat and milk generated huge margins for traders thanks to large differences between import prices and domestic sale prices. This stimulated the flow of capital primarily into food imports, and domestic production received the leftovers after the import quotas had been exhausted.

13 Decreasing Share of Food Expenditure Versus Decreasing Share of Income from Household Plots

The share of food expenditure in the family budget is an important indicator of the standard of living. One of the goals of agrarian reform was to improve the standard of living (especially of the rural population), and we accordingly expect to see the share of food expenditure decrease over time.

During the entire Soviet period after the Second World War, the share of food expenditure in family income indeed decreased steadily, bottoming out in 1990 at 28 % for both the urban and rural populations. All through the 1980s the share of food expenditure was practically the same for urban and rural people, which suggests equality of living standards in towns and villages during the late Soviet era. In the first decade of reform (the 1990s), the share of food expenditure increased markedly for both urban and rural families as a result of initial economic disruptions (Fig. 11). It peaked in 1998–1999 and began to decrease thereafter as

Fig. 11 The share of food expenditure and the share of income from the household plot in per capita income, 1990–2012. Source: see Table 9



the cumulative reforms began to take effect. The share of food expenditure for urban families was consistently lower than for rural families after 1992, an indication of lower standard of living in villages during the reform. After 2007 the share of food expenditure for urban families dropped below the 1990 level to less than 30 %, whereas for rural families it approached 30 % but remains above the 1990 level.

The reform aimed to close the rural–urban income gap. This goal remains unachieved. In the Soviet era, up to 1990, rural per capita incomes increased from about 40 % of urban per capita incomes in the 1940s to nearly 90 % at the end of the 1980s, approaching the goal of per capita income equality (Table 9). The post-Soviet reforms produced a steady deterioration in rural incomes: the ratio of rural to urban income dropped from 90 % in 1990 to less than 60 % in 2008 and recovered slightly to 65 % in 2012. The relatively low rural incomes, reinforced by a number of other factors (poor roads, inadequate medical care, lower quality of education, etc.), have led to accelerated out-migration from rural areas, which in turn reduced agricultural production and other productive activities and ultimately resulted in abandonment of large territories.

The food self-sufficiency paradigm underwent a radical change during the reform, especially for the rural population. In the pre-reform and early reform years, even the urban population tried to increase food self-sufficiency: the share of income in kind among urban families (Table 9, column 1) increased from between 1 % and 2 % before the reform to between 5 % and 6 % in the 1990s (reverting to 2 % after 2005). Among the rural population, income from the household plot (sales revenue plus the value of consumption of own food products) decreased steadily during the Soviet period, from about 40 % of total per capita income in the 1960s to 20 % in 1990 (Table 9, column 3). In the early 1990s, when economic difficulties were the greatest, the share of income from the household plot rebounded to between 30 % and 40 % (Table 9, column 3; Fig. 11, blue line). It then resumed its decline to 20 % in the late 1990s and early 2000s, eventually dropping

Table 9 Composition of household income, rural–urban gap and share of food expenditure (% per family member)

Year	Urban income in kind (1)	Rural income		Rural-to-urban income ratio (4)	Share of food expenditure	
		Wage income from agricultural enterprise (2)	Income from household plot (3)		Urban (5)	Rural (6)
Pre-reform years						
1940	9.0	39.7	48.3	43.3	53.0	67.3
1960	1.5	34.7	42.1	48.5	36.9	52.3
1970	1.3	39.3	31.4	69.7	34.7	39.7
1980	2.5	53.5	25.1	79.2	35.0	35.4
1985	2.3	57.3	21.8	87.0	32.8	32.5
1990	2.3	57.6	21.5	88.4	28.2	28.1
Reform years						
1991	4.3	45.3	30.0	86.0	33.0	34.9
1992	5.7	37.0	41.6	77.5	39.8	48.1
1997	5.3	15.4	26.7	68.9	37.7	52.7
1998	5.6	14.3	27.3	68.9	45.9	59.6
1999	5.2	12.0	24.7	70.0	46.5	58.7
2000	4.5	12.4	21.9	65.4	40.8	55.1
2001	4.7	12.9	21.9	65.3	42.3	54.1
2002	4.1	12.6	19.9	63.3	35.7	50.6
2003	3.1	11.2	18.0	60.4	35.1	47.4
2004	2.9	10.6	15.7	56.8	32.5	44.8
2005	2.4	9.2	14.4	55.2	28.6	41.3
2006	2.1	8.4	12.5	56.3	26.2	37.4
2007	1.8	7.8	10.3	56.7	21.7	33.6
2008	1.6	7.5	9.2	57.8	22.9	32.9
2009	1.7	7.5	9.3	60.7	24.7	34.2
2010	1.7	7.2	8.3	62.3	23.9	31.8
2011	2.4	6.4	8.4	64.2	29.5	42.6
2012	2.2	6.1	7.6	65.3	28.2	39.6

Sources: authors' calculations based on Statistical Yearbook (1993: 160–163); Social situation in Russia (various years); data for 1940–1970 for the entire Soviet Union from Narkhoz SSSR (1987: 441–445)

to less than 10 % after 2007. The goal of Soviet policy—total replacement of traditional household plots with income from 'socially productive' activities (other than self-employment)—which had not been attained during 70 years of Soviet rule, was swiftly achieved in one decade of reform. Rural livelihoods have changed; rural people devote much less attention to their household plot as a safety net.

Not only the household plot lost its traditional importance during the transition to market. Agricultural enterprises are no longer the main source of rural livelihoods. In 1990, wage income (in cash and in kind) from agricultural enterprises represented 58 % of total per capita income in rural families. By 2010, per capita income from agricultural enterprises had dropped to a mere 7 % for rural families (Table 9, column 2). Looking at these changes from the perspective of the agricultural enterprise, we note that the share of labour costs in total production costs of enterprises also decreased markedly after 1990 (see Table 6). In an effort to improve their cost-efficiency, corporate agricultural producers reduced labour costs, diverting resources from labour to other uses, such as corporate profits, taxes and other payments to the state.

14 Conclusion

The Yeltsin agrarian reform fuelled the transition from plan to market in agriculture. In the new market economy, agricultural business is the driver of efficiency improvements. Judging by the results presented in this chapter, business has achieved considerable success in increasing the competitiveness of agricultural producers and improving returns on resource use. However, business success has often created major problems that the state failed to recognise and resolve. For instance, attempting to increase competitiveness, agricultural enterprises increased the average productivity of labour by a factor of 3.6, but this was achieved by shedding 6.8 million workers. Attention to rural employment is not really the responsibility of corporations; it is a major task for the government, which has grossly failed in its responsibility. No special social programmes to preserve the rural population have been adopted during the years of reform. As a result, we witness increasing rural poverty, massive depopulation of villages and the abandonment of more than 90 million ha of agricultural land.

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More Than Pouring Money Into an Ailing Sector? Farm-level Financial Constraints and Kazakhstan's 'Agribusiness 2020' Strategy

Martin Petrick, Dauren Oshakbaev, and Jürgen Wandel

1 Introduction

While much of the Republic of Kazakhstan's economic growth is driven by its oil and gas sectors, the country has also become one of the top ten global exporters of wheat and flour. International observers see the agribusiness sector as a key investment target deriving its attractiveness from the country's extensive arable land resources, positive demand prospects in neighbouring countries, growing domestic consumption and a relatively liberal trade regime (OECD 2011). However, with rising incomes, many countries are shifting towards more protein-rich diets, creating opportunities in addition to the export of wheat. Domestic beef and dairy production may well have considerable development potential, thus opening up regional export perspectives as well.

On the other hand, the vast distances from the landlocked country to markets pose considerable logistic challenges for all land-dependent producers in the country. At the same time, after the collapse of most of the industrial livestock producers during the transition crisis of the 1990s, cattle and sheep are now spread across 2.5 million households and mostly small-scale individual farms.

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The direction of Kazakhstan's policy response to these opportunities and challenges is codified in a number of strategy documents issued by the president's office and his cabinet of ministers. In December 2012, President Nursultan Nazarbayev announced a new long-term strategy ('Kazakhstan 2050'), followed by a more specific sectoral programme for agriculture ('Programme for the development of the agro-industrial complex in the Republic of Kazakhstan for the years 2013–2020 (Agribusiness 2020)'), passed in February 2013.[1] While the goal of the overarching Kazakhstan 2050 strategy is to make Kazakhstan one of the 30 most developed countries in the world by 2050, the single objective of Agribusiness 2020 is to 'create the conditions for an enhanced competitiveness' of agribusiness in Kazakhstan (Government of the Republic of Kazakhstan 2012: 5). To this end, an overall budget of approximately KZT 3.1 trillion (approximately USD 17 billion at the time of writing) was earmarked for spending until 2020. The overwhelming share of this budget is supposed to be for public funding of crop inputs, fodder purchases, restocking of livestock herds and preferential capital access for agricultural producers. In addition, outlays for phytosanitary and veterinary services as well as public research and development (R&D) are planned.

Against this policy background, the chapter examines the plausibility of the political strategy for economic development in Kazakhstan in general and with regard to agriculture more specifically. To shed light on a particularly important area of agricultural policy action, we illustrate our case by an empirical analysis of agricultural finance in Kazakhstan. In the following two sections, we outline the Kazakh approach to agricultural policymaking and analyse the main policy document, the 'Agribusiness 2020' programme. In Sect. 4, we present an original analysis of agricultural credit supply and demand based on unique farm survey data collected by the Leibniz Institute of Agricultural Development in Transition Economies (IAMO) in 2012. A hallmark of the survey data is that it covers the entire range of farm types currently operating in Kazakhstan. The survey data are particularly instructive with regard to farmers' access to credit, the main channel for government subsidies. We conclude with a discussion of the shortcomings of the official strategy and outline future areas for policy action based on our own findings.

[1]The 'Kazakhstan 2050' strategy (President of the Republic of Kazakhstan 2012) is explained on the website www.strategy2050.kz, where also the 'Agribusiness 2020' document (Government of the Republic of Kazakhstan 2012) is available for download. We quote from the officially provided English translation of 'Kazakhstan 2050' below. Translations from the original Russian-language version of 'Agribusiness 2020' are our own.

2 The Economic Policy Approach of the Kazakh Government

Kazakhstan pursues a highly centralised policy approach based on key interventions funded from the national budget. As detailed by Kalyuzhnova and Nygaard (2011) and Wandel (2009, 2010), agriculture thus follows the model of hydrocarbons and finance, two other sectors regarded as pivotal for Kazakhstan's economic development. In both of those sectors, a set of instruments is used to further the government's industrial policy goals. It includes the sovereign wealth fund Samruk-Kazyna as the principal platform for the strategic investment of oil revenues, the state ownership of enterprises and equity shares in private banks and enterprises, as well as the placement of government representatives on corporate management boards (Kalyuzhnova and Nygaard 2011). By the end of 2012, Samruk-Kazyna managed assets worth USD 100 billion, which equals about 50 % of Kazakhstan's gross domestic product. Some 72 % of these assets are invested in the oil, gas and financial sectors, and one-third of corporate deposits in banks belong to the sovereign wealth fund (IMF 2013: 16).

At least with regard to the key sectors of the economy, Kazakhstan's policy approach could thus be characterised as 'state-guided' capitalism, described by Baumol et al. (2007: 62–79):

governments, not private investors, decide which industries and even which individual firms should grow. Government economic policy is then geared to carry out those decisions, using various policy instruments to help out the chosen 'winners'. The overall economic system nonetheless remains capitalist because ... the state recognizes and enforces the rights of property and contract, markets guide the prices of the goods and services produced and the wages of workers employed, and at least some small-scale activities remain in private hands.

Among the key problems government authorities face when they try to develop new markets, technologies or business structures are *deficient knowledge* and *flawed incentives*. The knowledge required to target promising industries or business structures is dispersed among many people in a society and cannot be possessed by just a few policymakers, given the limited cognitive ability of every human. In addition, government bodies generally operate without the profit motive and, when they do, they often do not face the same constraints as private firms, such as the menace of bankruptcy in case of long-term losses (Kirzner 1985: 140). Any particular promotion of a branch, technology or form of business organisation that is deemed superior and hence supported by a central authority is what Hayek (1974) called 'pretence of knowledge'. In this view, it is both unnecessary and counterproductive for the government to nudge or push private entrepreneurship into certain directions with financial incentives.

On closer inspection, current strategy documents indicate a delicate balancing act between private business promotion and state planning that was already characteristic of Kazakhstan's economic and agricultural policy under previous programmes (Wandel 2009; Nellis 2014). For example, Kazakhstan 2050 recognises and emphasises private entrepreneurship as the driving force of the 'new economic policy', based on the insight that 'private businesses are normally more effective than state run enterprises'. From this follows the call for further privatisation, radical liberalisation by minimising the government's participation and intervention in business, the strengthening of private property rights and contract fulfilment, and a comprehensive overhaul of the existing tax system in order to stimulate saving, investment and exports. At the same time, the state is also attributed the leading role, namely that of showing the entrepreneurs where to become active. The president stipulated that 'the state, represented by national companies must stimulate the development of the economy of the future'. This includes the task of defining priorities and new markets as well as promoting exports. To this end, state planning and forecasting systems are to be improved. The driving seat in this process is assigned to the sovereign wealth fund, which manages the revenue windfall from the natural resources sector and should direct resources to long-term strategic projects.

Similarly, the commercial banks are called to provide the economy with monetary resources. At the same time, the state wants to keep control over the financial system, not only to restructure banks that have been battered by bad debts, but also to ensure that they fulfil their purpose of meeting the demand of the private sector for loans. Moreover, only so-called non-strategic enterprises and services are eligible for privatisation, while companies deemed 'politically vital' are to remain state owned.[2]

In some regards, experimenting with different policy and institutional approaches might even be easier in an authoritarian political environment than in democracies, by following the maxim also included in the Kazakhstan 2050 speech, 'economy first, then politics'. An authoritarian regime can insulate itself from rent seeking by various interest groups and avoid the critical influence of an electoral cycle. Not having to fear the loss of votes from vested interests means that it need not stop a policy approach that has turned out unsuccessful. In fact, a feature of policymaking in Kazakhstan has been the government's flexibility in learning and adapting policies (Pomfret 2013). For example, after the turn of the millennium, a redirection of land policy took place (Petrick et al. 2013), and more recently various approaches to credit facilitation for agricultural operators were tested. On the other hand, abrupt changes lead to policy uncertainty and resource misallocation by potential beneficiaries. Moreover, there was little change in the hierarchical way political programmes are invented, designed and implemented, with the president's office as the key agency.

[2]A public debate in the Kazakh business media revolved around the question of whether or not the country needs a 'second wave of privatisation' to overcome the legacies of 'state-oligarchic capitalism' and to encourage individual entrepreneurship. Domestic observers complained that no progress was made on this front. Moreover, the state enterprises seriously envisaged for privatisation were public services, such as hospitals or waste management, and not from strategic sectors of the economy (Kasenova 2013; Temirkhanov 2013).

3 Kazakhstan's Agribusiness 2020 Strategy

3.1 The Agricultural Strategy

Based on the agenda set by the president's Kazakhstan 2050 strategy, Agribusiness 2020 maintains the orientation of previous agricultural policy documents issued by the government with regard to growing output and increasing competitiveness. Other challenges of the 2050 strategy associated with agricultural development—the sustainable use of natural resources and rural development—are not included in the programme. This underlines the overall importance the government attributes to enhancing agribusiness competitiveness (Prime Minister of Kazakhstan 2013). To achieve this goal, the strategy document emphasises a series of measures defined by the following four policy objectives:

1. the financial rehabilitation of agribusiness
2. improving access to material inputs and services
3. developing a governmental service supply system for agribusiness entities
4. improving the effectiveness of government regulation in the sector.

The document moves on to detail a set of specific actions for each of the goals, accompanied by quantitative success indicators. Together with a statement of indicative budget allocations for each of the actions, the Agribusiness 2020 programme boils down to a plan with clearly visible priorities, summarised in Fig. 1. As can be seen, the largest part of the budget is earmarked for capital subsidies or direct capital transfers to agribusiness entities.

It is planned to allocate an aggregate of KZT 3.1 trillion (USD 17 billion) over the 8 years of the programme's implementation (2013–2020). A significant part of the overall budget, including fuel and input subsidies as well as livestock upgrading, will be spent under the responsibility of the provincial administrations (*akimats*). Altogether, according to government officials, 'over 10 trillion tenge of investments are planned to [be] attracted to the sector' (Prime Minister of Kazakhstan 2013). As a general tendency, there will be a move from direct support of certain products to more general support through credit and leasing arrangements (Government of the Republic of Kazakhstan 2012: 36). Indeed, this would be a notable move away from the more product- and output-related measures that the government had introduced after the turn of the millennium. In addition, the tax system will be subjected to a review. Future changes will aim to ensure a level playing field for Kazakh producers within the World Trade Organization and the Common Economic Space within the Eurasian Customs Union.

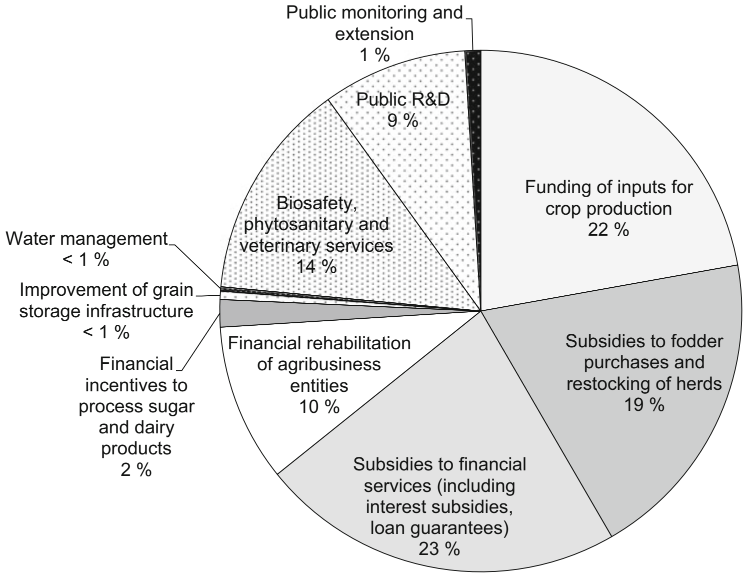

Fig. 1 Budget priorities of the Agribusiness 2020 programme. Source: authors' calculations based on Agribusiness 2020: 77–95

3.2 Improving Agricultural Competitiveness by Government-Mandated Capital Allocation?

In general, there are good reasons to strengthen the role of the agricultural sector in the Kazakh economy, given the relative resource endowments of the country. The same is true for the goal of diversifying away from natural energy resources and considering other sectors that provide a basis for adding value, employment and export growth. However, the problems are in the details. Many of the individual measures are inconsistent with the principles of good governance outlined before, and important areas for public action are missing from the menu of government activities. Some of the quantitatively set policy goals formulated in Kazakhstan 2050 look strange to the economically educated observer. In particular, the wish to increase agriculture's share in gross domestic product by five times seems odd given the typical decline of this share in the course of economic development. It is true that the Agribusiness 2020 document identifies many important constraints and seems, overall, realistic and balanced. Yet the budget priorities and the specific measures set out make it very clear how the political goals of the programme are to be achieved: by massive subsidisation of key production factors deemed necessary for the realisation of government targets. This applies to the funding of all kinds of variable inputs (fuel, seed, fertiliser, plant protection, fodder) and fixed factors (livestock, fixed capital), which consumes almost 75 % of the budget (see Figure 1). Only a small share of credits will be channelled through commercial banks in the form of long-term loans (Agribusiness 2020: 50–52); the rest will be extended by a daughter company of the state-owned KazAgro group. The main task of KazAgro is to implement government plans for the economic development of the agro-industrial complex. These include directing investments into sectors of special importance, developing the infrastructure, regulating and stabilising domestic agricultural markets, and helping with the formation of business clusters (Petrick et al. 2013).

In addition, land is given to its users almost for free—at least the significant share of land that is rented from the government. Inevitably, it is thus the government that determines to a large extent exactly which types of inputs should be used and by whom.

On the other hand, only about 25 % of the funding (Fig. 1) is for genuine public goods in the agricultural sector, such as biosafety control or public R&D. Several key issues receive only minimal funding or are completely disregarded in the budget, such as water management, dealing with climate risks, the management of public grazing land and fishing grounds, or improving the transport and storage infrastructure. Furthermore, very little funding for institution building in the direction of embeddedness and accountability is visible in the programme. Although the Agribusiness 2020 document was circulated and discussed among private-sector associations and interest groups at the drafting stage, collective action of private stakeholders in agribusiness is often very limited. According to the Organisation for Economic Co-operation and Development (OECD 2013: 120), it tends to be underfunded and its benefits are little appreciated.

While it is laudable that almost all policy instruments set out in Agribusiness 2020 are accompanied by benchmark indicators, these often come in the form of 'hectares covered by subsidies' or 'number of livestock bought under the national programme' (Government of the Republic of Kazakhstan 2012: e.g. 39, 45). It is not clear how such indicators actually measure the contribution to the overall policy goal of increasing competitiveness. It is also not apparent what role such evidence may play in the future review of policies, despite the rate-of-return rhetoric in the Kazakhstan 2050 document.

Given the one-sided dependency of the public budget on revenues from the oil and gas sector, there is a significant risk that funding cannot be made available in the proposed amounts because of budget shortages. Indeed, by the end of 2014, spending under Agribusiness 2020 was lagging behind initial targets, as government finances were under pressure from low oil prices. In fact, the Ministry of Agriculture had received only 68 % of its initially allocated budget in 2014.

4 Farm-level Financial Constraints to Agricultural Development in Kazakhstan

4.1 The Farm Survey

To obtain a deeper understanding of the actual financial constraints that farm operators in Kazakhstan perceive, and how agricultural policy addresses them, we now turn to evidence based on survey data collected in Kazakhstan. The data for this analysis come from a farm survey conducted by IAMO in 2012. It was carried out in Akmola and Almaty provinces, two important agricultural regions of Kazakhstan. Akmola is part of the northern grain region and its agricultural output is mostly grain, whereas agricultural production in the southern foothills province of Almaty is more diversified and oriented towards livestock. According to Petrick et al. (2013) and the OECD (2013), we identify four important farm groupings in Kazakhstan:

1. *Household producers*. These used to be an integral part of the rural food supply during the Soviet period, particularly with regard to vegetables and livestock products. During transition, many of them took over some of the livestock from the collapsing former state farms.
2. *Small- to medium-sized individual farms*. These were created during the land reforms of the 1990s. They are called 'peasant farms' in official terminology.
3. *Agricultural enterprises*. Many of these are former state farms.
4. *Agro-holdings*. These are agricultural enterprises that belong to a horizontally and/or vertically integrated business group, often established by outside investors (but, in Kazakhstan, typically domestic investors).

Within two counties per province, representatives of the second, third and fourth groups were selected randomly on the basis of company registers provided by the local government administration. Household producers were identified by a snowball sampling system and interviewed at home. All economic performance indicators refer to the cropping year 2011. The following analysis of the survey data complements the results provided by Petrick and Oshakbaev (2015). More detailed results of the 2012 survey are available from Petrick et al. (2014).

Table 1 gives an overview of the sample structure and some key measures of operational scale in the different sub-samples. It demonstrates the enormous variation in utilised area and herd sizes per farm across farm types. Household producers work on a tiny plot of land and keep one or two cows. Many individual farms have a size comparable to that of family farms in the West. Their median utilised area was 75 ha in 2011, and the median farm with cattle kept 30 animals. The enterprises are larger by several orders of magnitude, utilising a median of 12,800 ha of land for ordinary enterprises or even double the size for the median agro-holding. Cattle herds on enterprises are also much larger than on individual farms.

Table 1 Operational scale of different farm types in the survey data

Indicator	Households	Individual farms	Agricultural enterprises	Branches of agro-holdings
No of farms in survey sample	300	245	47	8
Utilised agricultural area (ha)[a]	0.04 (0.01; 0.07)	75 (20; 421)	12 800 (4 732; 18 136)	24 000 (17 152; 34 618)
Farms with cattle (%)	55	37	36	13
Among which: size of cattle herd (head)[a]	2 (1; 4)	30 (10; 89)	271 (77; 408)	920

Source: authors' calculations based on IAMO 2012 farm survey data
[a]Median (first; third quartile). All statistics based on non-missing data

4.2 Agricultural Credit-market Outcomes and Credit Rationing

In 2011, the year to which the survey data refers, companies in Kazakhstan's agricultural and food sector took out bank loans worth USD 2.3 billion in total. In that year, nominal interest rates for loans to legal entities stood at about 10–13 % for loans in national currency and 7–10 % in foreign currency. The majority of loans in the agricultural sector are made in the national currency. Since late 2007 and 2008, when commercial lending to the agricultural sector in Kazakhstan strongly contracted because of the unfolding global financial crisis, the sector has suffered from high default rates. For example, in September 2011, 10.6 % of loans to agriculture were non-performing, and 33.7 % were at risk (Issayeva 2012). Even so, the situation was even worse in other sectors of the economy. Because of the large share of non-performing loans and recent government bailouts, international observers regard the Kazakh banking industry as weak (European Bank for Reconstruction and Development 2012).

As a reaction to turmoil emerging from the global financial crisis, the Kazakh government promoted access to funding from the state-owned KazAgro holdings. Officially, the government declared that it feared negative consequences for domestic food security from the contracting private credit supply. The Agrarian Credit Corporation (ACC), a KazAgro subsidiary, has been the key government agency providing farmers with subsidised credit since then (for a detailed account, see OECD 2013: 138–150). To this end, it is linked to a network of some 160 so-called rural credit partnerships. These partnerships consist of 30 to 40 farms whose managers have to make a deposit in order to become members and thus eligible for funding. Based on available farm collateral, farmers submit their credit proposals via the credit partnerships to the ACC. If the proposal is accepted, the ACC grants credit at a subsidised rate (4 % in 2011) to the credit partnership. Loans offered to farmers then carry an interest rate that is twice the level of the subsidised rate (8 %). Unlike traditional credit cooperatives in other countries, the credit partnerships have no autonomy in decision-making (Gaisina 2007). They are not allowed to take regular savings and have no control over the deposits made by farmers. Only registered enterprises (including individual farms), not private individuals, can become members. Rural credit partnerships are simply the local branch of a centralised governmental subsidy programme. Recently, default rates have also been high. While well-managed individual farms and enterprises can attract funding from the ACC, overall participation is low. Even in the provinces with the highest penetration of credit partnerships (South Kazakhstan and Almaty), less than 2 % of all agricultural entities were members in 2011 (OECD 2013: 142).

In addition to the credit partnerships, there are also direct channels through which the ACC provides funding for the agricultural sector, and KazAgro funds a separate leasing programme for farm machinery.[3]

The 300 agricultural enterprises, including agro-holdings and individual farms, that were in the 2011 survey sample obtained a total of 39 loans in that year. Of these loans, 49 % were extended by KazAgro and 31 % by commercial banks. The rest came mostly from private money lenders, and concerned the co-financing of investment projects on smaller individual farms. These figures imply that only 6 % of all farms and enterprises in the sample obtained credit from KazAgro and 4 % from a bank loan. Reported annual interest rates ranged from 1.5 % to 13 %, with a mean of 6.5 %. KazAgro loans had a mean interest rate of 5.8 %, and bank loans of 7.8 %.

Borrowing behaviour by sub-groups of respondents is summarised in Table 2. In this table, clear trends become visible along a continuum of farm organisation, from households at one end to agro-holding branches at the other. While every second agro-holding took a loan in 2011, only 7 % of households did, with individual farms and agricultural enterprises displaying intermediate levels. The last but one row in the table suggests that debt levels on the farms' balance sheets are generally low. In fact, 80 % of farms and enterprises have debt levels below 5 % the value of their non-land assets.

Based on the survey data, we analyse producers' access to funding using a method that directly elicits individual borrowing status from the respondents. For both types of evidence we use a conceptual framework summarised by Boucher et al. (2009). This framework distinguishes the following four categories of credit-rationing outcomes:

1. *Price rationing*. The credit demand from price-rationed respondents is determined by the level of the interest rate they face. Such respondents may be borrowers who satisfied their credit demand at the going interest rate. Alternatively, they may be non-borrowers who did not request credit because they found that the interest rate offered exceeded the revenue-generation capacity of their investment. As this rationing mechanism follows conventional market price

[3]A number of grain enterprises in the north of the country were successful in attracting outside equity through agro-holdings (Petrick et al. 2013). We have not analysed this source of funding in depth, but there is casual evidence that it has resulted in widespread modernisation of equipment among the holding branches.

Table 2 Credit rationing outcomes for different farm types in 2011 (% of respondents)

Indicator	Households	Individual farms	Agricultural enterprises	Agro-holdings	Grain farms Akmola[a]	Households with dairy	Individual dairy farms
Took a loan in 2011	**7.0**	**11.0**	**25.5**	**50.0**	**25.9**	**7.1**	**15.4**
Price-rationed borrowers	7.0	7.8	17.0	25.0	15.7	7.1	12.9
Quantity-rationed borrowers	0	3.3	8.5	25.0	10.2	0	2.6
No new loan in 2011[b]	**93.0**	**88.9**	**74.5**	**50.0**	**74.1**	**92.9**	**84.6**
Price-rationed non-borrowers	90.0	81.6	70.2	37.5	66.7	89.7	75.6
Quantity-rationed non-borrowers	1.0	3.3	0	0	0	0	5.1
Risk-rationed non-borrowers	76.3	69.4	42.6	25.0	38.0	76.3	61.5
Transaction cost-rationed non-borrowers	47.7	23.7	14.9	0	6.5	53.9	23.1
Liabilities (% of non-land assets, sub-group mean)[c]	**–**	**3.8**	**7.7**	**5.0**	**6.7**	**–**	**5.4**
Number of respondents in sub-group	300	245	47	8	108	156	78

Source: authors' calculations based on IAMO 2012 farm survey
[a]Individual farms and agricultural enterprises including agro-holdings located in Akmola province
[b]Multiple classifications possible among non-borrowers
[c]Based on non-missing observations

signals, the respondents may be classified as unconstrained by credit-specific obstacles to borrowing.

2. *Quantity rationing*. Quantity-rationed respondents face a binding credit limit that prevents them from borrowing as much as demanded, as a result of unresolved problems of financial intermediation. Quantity-rationed borrowers would have liked to borrow more at the going interest rate than they actually obtained. Quantity-rationed non-borrowers applied for a loan and thus expressed some notional demand but the lender rejected the application in total. Such respondents are typically prepared to service the interest rate offered, but the bank turns down their credit application because they cannot provide enough collateral or the contract offered does not match the cash-flow schedule of the investment project.
3. *Risk rationing*. Risk-rationed respondents refrain from borrowing because they fear the risk of defaulting on the loan and possibly losing the collateral they pledged. They thus do not face a binding credit limit. Their credit demand is nevertheless affected by the uncertainties of generating their investment return and/or the collateral arrangements of imperfect credit markets.
4. *Transaction-cost rationing*. Alternatively, respondents may abstain from borrowing because they regard the application procedures as too complicated, or because there is simply no lender available in their area. Effective demand by such respondents is driven down to zero because of credit-specific costs that add to the interest rate.

In the farm survey, we made an attempt to measure the empirical relevance of the above categories in the Kazakh agricultural credit market. The individual rationing outcomes were elicited by a cascade of interview questions following Boucher et al. (2009) and the literature cited therein. Among the non-borrowers, multiple answers were possible to the question why they did not borrow. The results are summarised in Table 2.

Among the borrowers who took a new loan in 2011, both price and quantity rationing increase from households to agro-holdings, but price rationing is more prevalent in all sub-groups of farms. It is thus primarily the level of the regular debt service that discouraged borrowers from taking bigger loans, not so much the non-price elements of the contracts, such as collateral requirements.

Among the non-borrowers, multiple reasons for the absence of effective loan demand were recorded in the survey. Price and risk rationing were the two dominant reasons for not borrowing, with the former being mentioned more often. That is, farmers do not take loans at all because agriculture revenue streams are regarded as too low and too fluctuating to service regular interest and repayment rates. As the share of non-borrowers goes down with more commercialised farming operations, i.e. from households to agro-holdings, so does the share of price- and risk-rationed farmers as a percentage of all sub-group respondents. Among the households, nine out of ten are price rationed and three-quarters are risk rationed. Of the agro-holdings, only three out of eight are price rationed and one-quarter risk rationed. For about half of the households and one-quarter of the individual farms, high transaction costs are a main reason for not borrowing, whereas this reason is much less important for enterprises and agro-holdings. Quantity rationing is generally negligible among non-borrowers. In other words, farmers who expect that they are not creditworthy refrain from applying to a bank altogether.

4.3 Implications

Hence, by far the dominant driver of credit-market outcomes is the *lack of effective demand* given the low and uncertain returns from farm production. Given this evidence, most farm managers seem to be convinced that agricultural investments cannot currently deliver a sufficiently stable revenue stream that could service the going repayment rates. They are subject to price and risk rationing. Only a relatively small number (namely the quantity- and transaction cost-rationed respondents in Table 2) think that it is the *lack of access* to these sources of funding that ultimately prevents them from borrowing.

Farmers thus regard an unpredictable stream of revenue as the major reason for low financial investments in agriculture. At the same time, recent ratings of Kazakhstan's financial sector suggest that some of the problems are on the supply side of finance, reflecting the poor liquidity and stability of the banking industry. While it seems plausible that the overall competitiveness of the agricultural sector needs to be enhanced if external funding is to grow, it is a crucial question whether this demand problem can be resolved in isolation from the supply problems of the banking sector. One might argue that lacking competitiveness reflects a lack of money, so that better funding options allow the upgrading of farm equipment, which leads to higher and more stable returns in agriculture. This seems to be the logic of the governmental credit programme. However, despite low interest rates, penetration into the farming sector has been very modest so far. Among the likely reasons are that operations are very centralised and subject to interference by higher-level bureaucrats, whereas management capacity at the branch level is low and there is no active involvement of farmers, e.g. as depositors of savings (Gaisina 2007).

The question remains whether the availability of funding is the most constraining problem. Farmers suggest that this is not the case. In fact, the farmers' own assessment of their creditworthiness suggests that the changes necessary to raise the sector's profitability are not primarily dependent on more credit for farmers. Available evidence from the farm survey presented and discussed by Petrick et al. (2014) and Petrick and Oshakbaev (2015) suggests that the key problems are located in other areas: despite the vast land resources, a lack of land supply is now the most cited constraint to farm expansion in the highly regulated land market of the northern grain region. Another set of constraints in wheat production is related to the market power of elevators, the vagaries of trading over long distances with an underdeveloped rail and seaport infrastructure, and the intervention activities of state agencies. In the cattle sector, there are significant problems in year-round fodder supply. The value chains for beef and dairy are bifurcated into an import-dependent chain for industrially processed products serving urban consumers, and a local chain of raw products serving rural consumers and urban bazaars. It is here that the government should become more active, thereby making outsiders more likely to invest financially in Kazakhstan.

5 Conclusions

A key problem with the government's state-centred modernisation strategy is that successful agribusiness entrepreneurs, who detect business opportunities, create value and put the country's resources to productive use, require more or even something other than just cheap access to inputs and capital. They need the freedom to discover and seize the business opportunities they perceive to be profitable in their given local environment. The relevant information and knowledge to pursue this business goal successfully are highly dispersed. They require efforts in trial and error on the side of the entrepreneurs as well as a lot of flexibility and adjustment capacity to local market conditions. If the government makes costly and long-term financial commitments to specific activities that the entrepreneurs are expected to perform, these commitments may turn out to be misguided given the specific circumstances of businesses. Moreover, entrepreneurs are given incentives to engage in unproductive rent acquisition rather than productive business opportunities. As a result, the subsidies may turn out to be a waste of money. Furthermore, they may crowd out private initiative to provide the necessary resources in an economically more sustainable way.

Even so, there is a role for the Kazakh government to coordinate and monitor the modernisation process of agribusiness. It means providing impartial, reliable and high-quality public services to the sector, making sure that the weakest links in food-chain development are identified and private entrepreneurs are incentivised to strengthen them. This typically requires effective institutional arrangements at the local level. Such public services should be endowed with the necessary human, financial and political resources to support entrepreneurs in a flexible and timely manner without overly interfering in their individual decisions. There is now substantial evidence that helps to pinpoint a number of areas where the government might reconsider its priorities (OECD 2013; Petrick et al. 2014). These areas include the improvement of farmers' know-how, lifting constraints on access to land, the promotion of private storage capacity for grain, improved local management of public grazing land, a stepwise introduction of stricter quality standards in livestock production, encouraging commercial banks to engage in rural banking, and the introduction of effective evaluation mechanisms for public funding programmes.

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The New Wheat Exporters of Eurasia and Volatility

David Sedik

1 Introduction

The international grain-trading system is in an era in which new exporters are taking a larger role in international wheat markets. The exporters of the Commonwealth of Independent States (CIS) are relatively new to world export markets. In 1999–2001 (three year average) they captured only 9 % of total world wheat exports. By 2009–2011 this proportion had more than doubled to 21 %. As world wheat demand increases, the dependence on new exporters will continue and will probably grow. According to forecasts by the Organisation for Economic Co-operation and Development (FAO), the Food and Agriculture Organization of the United Nations (FAO) (OECD-FAO 2015) and the Economic Research Service of the United States Department of Agriculture (USDA ERS), the CIS exporters will significantly increase their share of world exports over the next 10 years, primarily at the expense of the United States.

The rise of these CIS countries as world wheat exporters has been accompanied by uncommonly volatile commodity prices. According to many studies (Brown et al. 2008; Dollive 2008; Welton 2011; Headey 2011; Sharma 2011) the CIS countries have themselves contributed to the volatility of prices. High price volatility can be characterised as a situation when prices fluctuate significantly and unpredictably over a short time. There are therefore two aspects to volatility: variability and uncertainty.[1] Variability describes the movement of prices, while uncertainty refers to the unpredictability of that movement (Prakash 2011).

[1]There is a difference between risk and uncertainty. Risk refers to uncertain events, where the distribution of outcomes is known. Uncertainty refers to events for which the distribution of outcomes is unknown and probabilities assigned to events cannot be assigned.

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Whereas households may cope with predictable variation (risk), unpredictable changes are more a cause for concern. When unpredictable changes surpass a certain critical threshold and persist at those levels, traditional policy prescriptions and coping mechanisms are likely to fail (Wolf 2005).

Volatile prices are a cause for concern, first, because they tend to be associated with higher prices. It is in principle possible to have low but volatile prices, but the variability and unpredictability of such prices usually increase them. Higher food prices have a disproportionately negative effect on the living standards of poorer households, since a higher proportion (often 60–75 %) of the poor's expenditures are on food (Prakash 2011). Second, volatile food prices, with their combination of variability and uncertainty, make households more vulnerable to the erosion of living standards. Gradually rising food prices are far less destructive for poor households, because they give time for households to adapt and cope with the increases.

The purpose of this chapter is to explore price volatility in the CIS wheat producers. Wheat is chosen because of its key role in food security. We explore two possible sources of price volatility: production and export volatility. Production volatility is characterised more by risk, since production in these countries exhibits a high coefficient of variation, but this is a long-standing issue with an understandable agronomic basis. Export volatility is another possible source of price volatility, although it is characterised more by uncertainty, since exports are affected by political interventions in grain markets, which are far less predictable than normal weather-related year-to-year yield variations. We conclude with some observations on how production and export volatility in these countries could be addressed.

1.1 Emergence of Russia, Ukraine and Kazakhstan on World Wheat Markets

Wheat is the most important grain produced and exported in the Russian Federation, Ukraine and Kazakhstan (RUK), making up 58 % of production and 59 % of grain exports in 2013. Exports of wheat from these countries have made a quantum leap, climbing from 8.9 million tonnes at the turn of the century to an average of 28.5 million tonnes in 2009–2011. The OECD and FAO project that this region will continue to increase its market share to 28 % of world wheat exports by 2020–2022 (Table 1).

The evolution of the share of the world market for wheat shows the sizeable change that took place in the first decade of the twenty-first century and the further changes that are expected to take place by 2020–2022. According to forecasts, the USA will lose the most market share as a result of the expanding wheat exports of RUK, but the other 'traditional' wheat exporters such as Canada, Australia and the European Union (EU) will also lose market share (Fig. 1).

Table 1 Major wheat exporters ('000 tonnes)

Region	Average for years			
	1992–1994	1999–2001	2009–2011	2020–2022
World	81,415	98,203	134,137	148,929
Australia	10,175	16,575	19,340	17,621
Canada	20,134	17,212	17,393	20,988
EU-27	–	9030	19,808	17,112
USA	34,199	28,221	29,212	24,446
RUK	5308	8840	28,506	42,249
Kazakhstan	4407	4499	7953	12,853
Russia	673	1821	14,376	20,400
Ukraine	228	2520	6177	8996
Argentina	5816	10,127	6721	10,257
Other	5783	8198	13,157	16,256

Source: OECD/FAO Agricultural Outlook, 2013–2022 database

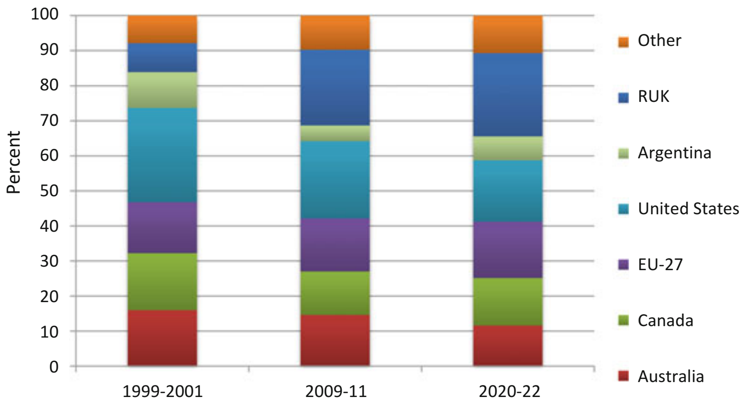

Fig. 1 Major wheat exporters, share of global market. Source: Table 1

1.2 *The Contribution of Russian, Ukraine and Kazakhstan to Wheat Market Price Volatility*

The literature on the role of RUK in price volatility has focused on individual instances of export restraints imposed in 2007/2008 and 2010, noting three causal connections between export restraints and price volatility:

1. *'Cascading effect' of export restrictions in 2007/2008*. Dollive (2008) stated that the Ukrainian grain export ban established on 1 March 2007, followed by export quotas on wheat (from November 2007), led to a cascading effect, causing other countries to enact restrictions as well. Although Ukraine enacted export

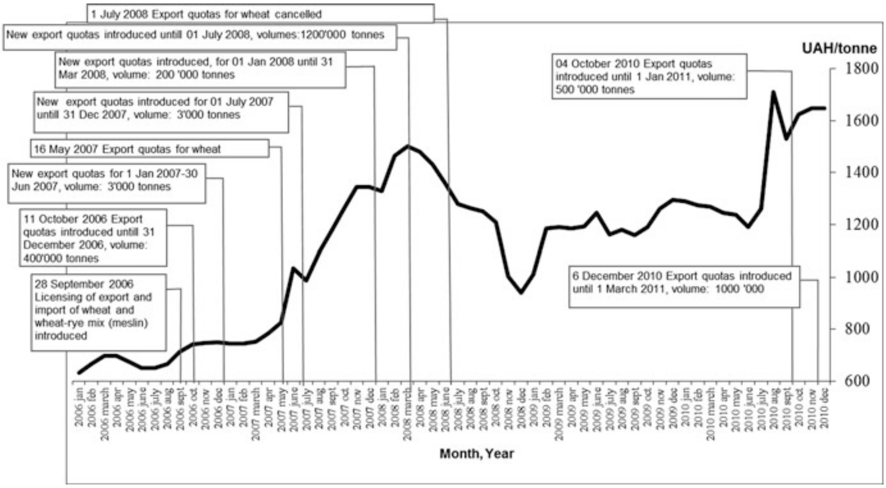

Fig. 2 Prices of third-class wheat in Ukraine and export restrictions. Source: Kobuta et al. (2012)

quotas starting in October 2006 (World Bank 2008), the export ban in the following year forced buyers to look to other sources for grain exports, raising prices and putting pressure on other suppliers, including Kazakhstan and Russia. This added demand on other suppliers in the region caused their stocks-to-use ratios to fall, leading them to enact grain-export restraints. This cascading effect affected the entire global market by encouraging further export restraints and higher prices. The unpredictability of the ‘cascading’ effect on supplies and prices tended to raise prices above levels consistent with market supply–demand fundamentals.

Kobuta et al. (2012) juxtaposed export policy changes for wheat from January 2006 to December 2010 with the price of third-class wheat on Ukrainian markets. The juxtaposition appears to show an exacerbation of price increases after the imposition of export constraints in 2006/2007 as well as 2010. On the other hand, the fall in wheat prices starting in March 2008 clearly predated the relaxation of export constraints, just as the initial rise in wheat prices did in July 2010 (Fig. 2). The behaviour of prices in Fig. 2 is consistent with the ‘cascading’ explanation by Dollive (2008).

2. *Diminished supply response due to dampened integration of domestic producer prices into world markets*. Gotz et al. (2013) noted that an indirect effect of export restraints is the increase in grain supplies remaining on domestic markets. This ‘oversupply’ of grain on domestic markets drove down its price. Gotz et al. (2013) showed that the export restrictions introduced by Russia and Ukraine in 2007/2008 temporarily reduced the degree of integration of domestic and world wheat markets, increasing market instability and reducing the supply response of producers for the following marketing year. The effects were more severe in

Ukraine, where an outright ban and quotas were used, whereas Russia relied mainly on export taxes.[2]

3. *In the longer run, the increased political uncertainty caused by government intervention decreased investment incentives for Russian and Ukrainian agriculture*. Gotz et al. (2013) and Kobuta et al. (2012) noted that unpredictable state interventions in grain markets, exemplified by export restrictions, probably diminished incentives for investment in the sector, thus lowering long-run growth prospects. Thus, unpredictable export restraints can inhibit the supply response to high grain prices, thus increasing the likelihood of continued high prices and further price volatility.

While the connections between unpredictable export restraints and price volatility are well taken, by focusing exclusively on these individual instances of export restraints the literature emphasises only one of a number of potential sources of volatility represented by the emergence of RUK onto world markets as significant wheat exporters. In this chapter, therefore, I will focus on two further potential sources of volatility. The first is production volatility. The reason given by the authorities for grain export restrictions in 2007/2008 and 2010 was to prevent the growth of domestic food prices as a result of unexpectedly low grain harvests. Wheat yield and production volatility in RUK since 2000 has been the highest among the main wheat exporters. Reducing the variance of wheat yields and production would reduce a potential source of price volatility in world markets.

Second, it should be recognised that grain export limitations are not isolated instances. Rather, they are part of a general pattern of political intervention in agricultural markets and protectionism by the governments of Russia, Ukraine and Kazakhstan. Political intervention in agricultural markets, particularly wheat markets, has been on the rise since 2010, as is protectionism overall. Thus, the grain-export limitations should be seen as part of a general pattern of government intervention that is increasing in scope and severity. Addressing this new protectionism through more robust international agreements is another way to reduce a potential source of price volatility in world markets.

1.3 Production Volatility in Russia, Ukraine and Kazakhstan

A characteristic shared by all leading exporting countries is that production is far more variable than consumption. Figure 3 illustrates this observation using the

[2]Interestingly, however, the excess grain on domestic markets did not stop retail prices for retail grain products from rising. Welton (2011) cited Russian statistics showing that, despite the wheat-export restrictions enacted in 2007, wheat-flour prices rose by 17 % in 2007 and 41 % in 2008. Bread prices rose by 16 % in 2007 and 30 % in 2008. In 2010, despite the grain-export ban, flour prices rose by 18 % from July to December 2010, and bread prices rose by 10 %. Commenting on the differences between food price rises and grain availability, President Medvedev blamed the price increases on speculators (*Moscow Times* 2010).

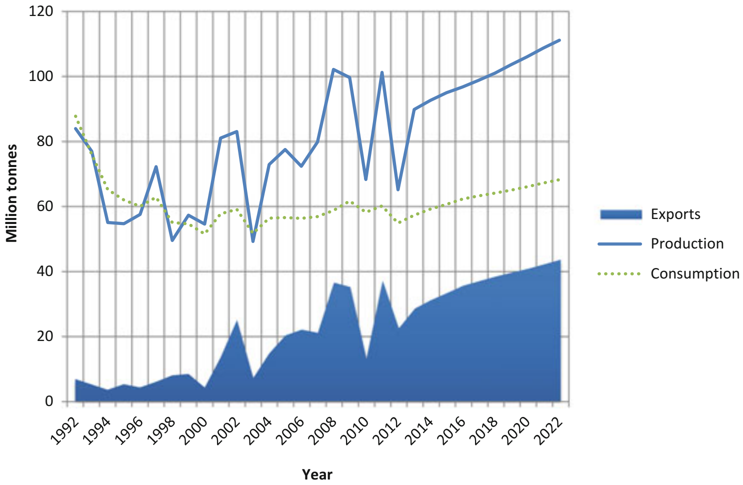

Fig. 3 Wheat: aggregate production, consumption and export of RUK, 1992–2022 (forecasts begin in 2013). Source: OECD/FAO Agricultural Outlook, 2013–2022 database

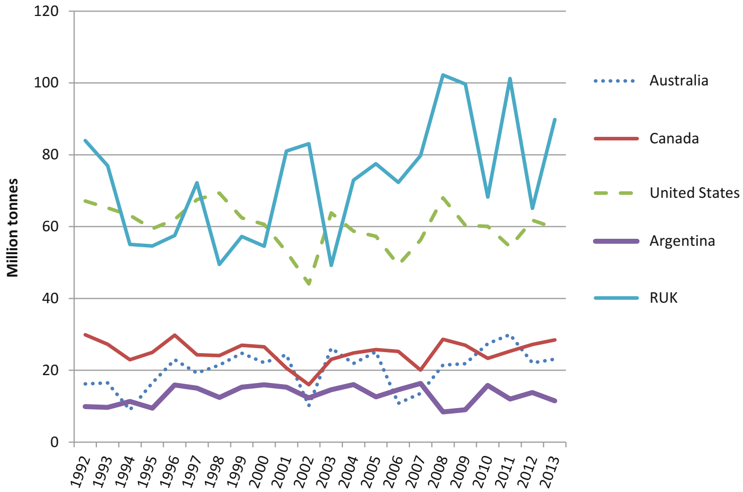

Fig. 4 Wheat: production of selected major exporters, 1992–2013. Source: OECD/FAO Agricultural Outlook, 2013–2022 database

example of RUK, where historical data to the end of 2012 show a relatively smooth wheat-consumption curve, but quite variable production. A comparison of production between countries (Fig. 4) shows that production in RUK was more variable than elsewhere, particularly after 2000. In fact, if the standard deviation of production in RUK is taken as 100, then the corresponding figures for Australia (30), the USA (33), Argentina (14), the EU (52) and Canada (17) were far less.

Table 2 Leading wheat exporters: volatility of yield, area harvested, production and exports, 2000–2012

	Coefficient of variation, 2000–2012				
	(1)	(2)	(3)	(4)	(5)[a]
Region	Yield	Area harvested	Production	Exports	Sum
World	5	29	7	14	55
USA	7	37	11	13	68
EU-27	7	46	8	28	89
Canada	15	54	14	16	99
Argentina	16	81	19	24	140
Australia	26	94	29	32	181
Kazakhstan	**24**	**103**	**29**	**39**	**195**
Russia	**14**	**105**	**20**	**62**	**201**
Ukraine	**22**	**146**	**33**	**71**	**272**

[a]Column 5, 'Sum' is the simple sum of columns 1–4
Source: OECD/FAO Agricultural Outlook, 2013–2022 database

A proper comparison of the variability of production should take into account both the standard deviation as well as the level of production. A given standard deviation of production with a small mean is in reality much more variable than the same standard deviation with a large mean. The coefficient of variation is a measure of variance that takes into account both the standard deviation of a series as well as the mean of the series.[3] Table 2 illustrates that the coefficients of variation of yields, production and exports in RUK have tended to be higher than in the traditional exporting countries. The only exception is Australia, where wheat yields are much closer to those in Kazakhstan than the other major exporters. Russia and Ukraine are by far the most volatile exporters.

2 Rapid Growth as an Explanation for Production Volatility

Table 1 showed that exports in RUK grew quite rapidly. The same can be said for production as well. Growth of wheat production in RUK was the fastest of all leading exporters (Table 3) between 1999/2001 and 2009/2011. RUK, along with the European Union, also had the fastest growth in exports. There is a high correlation between the rapid growth of exports and their volatility. The correlation coefficient between the average growth rates per annum and the coefficient of variation for 2000–2012 was 0.74. It is unclear why rapid growth and volatility are correlated, but it appears that they are.

[3]The coefficient of variation is defined as the standard deviation of a series divided by the mean.

Table 3 Major wheat exporters, annual growth rates, 1999/2001–2009/2011

Region	Area harvested	Yield	Production	Exports	Consumption
Argentina	−4.62	2.23	−2.33	−4.02	−1.79
USA	−0.81	0.69	−0.07	0.35	−1.03
Canada	−1.82	2.23	0.19	0.10	0.34
EU-27	−0.05	0.78	0.81	8.17	0.59
Australia	1.44	−0.34	1.07	1.56	1.46
World	0.44	0.94	1.47	3.17	1.86
Ukraine	1.44	1.23	2.40	9.38	0.49
Russia	1.93	1.64	3.56	22.95	0.86
Kazakhstan	3.75	0.29	4.16	5.86	2.45

Source: OECD/FAO Agricultural Outlook, 2013–2022 database

3 Low-Input Applications as an Explanation for Production Volatility

Year-to-year yield (and grain-quality) fluctuations in rain-fed crops are mostly a function of weather-related phenomena: rainfall amount and distribution throughout the year, temperature distribution and resulting evapotranspiration, and length of growing season—all these factors play a role in annual yields. Winter wheat has the added issue of requiring sufficient snow cover over the winter period to avoid damage. One way to solve much of this problem is irrigation, but this is not, and never will be, practical for most rain-fed cropland. Intuitively, zero-tillage systems should decrease the year-to-year yield variability given that the soil is not disturbed, thereby conserving moisture.

Year-to-year input use may also contribute to yield stability, just as it raises the level of yields. Table 4 shows fertiliser applications for wheat for a number of exporters. Russia and Ukraine apply less fertiliser per hectare than the traditional exporters. This is reflected in the level of their yields, but also may contribute to yield variability. In fact, comparing the leading exporters of wheat in the world, there is a distinct negative correlation between the variability of yields and their level (−0.68). In other words, the higher the yield, the less variable are yields from year to year. Correspondingly, the lower are the yields, the higher the variability of yields (Table 5).

Table 4 Mineral fertiliser applications and yield for wheat (kg/ha), 2000

Region	Fertiliser application	Yield
USA (1998)	110	2.82
Austria (1999/2000)	168	4.47
Argentina (2002/2003)	66	2.49
Canada (2000)	82	2.44
Germany (1999/2000)	235	7.28
France (1999/2000)	230	7.12
Kazakhstan (2000/2001)	1–2	0.9
Ukraine (2000)	24	1.98
Russia (2000)[a]	20	1.61

[a]Grains and pulses without maize
Sources: FAO-FERTISTAT (2014); Federal state statistics service (Russian Federation) (2009, 2011, 2013); State statistics service of Ukraine (2010, 2012, 2013, 2014); Reynolds *et al.* (2008)

Table 5 Wheat yields in leading wheat exporters: coefficient of variation and yield level, 2000–2012

Region	Coefficient of variation of yield	Actual yield (kg/ha, annual average)
Australia	26.2	1.65
Canada	15.0	2.54
EU-27	6.7	5.14
USA	7.3	2.85
Kazakhstan	23.8	1.04
Russia	13.9	1.92
Ukraine	22.4	2.71
Argentina	16.3	2.58

Source: FAO-FAOSTAT (2014)

4 Increasing Winter-Wheat Cultivation in Russia as an Explanation for Production Volatility

One final factor influencing the volatility of wheat yields is the difference between spring and winter wheat. Spring wheat is planted in the spring and harvested in the autumn, whereas winter wheat is planted in the autumn, undergoes a period of vernalisation (a period of 30–60 days of cold weather from 0 °C to 5 °C) during the winter months, and then begins to grow in the spring to be harvested in the autumn. Although spring wheat has lower yields, they tend to be less volatile than winter wheat. Winter wheat has higher yields, but, because of vernalisation, is more affected by the environment, and therefore has more variable yields.

About 95 % of wheat in Kazakhstan is spring wheat and the same proportion is winter wheat in Ukraine. Thus, in these two countries any increase in yield

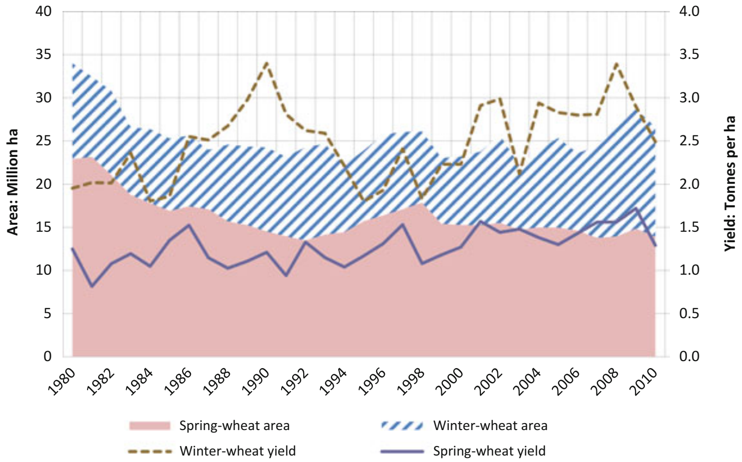

Fig. 5 Russia: spring- and winter-wheat area and yield, 1980–2010. Sources: CISSTAT (2010); Federal State Statistics Service (2009, 2011, 2013)

volatility could not be attributed to the increased area under winter wheat. However, Russia has been undergoing a rapid transition from spring- to winter-wheat production since 1998 (Fig. 5). In 1998 only 32 % of total land sown with wheat had winter wheat, but by 2010 that proportion had increased to 48 %. Figure 5 indicates that spring-wheat yields are less variable than winter-wheat yields. In fact, from 2000 to 2010, the coefficient of variation for spring-wheat yields was 9.7, while for winter wheat it was 13.0.

5 Export Volatility in Russia, Ukraine and Kazakhstan

Table 2 indicates that exports were more volatile in RUK than in other major exporters during 2000–2012. Russia and Ukraine had the most volatile exports, with coefficients of variation of 71 and 62, compared with 13 in the United States, 17 in Canada and 28 in the EU-27. Production variability itself is a reason for export volatility, since in all countries domestic consumption is quite regular, and the difference between production and consumption is net exports. With the greater production variability of RUK, then, inevitably comes added volatility of exports. In addition, greater production variability would seem to offer more opportunities for political intervention in the name of protecting consumers from rising prices.

5.1 Political Export Restraints

The elevated fluctuations of yields in RUK are caused by weather variation and other agronomic factors. Thus, they seem to be more of the nature of risk, which has an understandable scientific basis, and can be controlled by higher input applications and better agronomic practices, including wider use of low-till agriculture. Political border interventions aimed at limiting grain exports are of a different nature, since they are highly unpredictable. Table 6 illustrates that during the crop years 2006/2007 to 2011/2012 RUK were plagued by a number of non-tariff barriers to grain trade. It is this policy volatility that increased the coefficient of variation of exports well above that of production. Such policy volatility can increase the volatility of world prices through the mechanisms noted in the literature on the connection between export restraints and price volatility (Brown et al. 2008; Dollive 2008; Welton 2011; Headey 2011; Sharma 2011).

It should be noted that Kazakhstan seemed less prone than Ukraine and Russia to political interventions aimed at limiting grain exports, since the Kazakh government did not impose restrictions on grain exports in 2010, despite pressure from the Russian government (Oshakbaev 2012).

5.2 Politicised State Intervention in Grain Markets

Political border interventions are part of a wider politicisation of grain and particularly wheat markets that can be observed in RUK in the 2000s. Grain, and particularly wheat, markets have long been politicised in Russia and Ukraine. Regional authorities restricted the movement of grain, and state parastatal organisations supplied inputs and procured wheat in the 1990s (Serova 2000; Brümmer and Zorya 2005; Chapko and Sedik 1998). However, grain-export restrictions with implications for world markets started only when the CIS exporters became global grain exporters in the 2000s. Essentially, only then did domestic political interventions in RUK become an issue for global grain markets.

An example of the politicisation of grain markets is that, in all three countries, state grain interventions and state grain intervention/trading/export agencies appeared in the 2000s and have quickly become the largest purchasers and holders of grain in the countries. In Russia, state grain interventions began in 2001 with the intent of stabilising prices on food markets by purchasing grain when harvests were large and selling grain when harvests were low. In practice, most of the interventions were grain purchases, because Russia consistently produced more grain than was necessary for domestic consumption. Export opportunities were limited by export infrastructure, particularly the bottleneck at the Novorossiysk port, which allowed a maximum shipment of 2–2.5 million tonnes per month (Azarieva 2014). During the 2008/2009 marketing year, the state purchased 9.6 million tonnes of grain, accounting for 9 % of the total harvest, in an effort to support domestic grain

Table 6 Grain-export limitations in Ukraine, Russia and Kazakhstan, 2006/2007–2011/2012 MY

Date	Ukraine	Russia	Kazakhstan
2006/2007 MY			
September 2006	28 September, licensing of export and import of wheat and meslin introduced		
October 2006	17 October, grain-export quota regime introduced (1.6 million tonnes including 400 000 tonnes of wheat) until 31 December		
November 2006			
December 2006			
January 2007	8 December 2006, new export quotas introduced for 1 January 2007 to 30 June 2007 (3 000 tonnes of wheat, 600 000 tonnes of barley, 500 000 tonnes of maize, 3 000 tonnes of rye). Quota regime cancelled for wheat in June 2007		
February 2007			
March 2007			
April 2007			
May 2007			
June 2007			
2007/08 MY			
July 2007	Monthly wheat export quotas of 3 000 tonnes introduced until 31 December. Followed by ban on wheat exports. Lifted in May 2008		
August 2007			
September 2007			
October 2007		Seasonal export taxes on wheat and barley (barley tax imposed from 12 November). The export tax on wheat was set at a rate of 10 % ad valorem but not lower than EUR 22/million tonnes. The barley duty was set at 30 % but not lower than EUR 70/million tonnes. The restriction lasted 9 months until 1 July 2008. 1 January 2008, Russia raised milling wheat export duty to 40 % (but at least EUR 105/million tonnes). The prohibitive duty was cancelled on 1 July 2008. 18 February 2008, ban on	
November 2007			
December 2007			
January 2008	New export quotas introduced for wheat, barley, maize, rye. For maize abolished 1 April, replaced by licensing until 1 July. 1 April, grain-export quotas imposed in July 2007, extended until 1 July 2008		
February 2008			Wheat export limits (5.8 million tonnes)
March 2008			1 March, agreements with traders on quantities of grain to be exported. Announcement that Kazakhstan will not limit exports of wheat
April 2008			15 April, export ban on wheat until 1 September
May 2008			
June 2008			

(continued)

Table 6 (continued)

Date	Ukraine	Russia	Kazakhstan
		wheat exports to Belarus and Kazakhstan, until 30 April	
2008/09 MY			
July 2008			Export ban on wheat until September
August 2008			
September 2008			
October 2008			
November 2008			
December 2008			
January 2009			
February 2009			
March 2009			
April 2009			
May 2009			
June 2009			
2009/10 MY			
July 2009			
August 2009			
September 2009			
October 2009			
November 2009			
December 2009			
January 2010	1 January, measures on grain market stabilisation approved, setting the maximum profitability rate at 20 % for enterprises that are engaged in receiving, handling, storage and shipment of grains. Resolution validity is from January to December 2010		30 January, requirements to qualify grain exporters and the licence-obtaining process simplified (licences introduced in 2007/2008 season)

(continued)

Table 6 (continued)

Date	Ukraine	Russia	Kazakhstan
February 2010			
March 2010			
April 2010			
May 2010	1 May, quota restrictions on grain exports, imposed in July 2007, cancelled		
June 2010			
2010/2011 MY			
July 2010			
August 2010		15 August, ban on wheat and flour exports. Wheat flour exports allowed from 1 January 2011; ban on wheat exports lifted on 1 July 2011	
September 2010			
October 2010	19 October, imposition of export quotas until 31 December 2010: 500 000 tonnes for wheat, 200 000 for barley and 3 million tonnes for maize. 17 December, 28 December, Export quotas for grain imposed in October 2010 are extended until 30 June 2011		20 October, export ban on buckwheat, buck-wheat cereal prepara-tions, soybeans, sunflower seeds, cotton seeds, some vegetable oils and animal fats. Ends 20 April 2011
November 2010			
December 2010			
January 2011			
February 2011	1 February 2011, all export contracts for wheat, maize, barley, soybeans, sunflower seeds and oil, rapeseeds and others crops must be registered at the state-designated exchange to be concluded		
March 2011	30 March, maize export quota for marketing year July 2010 to June 2011 increased from 3 million tonnes to 5 million tonnes		1 March, customs union (Kazakhstan, Russia and Belarus) suspended the 5 % import duty for wheat, rye and oats, until 30 June
April 2011			
May 2011	4 May, announcement of abolishment of grain-export quotas. Announcement of export duties of 9 % for wheat, effective from June to December 2011		
June 2011			

(continued)

Table 6 (continued)

Date	Ukraine	Russia	Kazakhstan
2011/2012 MY			
July 2011	1 June, elimination of value added tax (20 %) refund for grain exporters from 1 July. Grain-export quota system abolished and replaced by export taxes set at 9 % for wheat (but not less than EUR 17/tonne), 14 % for barley (but not less than EUR 23/tonne) and 12 % for maize (but not less than EUR 20/tonne). The duties effective from 1 June 2010 to 1 January 2012		
August 2011			
September 2011			
October 2011			
November 2011			
December 2011			
January 2012			
February 2012			
March 2012			
April 2012			
May 2012			
June 2012			

Sources: FAO (2014); Sharma (2011); World Bank (2008); Kim (2010)

prices. This included 7.5 million tonnes of wheat, which is 11.8 % of the wheat harvest or 23.6 % of marketed wheat (Evdokimova 2011). At the end of the 2009/2010 marketing year nearly half of all grain stocks in Russia were in the state grain-intervention fund (Azarieva 2014).

In 2009 the Russian government considerably expanded its role in the grain sector by establishing the state-owned United Grain Company (UGC). The UGC was formed by revamping the Agency for Food Market Regulation, the government organisation responsible for grain interventions and ensuring the safety of the state grain fund. The UGC expanded the mandate of the organisation to include the reconstruction and modernisation of grain infrastructure and grain export. It did this by acquiring storage elevators, flour mills, cereal companies, port facilities, and storage and trans-shipment facilities. The accumulated general storage facilities and trans-shipment grain facilities for export made the UGC the company with the largest infrastructure and export facilities on the Russian market (Azarieva 2014). In 2010 the Russian government reformed grain rail transport by creating one large monopoly grain-transport company, Rusagrotrans, which owned nearly all grain railway carriages in the country (Azarieva 2014).

In sum, the Russian state now controls much of the grain storage, transport and export facilities, as well as rail-transport prices and grain-storage prices (through its large role as a purchaser of grain-storage services in private elevators). It has taken an active role in both investing in and attracting private investment for export facilities, as well as infrastructure for grain transport.

In Kazakhstan the State Food Contract Corporation was created in 1995, and was subsequently reorganised in 1997 into a state-owned entity. The purpose of the Corporation was originally to purchase and store the state reserve. However, the mandate of the organisation grew, and the Corporation buys and sells, stores, finances, invests in and exports grain. In 2012 the Corporation was the largest holder of grain in Kazakhstan. Besides the state reserve, the Corporation finances the production of grain, sells it on domestic markets and exports it. In 2009 the Corporation became the largest grain trader in Kazakhstan, buying up 30 % of the wheat harvest. The Corporation is not well liked by farmers in Kazakhstan, primarily because since 2010 each farm with a sown area over 500 ha is obliged to sell 20 % of its harvest to it. Since the Corporation has a so-called counter-cyclical price policy, in 2010 it purchased wheat at lower than market prices (Oshakbaev 2012: 52–53).

In Ukraine the architecture of state involvement in the grain sector is even more complex than in the other two countries; it has a preponderance of state institutions with seemingly overlapping mandates. In 1996 the state joint-stock company Khlib Ukrainy was formed as the successor to the State Central Administration Board for Grain Products and the Central Administration Board for the Mixed Fodder Industry. Khlib Ukrainy was essentially a vast conglomerate of flour mills, storage elevators, grain transport companies and other grain-related infrastructure. The purpose of the conglomerate was to ensure a vehicle to enact state policy in the sector. Until 2005 Khlib Ukrainy was active in purchasing grain for the state, as well as in providing producers and commercial companies with services related to processing, storage, transport and production of grain products for farms and the retail sector. In August 2010 the government of Ukraine established the State Food and Grain Corporation as a successor organization to Khlib Ukrainy, transferring to it the main assets of the latter, such as elevators, mills, grain export and transport facilities. In addition to production, financial, storage, processing, transport and other services, the State Food and Grain Corporation is one of the five largest grain traders in Ukraine, and received a fifth of grain export quotas in 2010/2011 (Kobuta et al. 2012).

The state budget organisation the Agrarian Fund was established in 2005 with the mandate to implement government price regulation in the grain sector and to carry out state interventions on grain markets. However, the tasks assigned to the Agrarian Fund grew over time, extending to forward purchases of grain, grain financing, buying and selling of grain and flour, sugar intervention purchases, and sales of diesel fuel and fertiliser. FAO figures on market price support for wheat during 2005–2010 show that Ukrainian domestic wheat prices were consistently below world prices, meaning that efforts by the government to support wheat prices through the Agrarian Fund seem to have been rather ineffective. Moreover, while the agency was intended to exert control over retail prices for bread and bread products, it was not able to carry out this function either (Kobuta *et al*. 2012).

A third state-owned operator on grain markets is the State Reserve Agency, charged with purchasing food, including grains, for the state reserve. This mandate overlaps with that of the Agrarian Fund, with the result that uncoordinated actions by the two agencies tend to undermine efforts by the Agrarian Fund to establish minimum prices for grain.

To summarise, the state in RUK has taken a larger and larger role in grain markets through controlling ownership in the 'commanding heights' of the grain sector and an ever-expanding mandate for 'stabilising' markets through buying, selling, transporting, exporting, storing, processing and producing grain products. However, the consistent, stabilising effects of these interventions are difficult to discern. Rather, the ever-growing role of the state in these markets adds a degree of uncertainty that seems to have far from a stabilising effect.

5.3 The New Protectionism

In 2008, in the wake of a surge of protectionism in the world, G20 leaders publicly committed themselves to creating no new distortions to global commerce. However, citing data from the Global Trade Alert website (www.globaltradealert.org), which chronicles protectionist trade measures by national governments, Evenett (2013) showed that, rather than diminishing, the G20's resort to protectionism has picked up over time; total protectionist measures in 2012 registered a 23 % increase over 2009. Many of these were of the 'murky' variety, such as preferential treatment, loan forgiveness and bailouts. The increase in beggar-thy-neighbour protectionism is not limited to the G20. The same may be said for the governments of the ten next-largest trading nations (as measured by the sum of their total value of annual imports and exports).

The EU-27, Germany, Italy, China, Russia and Kazakhstan have been some of the leading figures in this increased protectionism. Among individual countries, Russia led the list by the number of discriminatory protectionist measures imposed between November 2008 and November 2012. Interestingly, Ukraine did not make the top 10 lists of protectionist countries measured by any of the ranking criteria in Table 7.

The rapid increase in the role of the government in grain markets in RUK, as well as the grain-export restraints, can be understood as a part of this rising wave of protectionism that began in 2007/2008 and has continued since that time. It is symptomatic of this affinity that the leading sector by number of discriminatory measures affecting commercial interests since November 2008 has been agricultural products, horticulture and market gardening (Evenett 2013).

Table 7 Which countries have inflicted the most harm through protectionist measures since November 2008?

Rank	Ranked by: Number of discriminatory measures imposed	Number of tariff lines affected	Number of sectors affected	Number of trading partners affected
1	EU-27 (382)	Vietnam (943)	EU-27 (78)	EU-27 (201)
2	Russia (247)	Venezuela (807)	Italy (78)	Italy (194)
3	Argentina (198)	Kazakhstan (738)	Argentina (73)	China (193)
4	India (124)	China (710)	Germany (66)	India (172)
5	Belarus (120)	EU-27 (681)	Algeria (58)	Indonesia (170)
6	Germany (107)	Nigeria (603)	Russia (56)	Netherlands (164) UK (164)
7	UK (105)	Indonesia (558)	China (52)	
8	Italy (101)	India (551)	Kazakhstan (50)	Germany (160)
9	France (98)	Argentina (503)	US (47)	France (159) Poland (159)
10	Brazil (92)	Algeria (485)	Belarus (45)	

Source: Evenett (2013: Table 2.6)

6 Conclusions

The purpose of this chapter has been to explore volatility in the wheat-producing CIS countries in an effort to gauge their past and potential future role in supporting price volatility. We explored two possible sources of price volatility: production and export volatility. It was found that the coefficient of variation for production and export in 2000–2012 was higher in RUK than in other, more traditional, exporters. While production variability can be partly explained by its rapid increase, by low input applications and by a rapid change from less to more volatile yield varieties, the political export restraints seem to be part of a larger politicisation of grain and particularly wheat markets in RUK and of a rising wave of protectionism.

The high fluctuations of yields in RUK are caused by weather variation and other agronomic factors. Thus, they seem to be more of the nature of risk, which has an understandable scientific basis and can be controlled by higher input applications and better agronomic practices, including wider use of low-till agriculture. Political border interventions aimed at limiting grain exports are of a different nature, since they are highly unpredictable. In this respect they are akin to the increased state measures aimed at 'stabilising' and exerting state control over grain markets observed in RUK since 2001. Grain export limits may also be understood as part of a new wave of protectionism that can be observed on world markets since 2007/2008. Taken together, these policies do not bode well for the stability of grain prices in the future.

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Part III
The Future of Grain Production and Export

Unlocking Ukraine's Production Potential

Michiel A. Keyzer, Max D. Merbis, Alex N. Halsema, Valeriy Heyets, Olena Borodina, and Ihor Prokopa

1 Introduction

This chapter considers the specifics of the agricultural sector in Ukraine as it emerged from the decollectivisation process after independence, a process that resulted in a dualised agrarian economy consisting of large corporate farms and private family farms, many of which largely produce for subsistence. It describes the present conditions in rural Ukraine, and, from this perspective of a dual structure, reviews constraints that inhibit its sustainable development both in general and more specifically in terms of unlocking the potential for wheat production and exports.[1]

The chapter is organised as follows. Section 2 deals with the wheat sector in Ukraine. Its farm structure and dualised nature are covered in Section 3. Section 4 focuses on some of the structural, technical and political factors that impede the

[1]The chapter draws on an earlier study (Keyzer et al. 2013) that for the first time could capitalise on an extensive set of household and farm surveys collected by Ukrainian statistical agencies (see also Acs et al. 2013). The authors of the present chapter acknowledge the efforts of their colleagues in the research team at the Institute for Economics and Forecasting in Kiev who conducted most of the background work for this study. They also thank the JRC that commissioned the study, in particular Jacques Delincé and Sergio Gomez-y-Paloma. An earlier draft of this chapter was presented by Michiel Keyzer at the JRC workshop 'The Eurasian wheat belt: future perspectives on regional and international food security', Istanbul, Turkey, 20–22 May 2014. Comments by participants are gratefully acknowledged.

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unlocking of Ukraine's farming potential, including the dualised nature of the rural economy, nutrient imbalances, limited access to foreign trade and the wider political context, in particular as regards dualisation and relations with Russia and the European Union (EU).

2 Wheat in Ukraine

Cereals are traditionally a dominant crop in the Ukrainian countryside. The cereals area declined in the late 1980s but rose to a relatively stable level of about 15–16 million ha, which has been maintained to the present, as a consequence of state support. Almost half of the cereals area is wheat and almost half is barley and maize, as shown in Fig. 1. The remainder includes rye, oats, millet, buckwheat and rice.

Wheat production takes place in all regions (Fig. 2), although it is concentrated in the Central Black Soil Region, where very fertile soils and favourable agro-climatic conditions are found, and the south-east regions, where soils are also fertile but where the agro-climatic conditions are less favourable and very variable.

Cereal yields are, however, low compared with EU levels: wheat and barley yields are about 60 % of the EU-27 level, but maize, with its record yield recorded in 2011, falls only 15 % below the EU level (see Fig. 3). This yield gap suggests that there is ample room for improvement of current yields.

Ukraine has made good progress in this regard. Wheat yield in Ukraine had by 2013 risen to 70 % above its level in 2000, whereas the EU-27 Member States achieved only a 10 % increase during that period.

Output variability is also an issue. Given that almost all of Ukraine's wheat is winter wheat, it is highly vulnerable to frost and snow mould in the northern half of the country, whereas the southern regions suffer from droughts owing to the lack of an adequate irrigation infrastructure. Consequently, climatic variation results in large output swings, often around 20–30 % from one year to the next, and under extreme weather conditions such as were seen in 2003, in a decrease of up to 80 %.

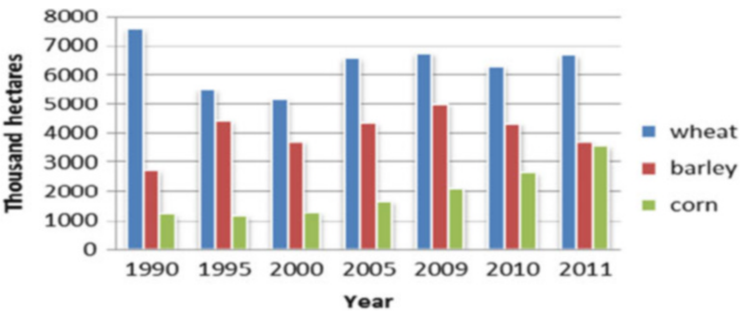


Fig. 1 Cereals area in Ukraine, 1990–2013

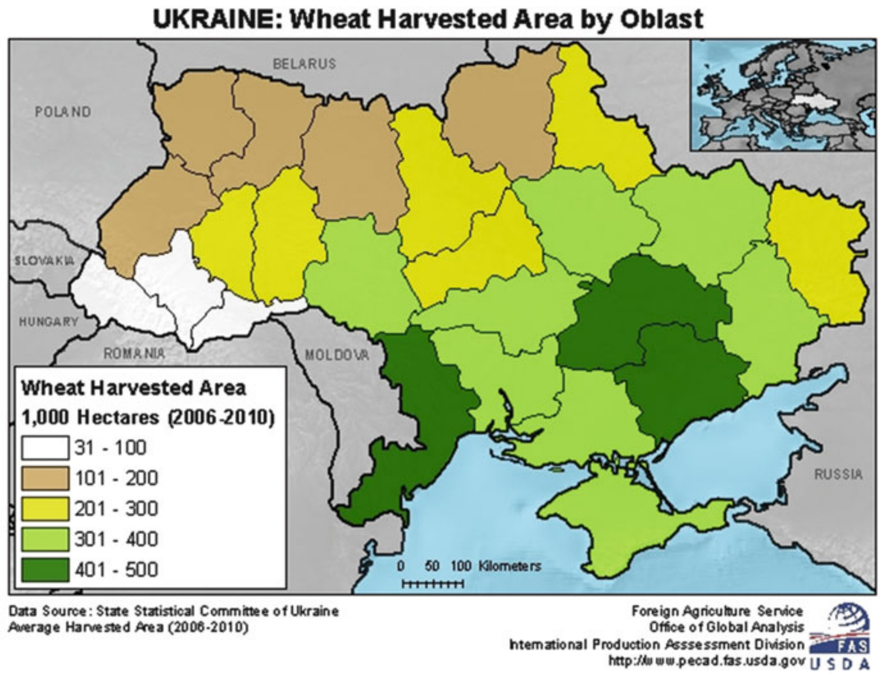


Fig. 2 Wheat harvested area in Ukraine

The untapped potential to raise and to stabilise cereal output is, therefore, significant. The global Agro-Ecological Zones study conducted by The International Institute for Applied Systems Analysis and The Food and Agriculture Organization of the United Nations (IIASA-FAO) estimates that this potential is currently realised for 40 % of the country only. Figure 4 shows the difference between the actual and potential yield given the current soil and agro-climatic conditions, but with significant investments in modern irrigation technologies, which also need to anticipate expected climate change. Average annual temperature has been increasing significantly in the south-eastern region of Ukraine and if this trend continues, cereal cultivation will shift from the central and south-east regions to the north-west. Climatic conditions will change in the north-west regions as well, probably for the worse. Consequently, strong winds, as well as rains and floods, are expected to affect soil fertility and to reduce crop yields.

A small part of Ukraine's production potential has been realised already, as cereal exports have risen significantly since 2000 (see Fig. 5). This is in part attributable to policy reforms that eased exports, but also to structural changes in agriculture such as a decrease of the area under forage crops and industrial crops (sugar beet, flax, hops) and contraction of the cattle sector, which halved in the 10-year period following independence. About 25 % of total agricultural exports now consist of wheat, the trade categories of animal and vegetable oils (primarily

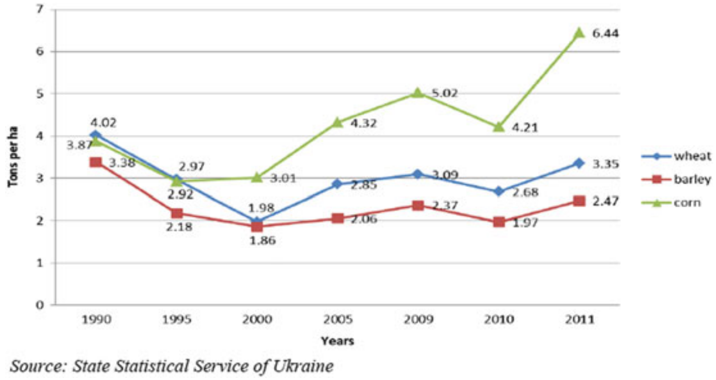
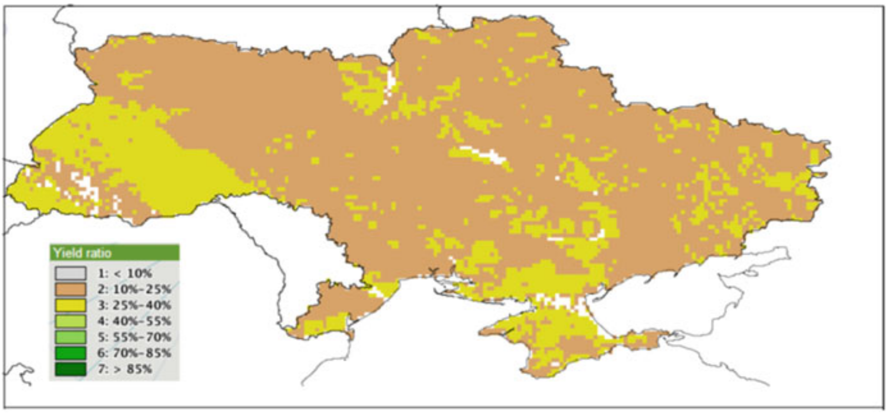


Fig. 3 Cereal yields in Ukraine, 1990–2011



Source: GAEZ v3.0., IIASA & FAO 2010 http://www.gaez.iiasa.ac.at

Fig. 4 Ratio of actual and potential wheat yield in Ukraine

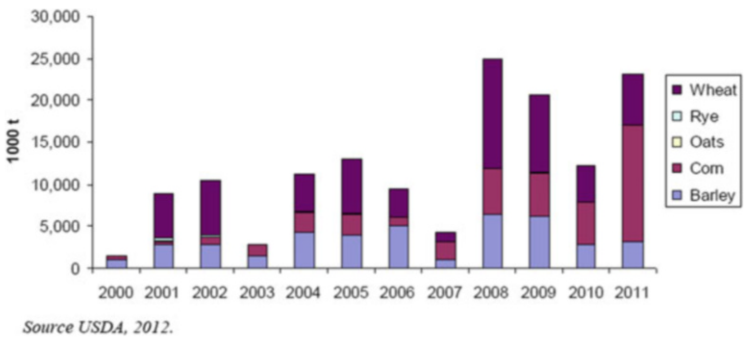


Fig. 5 Total grain export of Ukraine by crop type (000 tonnes)

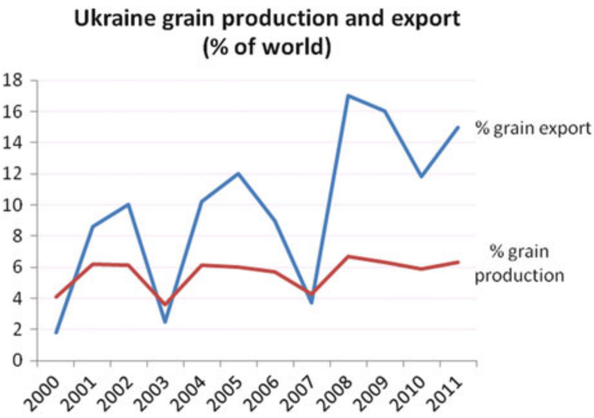


Fig. 6 Ukraine grain production and export, 2000–2011

sunflower oil) comprise 26 %, oilseeds and fruits (primarily rapeseed) make up 11 %, and dairy products account for 6.5 %.

Ukraine has become a major player in the world wheat trade, although its produce mostly consists of low-quality grain for use as feed and in biofuel production. Weather-induced volatility in output levels is reflected in export figures (see Fig. 6), whose fluctuations are amplified further by occasional export bans and a far from transparent export licensing system. Under average weather conditions, the export potential of Ukraine is seen to be significant in the near future, because with modest purchasing power in the domestic market, all rises in output can directly be used for exports. Projections with the Aglink model (OECD-FAO 2014) indicate that Ukraine's share in world wheat markets could rise to 20 % in the next decade, based on a small expansion of area and a continued yield increase of another 30 %.

3 Farm Structure

In Soviet times and shortly after independence in 1991, collective and state farms operated both as corporations and as communal public services. As corporations, they were engaged in crop and livestock production, as well as in numerous support activities, ranging from agricultural processing to industrial production and a wide range of public services in health care, education and entertainment.

The abrupt ending of such corporations after 2000 greatly affected rural areas. Collective agricultural enterprises were officially relieved of their obligation to provide social and community services, and agriculture started attracting industrial, banking and foreign capital and collective farms were transformed into corporations. A dramatic drop in the provision of social services and a loss of guaranteed employment were major consequences of this transformation. Mortality among the elderly increased significantly and as the young left the rural areas for the cities, the already existing demographic imbalance worsened further.

After privatisation and land reform, corporate farms set up land banks that leased private land plots from their new owners. The private land plots that were not rented out were used by rural households as expansions of the already existing household plots. Hence, the present situation is best characterised as a dual system comprising farming households and corporate enterprises.

Of the farming households, peasant farms comprise the smallest number. Their number rose from 35,000 farms in 2000 to 42,000 in 2010, before declining to 40,700 in 2013. Most of them cultivate less than 100 ha. They cover about 20 % of the agricultural land used by farming households. Some households operate large farms (more than 2000 ha) with approximately the same share and extra-large farms (more than 4000 ha), with about 8 % of agricultural land used by farming households. In total, they cultivate 11 % of the entire agricultural area (4.4 million ha) and produce 5 % of the total agricultural production value.

Approximately 20 % of all farming households (1 million) are fully commercial units, oriented on local markets; 40 % of farming households produce both for markets and self-consumption; the rest produce for self-consumption only. The number of plots has dropped from 5 million in 2005 to 4.2 million in 2013; most plots are very small (78 % of households have plots up to 1 ha, 18.5 % have plots up to 5 ha, 2 % have plots up to 10 ha and 1.3 % have plots of 10 ha and more). Units with land plots over 10 ha cover 30 % of all agricultural land used by farming households.

As regards corporate enterprises engaged in agriculture, the shift in ownership is the most remarkable feature. Many enterprises are now owned by a single individual, and were transformed into large holdings by consolidation. Their owners took hold of much of the equipment from the collective farms and gained access to finance, both from within Ukraine and from abroad. This largely happened in an opaque manner, on an informal land market, whereby lease, lease-to-purchase and purchase agreements led to the consolidation of large stretches of farmland by vertically integrated legal entities and natural persons.

At present, over 90 % of corporate farms lease land from private owners, and, in total, 80 % of all arable land is leased (Keyzer et al. 2013: pp. 45–52). Hence, such corporations now cultivate hundred of thousands of hectares, largely for exports. Their access to a wide array of financing vehicles has enabled them to initiate diversified activities along the full product chain, from input supply and basic crop production to agricultural processing and exports.

Despite their mechanised harvesting and ample use of chemical inputs and hired labour, yields of corporate farms remain low by international standards, although they are slightly higher than those of the peasant farms (2.76 t/ha versus 2.19 t/ha, respectively, in 2010), and their unit costs per kg of wheat are slightly higher: UAH 99.60 versus UAH 88.31 per 100 kg, respectively. The relatively low yields and low domestic prices result in gross revenues per hectare of approximately EUR 340 per hectare, compared with a gross revenue of EUR 1500 per hectare in France, which is the top wheat-producing country in the EU, and an average revenue of EUR 1150 per hectare for the EU-27.

In the period 2000–2010, the total number of corporate farms stabilised at around 15,000, but, among them, the number of business partnerships and private enterprises increased from 9,000 to 12,000, at the expense of cooperatives and state enterprises (Keyzer et al. 2013). Since 2010, farm takeover is the main trend in corporate Ukrainian agriculture. Vertically integrated agro-industrial units (agro-holdings) control many other agricultural enterprises, which are independent in name only. By 2013, the estimated number of agribusiness corporations was about 140. They control more than 6000 (40 %) other agricultural enterprises, amounting to 7.8 million ha in total (38 % of all agricultural land used by agricultural enterprises), with hundred of thousands of hectares each. Combined, these agro-holdings produce and sell about half of all wheat produced in Ukraine, more than half of maize and rapeseed, one-third of sunflower seeds, three-quarters of sugar beet, and over 80 % of poultry. They also benefit from their domestic monopoly position in supplying for exports and from special tax privileges. Unfortunately, the revenue earned by them is not spent in rural areas, depriving these of the urgently needed investments in social services, environmental conservation and employment creation.

4 Unlocking Ukraine's Farming Potential

As of winter 2015, given the present tensions in the country, few will immediately associate Ukraine with its great farming potential. However, this potential is there, waiting to be unlocked, in principle for the benefit of all.

Several factors currently impede its realisation, some of which are structural, others technical, and yet others political. These factors can be grouped into four broad categories: (1) the dualised agrarian economy; (2) nutrient imbalances; (3) limited access to foreign trade; and (4) the political context, in particular the relations with Russia and the EU.

4.1 Dualised Agrarian Economy

Since decollectivisation, the dualisation between very large commercial farms and small individual farms has divided rural areas of Ukraine. After independence, Ukraine placed a great deal of emphasis on maintaining strict rules for safeguarding access to land and land use, introducing the so-called Land Moratorium ('Zemelnyi codex'), which gradually led to further legislation that enabled rural and urban households to continue cultivating their own household plots of up to 2 ha for subsistence purposes, as in pre-reform times, but also to sell them. Furthermore, land that had previously been cultivated by the state and collective farms was split and distributed among the eligible population, mostly workers from the collective farms but also employees of the social service sector who lived and worked within the rural council in which the farms were located. The average land size thus given to a single individual was about 3–5 ha, far less than the maximum of 100 ha that any individual may own. The eligible individuals received a 'certificate' stating their personal details and the size of land owned, and a lease market thus emerged. However, as the actual location of the land was unspecified, no one could cultivate plots individually, leaving recipients with no other choice but to lease collectively to the larger holdings operating the full parcel of land.

In response, reforms that favoured further privatisation supported, at great cost, the setting up of a cadastre to locate the individual plots. This, however, neglected other impediments, such as the lack of access to these properties, which were often located somewhere in the middle of a large parcel of land, and were, consequently, not accessible by any road or without any formal right of passage across adjacent plots. It is no surprise, therefore, that most plot owners still lease their plots to large farms for minimal compensation, given that these tenants know the law better and also enjoy monopsony. Hence, almost all of rented land is currently from private households on terms laid down in certificates and acts.

Summing up, the arrangements for land distribution and the Land Moratorium have prevented the fragmentation of holdings into small parcels, and, in principle, the concentration of ownership of former state and collective farms in the hands of few. Lifting the Moratorium could, therefore, have dramatic consequences. First, it could result in the fragmentation of fields into plots that are hardly accessible, with all ensuing conflicts within local communities. Second, moving into the opposite direction, it could result in the concentration by fair as well as unfair means of all property rights by agro-holdings and other large players on the land market.

Rather than simply lifting the Moratorium, dedicated rulings that involve the distribution of land ownership rights are needed: cadastral registration needs to be supplemented by the introduction and registration of other formal titles such as the right of passage and the user rights of commons. This would treat the owners of such plots as shareholders of the full parcel or field or the farm. Shareholders of a large farm do not need to know the precise location of their property within the farm. Explicit cadastral registration of parcels into units smaller than the individual field is wasteful and should be avoided.

Background studies cited in Keyzer et al. (2013: pp. 39–44) also found that land rent is often predominantly paid in kind, if paid at all. This conflicts with official policy that requires land users to pay all due rent to landowners, be they private (e.g. pensioners) or public (e.g. municipalities). Abiding by the rules would strengthen social safety nets, stimulate activities in rural villages and improve the fiscal revenue of local governments.

Furthermore, there is a need to analyse the dual structures using all available agricultural data, including surveys, maps and census data for Ukraine, in accordance with transparent protocols, and to document the sampling frames for each of them, so as to build trust and credibility for the resulting outcomes and for the studies derived from these. This has been championed already (Keyzer et al. 2013), but now seem more topical than ever. An independent and recognisable unit could on a regular basis provide an update of the main developments affecting the country, initially focusing on agriculture and food security, while paying all due attention to the differences in living conditions and perceived concerns across the nation. Once in full operation, this unit could expand to offer a window for answering specified queries on a larger set of issues, as formulated by a select group of organisations from government, civil society and abroad.

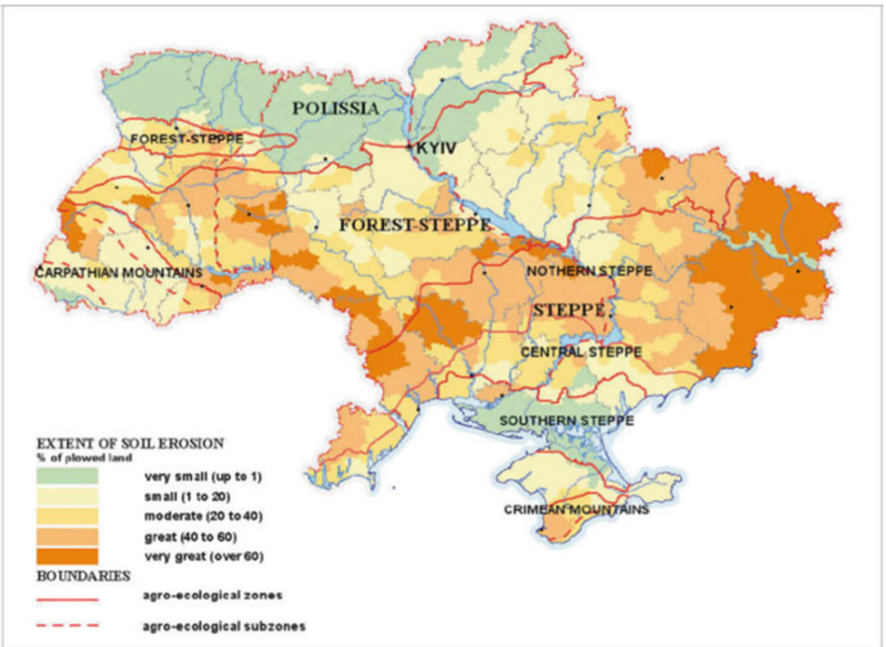
Such an observatory would also be helpful for the timely signalling of new developments that are otherwise noticed too late. A case in point is the monitoring of the position of the agro-holdings which has changed significantly since the Maidan Revolution (February 2014). Political elites have previously argued that these companies are less vulnerable and more effective than smaller ones in view of their economies of scale and scope, at a time at which agricultural prices were rising on world markets. This has led to the assertion that agro-holdings make it possible for Ukraine to become a key player in agricultural markets but also that they will contribute to solving the world hunger problem. However, since the Maidan Revolution, tables seem to have turned significantly, as the difficult political and economic situation has greatly affected the agro-sector and reduced its attractiveness for investment, particularly from abroad. According to the Agrisurvey agency, capitalisation of 15 Ukrainian agrarian companies decreased by more than USD 300 million in 2014. The number of agro-holdings with high risk of bankruptcy is increasing gradually. This dangerous trend may continue, owing to the overconcentration in agriculture, significant rise in costs and difficulties in financing. The causes are many and reach beyond the financial terms of the ventures to include unprofessional management, devaluation of the national currency and galloping inflation. After Maidan, owners of large agro-holdings have only strengthened their influence and representation in government and parliament, enabling them to lobby actively for financial support, tax exemptions and other privileges; however, this increased influence may be insufficient to compensate for the drop in international food prices that were predicted for 2015.

At the same time, the need for public investment to improve living conditions in rural areas is becoming all the more pressing, as growth in urban employment has been stagnating in recent years. Rather than financial support, which the state would hardly be able to provide at present, rural areas would benefit from an enabling legislation that is also effectively implemented to unlock the potential in horticulture, animal husbandry and agricultural processing, as well as from an expansion of household farms, possibly as small multi-household enterprises or cooperatives, on land returned from commercial farms. Rural farm households would also gain much from access to larger plots and access to mechanisation, financial resources and possibilities to renew human capital. This will increase their productivity, functional and organisational capacity and improve the safety and quality of their agricultural products.

4.2 Nutrient Imbalances

Nutrient imbalances have caused soil degradation across large parts of the country (Fig. 7). According to the National Report on Environment, soil erosion affected 57 % of the arable land in Ukraine, of which some 32 % was caused by wind erosion, 22 % by water erosion and 3 % by a combination of both. The loss of organic matter in soils as a result of the excessive removal of crop residues from the fields is in the range of 0.6–1.0 ton/hectare annually.

Ukraine will need significant volumes of plant nutrients to improve and to maintain its crop yields. The supply of nitrogen (N) is solely limited by the availability of energy. Whether Ukraine should import this or produce it by itself on the basis of its own resources is purely a matter of comparative advantage. For the other macro-nutrients phosphorus (P) and potassium (K), the situation is quite different. Both are essential for all life and have no conceivable substitutes. Phosphorus is mined in a major way in only a few countries (primarily Morocco, China and the USA) and deposits are limited. The potassium supply is abundant but the cost of development of new mines is particularly high. Both P and K originate from mineral deposits of mixed composition that are contaminated by toxic metals, in particular uranium and cadmium. Spreading vast quantities of such deposits on Ukraine's land creates additional contamination; this can be avoided by the



Source: Atlas of Ukraine, 2000, Institute for Geography NASU / Intelligence Systems GEO.

Fig. 7 Extent of soil erosion in Ukraine purification of fertilisers or by the recycling of organic matter, which also prevents the irrecoverable loss of P as it leaches into rivers and eventually into the sea. The prevention of soil degradation and the improvement of the systems for nutrient supply to the soil are thus important priorities for a country that seeks to realise its potential in a sustainable way.

The problem is particularly relevant for Ukraine because of its nutrient imbalances across the territory, which means that barely any nutrients in animal feed are returned to the land of origin, and because of the size of exports which currently amount to 40 % of production. If grain exports rise as predicted, this issue of nutrient outflows will become even more pressing. Any loss of nutrients has to be compensated for eventually, by imports of chemical fertiliser, which will become increasingly expensive, or of organic manure, and by domestic (organic) nutrient recycling. The organic pathway offers the advantage of avoiding recurrent infusion of contaminants. Ukraine is not the only country facing this challenge. All major grain exporters see the nutrient loss/supply ratio rising fast and further concentration of agricultural production at high yielding locations will only accelerate this trend.

4.3 Limited Access to Foreign Trade

Until recently, only a few trading companies that possess export licenses could export smoothly. Access to exports should be made available to all those who deliver goods of adequate quality and not only to specific trading companies. Product labelling on exports, with adequate inspections and with labels satisfactorily meeting social as well as environmental standards, could provide an effective means by which to complement and support local governance.

Ukraine has considerable scope to increase its exports of grain and oilseeds, which might significantly contribute to world food security. However, to effectuate this expansion without amplifying prevailing price volatility, Ukraine will have to enhance its management of irrigation, storage and plant protection, to limit its support to biofuels and to abstain from the imposition of export bans in response to shortfalls.

Keeping its domestic and sea trading channels open is a crucial element of this strategy. Ukraine may have to step up its cereal-handling capacity in the Odessa port region for its important Black Sea trade, given that access to the Crimea is now blocked. More importantly, trade access in general depends on the willingness of importing countries to trade, and, as such, Ukraine must maintain good relations with its trading partners.

4.4 *Political Context: Seeking Trilateral Balance with the European Union and Russia*

In the course of 2014, the name 'Ukraine' itself has in the news media almost become synonymous with border conflict, separatist movements and outside interference in internal affairs. Its eastern regions, which were previously known for coal mining, steel and vast spaces, have turned into battlefields. We cannot neglect this, of course, although the issue goes far beyond the remit of the study on which this chapter is based, which was published in 2013 and for which the present chapter is an inevitable post scriptum. However, whatever the present tensions, Ukraine has a given geographical position, with corresponding resource endowments and locational features that any peaceful settlement will have to account for, since it surely must build also on the country's strengths, rather than on its vulnerabilities only.

Ukraine is positioned between two far bigger neighbours (the EU and Russia). Whatever the present vicissitudes, it has in the future to maintain trade relationships and cultural and historical links with both, in various fields. Some balance has to be found that is largely agreeable to all three parties.

As regards its relationship with the EU, Ukraine wants to improve the access of goods and services. After independence it started a process of defining its relationship as a new neighbour to the EU, which in 2014 resulted in an Association Agreement, which is a treaty that establishes a political and economic association between the two parties. Each is committed to cooperate and converge economic policy, legislation and regulation across a broad range of areas, including equal rights for workers, steps towards the visa-free movement of people, the modernisation of Ukraine's energy infrastructure and access to the European Investment Bank. The so-called Deep and Comprehensive Free Trade Area (DCFTA) is an integral part of the Association Agreement, which will define a free trade area over a period of 10 years. The DCFTA may seem a remarkable outcome given that it has been under negotiation now for over 15 years, during which period it has faced strong opposition both in Ukraine and the EU, and it could have resulted into a trade agreement that accommodates only one of the many options the EU can offer. Indeed, the EU's trade regime is, as is the case for all important trading nations, multi-layered. First, the EU grants free access to the poorest countries, under the Everything But Arms protocols. Second, it offers free or preferential access to countries with an Association Treaty. Third, it adopts, as part of World Trade Organization legislation, the Generalized System of Preferences (GSP), which has a long list of tariff quotas to manage trade, mainly for historical or political reasons. Finally, the standard default option is the trade facing so-called most favoured nation (MFN) tariffs. For rogue states, special provisions apply that may block trade entirely.

These trade barriers can be seen as a playing field for 'economic diplomacy', as a country such as Ukraine asks for wider tariff quotas and graduation by a shift from MFN to GSP to Association Treaty. The EU also wants, in return, certain requirements to be met, particularly on phytosanitary and environmental norms for products traded and on wider Ukrainian policies such as the freedom of the press, the independence of courts, the integrity of the democratic process and transparency in the execution of these regulations. The Ukraine–EU Association Treaty in fact requires a gradual convergence to the Acquis Communautaire, which defines the complete set of EU standards, norm, laws and regulations. The DCFTA now outlines the path towards free trade. The Treaty has been signed by Ukraine and the EU, and is now passing the process of ratification by the parliaments in the individual EU Member States, envisaged to be concluded in the course of 2016.

At the same time as Ukraine has been negotiating its relationship with the EU, Russia has been actively promoting its Eurasian Union, which also requires convergence between the countries. Hence, Ukraine finds itself confronted with two systems, each with its own requirements for convergence, and it cannot simultaneously satisfy the requirements of the two systems without getting torn apart between both. Finding a way out of this has by now become a geo-political issue. Whatever the outcome of the present crisis, Ukraine's traditional relationships with Russia in trade and otherwise cannot be denied. At more technical level, one may agree that the problems in part result from a logical difficulty that can be resolved rationally.

It takes no King Solomon to reach the judgement that such convergence requirements are problematic and that for (baby) Ukraine's sake, the country should be free to decide about its future for itself, without external interference. The reversal or negation of convergence requirements is not, in fact, difficult. Trade agreements with Ukraine can place demands on traded quantities only and can refrain from imposing any wider requirements on the mode and conditions under which production takes place. Given that precedents abound, and include several agreements between the EU and China and between the EU and the USA, the legalities should not cause much delay in this regard.

5 Conclusions

The potential of the agricultural sector in Ukraine is being considered from the perspective of a dualised agrarian economy, consisting of large agro-holdings and a diversified set of farming households. Dedicated policies are needed to unlock this potential, including a balanced treatment of the dualised system itself, in particular to avoid further concentration and fragmentation, to restore the nutrient imbalances caused by monoculture and increased commodity exports, and to ease and broaden the access to foreign trade. In particular, Ukraine is now preoccupied by its conflicts in the eastern parts of the country, and it needs a rational solution to reformulate its trade and association agreements, both with the EU and Russia, so as to restrict the range of conflicting convergence requirements. Finally, there is a need for close monitoring of the development of rural areas, in particular dualisation, to find ways to address upcoming financial difficulties of agro-holdings on the one hand and to tailor the regulations of the household farms to local needs, which are now more pressing than ever, on the other hand.

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Assessing the Potential for Russian Grain Exports: A Special Focus on the Prospective Cultivation of Abandoned Land

Valery Saraykin, Renata Yanbykh, and Vassily Uzun

1 Introduction

The Russian Federation has one of the largest stocks of arable land in the world (8.7 % of total world arable land according to FAO, 2014), and thus it has huge potential to become the key player in providing regional and global food security. At present, Russia is one of the largest grain exporters in the world. Prime Minister Dmitry Medvedev has recently assessed the potential to increase the country's grain exports by stating that Russia will feed the world.[1] According to estimates by the former Russian Minister of Agriculture, Nikolay Fedorov, grain exports will reach 30–40 million tonnes production over the next 15–10 years. According to estimates by Liefert et al. (2010), Russia's wheat exports will overtake those of the USA by 2019. The objective of this chapter is to evaluate the potential for Russian grain export expansion on the basis of available land resources by taking into account production and transport costs.[2]

[1]htpp://vz.ru/news/2013/1/24/617280.html.

[2]For transport costs, see Annex 1.

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2 The Scale of Reduction in the Grain Crop Area

The shift from Soviet-era centrally planned agriculture to the free market was accompanied by a sizable reduction in the arable area and crop area cultivations (including grain crops) in Russia (Table 1).[3] Over the past twenty years, the arable land area in Russia has reduced by 16.5 million ha, which represents a drop of 12.5 % compared with the land area in 1990. During this period, the total land area given over to crops reduced by 42.4 million ha (36 %), whereas the land area given over to grain crops decreased by almost 20 million ha (31 %). However, although the share of the total arable land area given over to crops declined from 89.2 % to 65.2 %, the share of the grain area in the total cropland area increased from 53.6 % to 57.4 %.

The reduction of the land area for grain crops was observed in almost all Russian regions, but it occurred to the greatest extent in regions with less favourable physical and economic conditions, which have low bioclimatic potential, high production costs and low yields (Tables 2 and 3).

The regional results reported in Table 2 for area development over the period 1990–2010 are summarised in Table 3. Only three regions of the Southern Federal District (Krasnodarsky Kray, Stavropolsky Kray and Kabardino-Balkarskaya Republic) report a growth in the grain cropland area in 2010 compared with 1990. All other regions exhibit a reduction in the area, varying from a small decrease to a total liquidation of grain production; the latter is characteristic for the North-Western Federal District. As shown in Table 3, grain area reduced in those regions in which yields were lower than 2 tonnes/ha and production costs per tonne of grain exceeded USD 114. There is a negative correlation between profitability and grain area reduction. Regions with lower profitability (or higher costs) exhibit greater reductions in grain area cultivation than other regions.

Table 1 Arable land and cropland area, historical data for Russia

	1990	1995	2000	2005	2010	2010 vs 1990 (million ha)	2010 vs 1990 %
Arable land (million ha)	131.8	127.6	119.7	116.1	115.3	−16.5	87.5
Cropland (million ha)	117.6	102.5	85.4	77.5	75.2	−42.4	63.9
Share of cropland in the arable land (%)	89.2	80.3	71.3	66.8	65.2		
Grain cropland area (million ha)	63.0	54.7	45.6	43.4	43.2	−19.8	68.6
Share of grain crops in the total cropland (%)	53.6	53.4	53.4	56.0	57.4		

Source: Annual Russian Statistics (2006, 2011)

[3]Grain crops include wheat, barley, maize, oats, millet, buckwheat, rice and legumes.

Table 2 Development of the land area for grain crops, regional data for Russia

Region	Grain area and yield[a]					Costs and profitability of grain production[b]	
	1990 (ha)	2010 (ha)	2010 vs 1990		Average yield in 2008–2010 (t/ha)	Average cost in 2008–2010 (USD/t)	Profitability (%)
			000 ha	%			
Russian Federation	**62,869**	**43,194**	**−19,674**	**−31.5**	**1.95**	**118.9**	**17.6**
Belgorod Region	718	614	−104	−14.5	2.94	128.5	3.6
Bryansk Region	622	315	−307	−49.4	1.68	109.8	7.2
Vladimir Region	293	84	−210	−71.4	1.75	151.1	12.3
Voronezh Region	1518	1086	−432	−28.5	2.31	112.1	6.8
Ivanovo Region	279	68	−212	−75.8	1.50	140.7	6.9
Tver Region	622	74	−548	−88.1	1.28	167.7	−7.2
Kaluga Region	370	75	−295	−79.8	1.98	140.0	13.7
Kostroma Region	287	52	−235	−81.9	1.13	196.9	−12.4
Kursk Region	966	895	−71	−7.4	2.76	112.1	14.8
Lipetsk Region	848	760	−89	−10.5	2.90	113.6	12.5
Moscow Region	286	85	−201	−70.2	2.47	153.8	−0.2
Oryol Region	908	782	−126	−13.9	2.66	113.2	9.0
Ryazan Region	901	501	−400	−44.4	2.47	109.4	25.4
Smolensk Region	611	87	−524	−85.8	1.44	153.4	3.0
Tambov Region	1165	818	−348	−29.8	2.36	106.8	7.6
Tula Region	818	515	−304	−37.1	2.41	116.3	16.6
Yaroslavl Region	316	48	−269	−84.9	1.55	170.2	5.0
Total, Central Federal District	**11,530**	**6856**	**−4674**	**−40.5**	**2.47**	**116.0**	**10.4**
Arkhangelsk Region	84	2	−82	−97.4	1.54	295.3	20.8
Vologda Region	288	134	−154	−53.5	1.53	170.7	2.9
Kaliningrad Region	184	64	−120	−65.2	3.35	157.0	14.2
Leningrad Region	37	32	−5	−14.5	2.78	171.9	−2.0

(continued)

Table 2 (continued)

Region	Grain area and yield[a]					Costs and profitability of grain production[b]	
	1990 (ha)	2010 (ha)	2010 vs 1990		Average yield in 2008–2010 (t/ha)	Average cost in 2008–2010 (USD/t)	Profitability (%)
			000 ha	%			
Murmansk Region	0.3	0.0	−0.3			0.0	
Novgorod Region	151	12	−139	−92.3	1.50	235.8	−15.2
Pskov Region	281	18	−263	−93.7	1.37	233.6	−6.1
Karelia Republic	0.4	0.1	−0.3	−76.2	1.67	216.4	24.6
Komi Republic	0.6	0	−0.6	−100.0	1.62	233.5	
Total, North Western Federal District	**1026**	**261**	**−765**	**−74.6**	**2.12**	**171.2**	**5.0**
Krasnodar Kray	1976	2155	179	9.1	4.71	117.5	37.5
Astrakhan Region	164	23	−141	−86.0	1.86	236.9	10.2
Volgograd Region	2670	1619	−1050	−39.3	1.72	108.0	15.8
Rostov Region	2941	2823	−118	−4.0	2.56	110.8	19.9
Adygeya Republic	120	114	−5	−4.6	4.08	98.9	23.1
Kalmykiya Republic	403	217	−187	−46.3	1.55	104.8	24.2
Stavropol Kray	1792	2139	347	19.4	3.34	109.2	25.0
Ingushetiya Republic		39	39		1.47	159.6	−16.4
Dagestan Republic	221	104	−117	−52.9	2.15	15.1	0.5
Kabardino-Balkariya Republic	152	176	24	15.5	3.37	120.3	16.5
North Osetiya Republic	109	108	−1	−1.1	3.95	126.0	5.7
Karachayevo-Cherkessiya Republic	62	58	−4	−6.4	2.22	141.5	−11.5
Chechen Republic		102	102		1.38	19.4	−26.5
Total, Southern Federal District	**10,610**	**9677**	**−933**	**−8.8**	**3.07**	**112.5**	**26.4**
Nizhny Novgorod Region	1071	563	−508	−47.5	1.87	138.8	4.9

Kirov Region	1186	327	−859	−72.4	1.63	130.5	17.0
Samara Region	1599	990	−609	−38.1	1.03	11.9	17.0
Orenburg Region	3754	2808	−946	−25.2	0.79	126.5	21.6
Penza Region	1359	640	−719	−52.9	1.50	118.9	5.4
Perm Kray	923	285	−637	−69.1	1.30	152.4	10.0
Saratov Region	3371	2224	−1147	−34.0	1.05	117.8	11.4
Ulyanovsk Region	983	596	−387	−39.4	1.38	125.7	11.7
Bashkortostan Republic	2594	1761	−833	−32.1	1.53	131.6	7.7
Mariy El Republic	318	141	−177	−55.6	1.33	130.1	11.0
Mordoviya Republic	658	430	−228	−34.6	2.13	127.6	11.3
Tatarstan Republic	1955	1512	−442	−22.6	2.23	139.3	1.9
Udmurtiya Republic	739	416	−323	−43.7	1.29	136.4	10.4
Chuvashiya Republic	402	253	−148	−36.9	1.65	127.7	9.5
Total, Volga Federal District	**20,911**	**12,947**	**−7964**	**−38.1**	**1.35**	**129.5**	**9.7**
Kurgan Region	1565	1119	−446	−28.5	1.21	130.6	18.1
Sverdlovsk Region	710	350	−360	−50.7	1.57	154.6	4.3
Tyumen Region	903	708	−195	−21.6	1.89	14.0	−2.2
Chelyabinsk Region	1479	1471	−8	−0.5	0.88	143.0	14.6
Total, Ural Federal District	**4657**	**3648**	**−1009**	**−21.7**	**1.25**	**139.7**	**9.3**
Altay Kray	3998	3394	−604	−15.1	1.25	108.6	32.5
Buryatiya Republic	357	107	−250	−70.0	0.85	152.4	28.4
Krasnoyarsk Kray	1652	978	−674	−40.8	2.23	112.4	25.9
Irkutsk Region	727	358	−369	−50.8	1.68	139.0	16.5
Kemerovo Region	699	684	−15	−2.2	1.93	108.5	23.3
Novosibirsk Region	1977	1561	−416	−21.0	1.65	10.3	28.1
Omsk Region	2055	1894	−161	−7.8	1.41	113.5	12.5
Tomsk Region	288	240	−48	−16.6	1.57	139.8	4.1

(continued)

Table 2 (continued)

Region	Grain area and yield[a]					Costs and profitability of grain production[b]	
	1990 (ha)	2010 (ha)	2010 vs 1990		Average yield in 2008–2010 (t/ha)	Average cost in 2008–2010 (USD/t)	Profitability (%)
			000 ha	%			
Zabaikalsk Kray	932	152	−780	−83.7	1.21	114.2	16.2
Altay Republic	39	9	−30	−76.4	0.95	10.4	37.7
Tyva Republic	146	18	−128	−87.6	0.89	22.8	−20.8
Khakasiya Republic	312	91	−221	−70.8	1.22	157.0	6.0
Total, Northern Federal District	**13,182**	**9485**	**−3697**	**−28.0**	**1.51**	**11.2**	**23.8**
Primorsk Kray	229	80	−149	−65.0	1.64	221.1	4.9
Khabarovsk Kray	18	6	−12	−66.0	1.42	255.2	−4.3
Amursk Region	637	204	−433	−68.0	1.04	15.5	−2.3
Kamchatka Kray	0.0	0.3	0.3		0.83		
Sakha (Yakutiya) Republic	24	15	−9	−36.3	0.58	423.5	−49.7
Jewish Autonomous Area	44	15	−29	−66.9	1.07	198.2	4.4
Total, Far Eastern Federal District	**953**	**321**	**−632**	**−66.4**	**1.18**	**188.5**	**−1.7**

[a]Based on data for all agricultural entities (i.e. agricultural enterprises, family farms and household plots)

[b]Based on data for agricultural enterprises under statistical surveillance. The average yield by region for the period 2008–2010 was calculated based on the Rosstat enterprise data as the ratio of total grain production in the region to the total area under grain crops. The average cost was calculated based on enterprise data averaged over all enterprises

Source: EMISS (2010)

Table 3 Regions grouped by percentage of grain cropland reduction in Russia, 2010 vs 1990

Groups by % change of grain cropland area	Number of regions	Change of grain cropland area in 2010 compared with 1990		Average grain yields 2008–2010 (t/ha)	Costs and profitability of grain production	
		000 ha	%		Production costs of grains (USD/t)[a]	Sales profitability in 2008–2010 (% of profit in value of sales)
Above 0	3	550	14.0	4.00	114.3	32.0
−20–0	14	−1361	−8.9	1.93	114.7	17.0
−40–(−20)	16	−7941	−30.6	1.53	121.3	11.5
−60–(−40)	12	−4295	−47.7	1.82	124.3	14.3
−80–(−60)	15	−3658	−70.9	1.54	151.5	10.0
−80 and lower	11	−3110	−86.5	1.32	163.6	1.5
Total	**71**	**−19,815**	**−31.5**	**1.95**	**118.9**	**17.6**

[a]The USD/RUB exchange rate was 30 in 2012; this rate has been used throughout the chapter
Source: authors' calculations

3 Potential for Grain Export Expansion in Russian Regions

For the purpose of this assessment, we assume the following conditions under which the grain area is expected to expand in any given region in Russia:

- A region is deemed a potential exporter if grain production is profitable in the region. Regional profitability is calculated as the difference between the selling price at the port of shipment and the cost of railway transport from the regional central railway terminal to the port. Profitability is attained when $(P_i - T_i) > K_i$, where P_i is sales price per tonne of grain at the port; T_i is the transport delivery costs of grain to the nearest port (USD/tonne); and K_i is the production cost of grain sold (USD/tonne). Those regions in which calculated grain growing was not profitable were not viewed as potential exporters.
- Given the current grain export prices, the expansion of grain cultivation into new areas is assumed to be unprofitable. This assumption is based on the fact that if the cultivation of new areas was profitable with the current prices, this would have happened in reality. This further implies that lands newly involved in cultivation are inferior in quality and location to the already cultivated ones, and the cost per unit of production on such lands is higher. In addition, cultivating new lands requires additional costs and capital investments.
- Following these hypotheses, a positive relationship can be expected between the profitability of grain production and the expanding grain cropland area: $N_i = f(R_i)$, where N_i is the change of grain area in region 'i' and R_i is the profitability of grain production.

- The average yield per hectare, costs per unit of production and marketability of grain grown on newly introduced lands in a region are assumed to be the same as in the observed period (i.e. 2010) in each region.

4 Methodology

This section provides a description of the methodology applied for determining the maximum possible expansion of regional grain area. Two indicators are used to calculate the maximum possible expansion of grain area: (1) the reduction of total cropland area ($\Delta S_i = S_i^{1990} - S_i^{2010}$); and (2) the share of grain in the total cropland area (DG_i). These two indicator are calculated for each region using the data for 1990 and 2010, that is, $DG_i^{1990} = (SG_i^{1990}/S_i^{1990}) \times 100$ and $DG_i^{2010} = (SG_i^{2010} / S_i^{2010}) \times 100$, where SG_i represents grain area. For each region, DG_i is selected as the maximum value from the 2 years, DG_i^{1990} and DG_i^{2010}. The maximum possible expansion of grain cropland area in region 'i' is then calculated by multiplying the two indicators: $\Delta G_i = \Delta S_i \times DG_i$.

The estimates of possible expansion of the grain area in different Russian regions are reported in Table 4. For example, in the Belgorod region, the cultivated crop area in 2010 was 338,000 ha less than in 1990. We assume that this amount represents the potential additional area that can be cultivated in the Belgorod region in the case of favourable market conditions. The grain area in 1990 amounted to 718,000 ha representing 45.3 % of the total cultivated agricultural area. In 2010, the grain area had reduced to 614,000 ha, or 49.2 % of the total cultivated area. The larger of these two values (i.e. 49.2 %) determines the share of the additional area available for grain cultivation of the total possible. Therefore, only 49.2 % of a possible 338,000 ha (i.e. 166,000 ha is available for grain area expansion (the last column of Table 4). The expansion of grain cultivation will depend on grain prices and other factors but, overall, it is assumed that it cannot exceed this estimated maximum value.

The cost of grain transport by railway to sea ports (i.e. Novorosiysk, Tuapse, Azov, St Petersburg, Vladivostok) was calculated based on the distance between the railway terminal and the port (RICCOM 2013) and the established average tariffs for transport per tonne of grain, which depend on the distance (Transfin-M 2013). For the purpose of this calculation, the transport costs for each region were assumed to be the minimum value among the existing range of transport costs to various ports (Annex 1).

We have estimated the regression equation between the grain cropland area expansion and the profitability of grain sales. The main hypothesis is that a higher grain sales profitability leads to expansion of the cropland grain area. The estimations were based on the data of a comparable group of agricultural enterprises for

Table 4 The maximum possible expansion of grain area in Russian regions

Region	Cropland (000 ha)			Grain cropland area (000 ha)		Share of grain in the cropland			Maximum grain area expansion (000 ha)
	1990 (S_i^{1990})	2010 (S_i^{2010})	Variance (ΔS_i)	1990 (SG_i^{1990})	2010 (SG_i^{2010})	1990 (SG_i^{1990}/S_i^{1990})	2010 (SG_i^{2010}/S_i^{2010})	Maximum value	
Belgorod Region	1586	1249	−338	718	614	0.453	0.492	0.492	166
Bryansk Region	1292	672	−620	622	315	0.482	0.469	0.482	299
Vladimir Region	644	331	−312	293	84	0.456	0.253	0.456	142
Voronezh Region	2986	2337	−649	1518	1086	0.509	0.465	0.509	330
Ivanovo Region	609	219	−390	279	68	0.458	0.308	0.458	179
Tver Region	1475	633	−842	622	74	0.422	0.117	0.422	355
Kaluga Region	919	302	−617	370	75	0.403	0.248	0.403	248
Kostroma Region	662	207	−455	287	52	0.433	0.251	0.433	197
Kursk Region	1855	1355	−500	966	895	0.521	0.660	0.660	330
Lipetsk Region	1513	1214	−299	848	760	0.561	0.625	0.625	187
Moscow Region	1224	551	−673	286	85	0.234	0.155	0.234	158
Oryol Region	1568	1077	−492	908	782	0.579	0.726	0.726	357
Ryazan Region	1687	771	−916	901	501	0.534	0.650	0.650	596
Smolensk Region	1439	456	−983	611	87	0.425	0.191	0.425	417
Tambov Region	2068	1427	−642	1165	818	0.563	0.573	0.573	368
Tula Region	1448	750	−699	818	515	0.565	0.687	0.687	480
Yaroslavl Region	769	337	−432	316	48	0.411	0.142	0.411	178
Arkhangelsk Region	295	104	−191	84	2	0.286	0.021	0.286	55
Vologda Region	815	452	−363	288	134	0.353	0.296	0.353	128
Kaliningrad Region	416	148	−268	184	64	0.441	0.431	0.441	118
Leningrad Region	437	251	−186	37	32	0.085	0.126	0.126	23
Murmansk Region	25	7	−18	0	0	0.014	0.000	0.014	0
Novgorod Region	485	181	−303	151	12	0.311	0.064	0.311	94

(continued)

Table 4 (continued)

Region	Cropland (000 ha)			Grain cropland area (000 ha)		Share of grain in the cropland			Maximum grain area expansion (000 ha)
	1990 (S_i^{1990})	2010 (S_i^{2010})	Variance (ΔS_i)	1990 (SG_i^{1990})	2010 (SG_i^{2010})	1990 (SG_i^{1990}/S_i^{1990})	2010 (SG_i^{2010}/S_i^{2010})	Maximum value	
Pskov Region	875	276	−599	281	18	0.321	0.064	0.321	192
Karelia Republic	83	38	−44	0	0	0.005	0.003	0.005	0
Komi Republic	101	41	−60	1	0	0.006	0.000	0.006	0
Krasnodar Kray	3903	3634	−268	1976	2155	0.506	0.593	0.593	159
Astrakhan Region	324	76	−249	164	23	0.507	0.305	0.507	126
Volgograd Region	4619	2726	−1893	2670	1619	0.578	0.594	0.594	1124
Rostov Region	5224	4351	−873	2941	2823	0.563	0.649	0.649	566
Adygeya Republic	270	229	−41	120	114	0.444	0.499	0.499	20
Kalmykiya Republic	727	299	−428	403	217	0.555	0.725	0.725	310
Stavropol Kray	3434	2891	−543	1792	2139	0.522	0.740	0.740	402
Ingushetiya Republic	111	63	−48	0	39	0.000	0.624	0.624	30
Dagestan Republic	435	271	−164	221	104	0.507	0.383	0.507	83
Kabardino-Balkariya Republic	325	291	−34	152	176	0.467	0.603	0.603	21
North Osetiya-Alaniya Republic	206	161	−45	109	108	0.530	0.671	0.671	30
Karachayevo-Cherkessiya Republic	192	122	−70	62	58	0.323	0.477	0.477	34
Chechen Republic	329	189	−140	0	102	0.000	0.537	0.537	75
Nizhny Novgorod Region	2055	1165	−890	1071	563	0.521	0.483	0.521	464
Kirov Region	2194	853	−1341	1186	327	0.541	0.383	0.541	725
Samara Region	2679	1834	−845	1599	990	0.597	0.540	0.597	504

Orenburg Region	5569	4061	−1508	3754	2808	0.674	0.691	0.691	1042
Penza Region	2230	1169	−1060	1359	640	0.609	0.547	0.609	646
Perm Kray	1850	795	−1055	923	285	0.499	0.359	0.499	526
Saratov Region	5564	3605	−1960	3371	2224	0.606	0.617	0.617	1209
Ulyanovsk Region	1644	950	−694	983	596	0.598	0.627	0.627	435
Bashkortostan Republic	4399	3147	−1252	2594	1761	0.590	0.560	0.590	738
Mariy El Republic	603	300	−304	318	141	0.527	0.470	0.527	160
Mordoviya Republic	1137	726	−411	658	430	0.579	0.593	0.593	243
Tatarstan Republic	3402	2928	−475	1955	1512	0.575	0.517	0.575	273
Udmurtiya Republic	1401	1067	−334	739	416	0.528	0.390	0.528	176
Chuvashiya Republic	800	572	−228	402	253	0.502	0.443	0.502	115
Kurgan Region	2640	1374	−1266	1565	1119	0.593	0.815	0.815	1032
Sverdlovsk Region	1516	852	−664	710	350	0.468	0.411	0.468	311
Tyumen Region	1634	1091	−543	903	708	0.553	0.649	0.649	352
Chelyabinsk Region	2694	2074	−620	1479	1471	0.549	0.709	0.709	440
Altay Kray	6380	5149	−1231	3998	3394	0.627	0.659	0.659	811
Krasnoyarsk Kray	2879	1461	−1418	1652	978	0.574	0.669	0.669	949
Irkutsk Region	1573	639	−934	727	358	0.462	0.560	0.560	523
Kemerovo Region	1447	1037	−410	699	684	0.483	0.659	0.659	270
Novosibirsk Region	3443	2326	−1117	1977	1561	0.574	0.671	0.671	749
Omsk Region	3745	2798	−947	2055	1894	0.549	0.677	0.677	641
Tomsk Region	623	381	−242	288	240	0.463	0.630	0.630	152
Zabaikalsk Kray	1543	217	−1326	932	152	0.604	0.700	0.700	928
Altay Republic	147	103	−43	39	9	0.266	0.089	0.266	12
Tyva Republic	282	28	−254	146	18	0.519	0.651	0.651	166
Khakasiya Republic	598	223	−375	312	91	0.521	0.408	0.521	195
Primorsk Kray	742	314	−428	229	80	0.309	0.255	0.309	132

(continued)

Table 4 (continued)

Region	Cropland (000 ha)			Grain cropland area (000 ha)		Share of grain in the cropland			Maximum grain area expansion (000 ha)
	1990 (S_i^{1990})	2010 (S_i^{2010})	Variance (ΔS_i)	1990 (SG_i^{1990})	2010 (SG_i^{2010})	1990 (SG_i^{1990}/S_i^{1990})	2010 (SG_i^{2010}/S_i^{2010})	Maximum value	
Khabarovsk Kray	121	73	−49	18	6	0.148	0.084	0.148	7
Amursk Region	1623	790	−833	637	204	0.393	0.258	0.393	327
Kamchatka Kray	65	22	−43	0	0	0.000	0.014	0.014	1
Sakha (Yakutiya) Republic	107	44	−63	24	15	0.224	0.347	0.347	22
Jewish Autonomous Area	147	108	−38	44	15	0.300	0.135	0.300	12
Buryatiya Republic	767.8	192.8	−575	357	107	0.465	0.555	0.555	319
Russian Federation	**117,619**	**75,157**	**−42,462**	**62,869**	**43,194**	–	–	**0.570**	**24,188**

Source: Authors' calculations

the period 2004–2007.[4] We selected from the database a set of economic indicators related to grain sales for each of the agricultural enterprise (such as sales volume, sales revenue, cost of grain sold) and the grain cropland area. Based on these indicators, we have calculated the average grain sales profitability and cropland area for 3 years (2004–2006). All agricultural enterprises were grouped in the following profitability categories: over 100 % profitability of total sales; 80–90 %; 70–80 %; 60–70 %; 50–60 %; 40–50 %; 30–40 %; 20–30 %; 10–20 %; 0–10 %; −10–0 %; (−20)–(−30) %; (−30)–(−40) %; and below −40 %. For each of these profitability groups, we have calculated average grain cropland areas for 2004–2006 and 2007 (Table 5).

Comparative results obtained for different profitability groups indicate that: (1) stable growth of grain cropland area was observed in enterprises with profitability over 40 % in the period 2004–2006; (2) volatile changes in grain cropland area are associated with enterprises with profitability between 0 % and 40 %; and (3) a stable reduction in grain cropland area is observed for unprofitable enterprises (Table 5).

Using the data for these profitability groups, we use a logarithmic regression model to estimate the relationship between the grain cropland area expansion and the profitability of grain sales. However, because of the negative value of the arguments in the logarithmic variable ‘X’, all values were increased by 50 to convert them into positive values. The final estimated regression is as follows (where $R^2 = 0.90$):

$$Y = -42.82 + 9.56 \times \mathrm{Log}_e(X + 50)$$

where Y is a change (reduction) in the grain cropland area (%) and X is the level of sales profitability (%).

The estimated regression is used to predict how grain area responds to different levels of grain profitability. We calculate the different level of profitability by altering world grain price (see Table 6). Other parameters (including production and transportation costs) are assumed to be fixed.

5 Simulation Results

In this section, we present the simulation results for grain area and grain export changes under different scenarios of global grain price development. The simulations were performed for 11 options of grain export price measured at a sea port (USD/tonne) varying between USD 200/tonne and USD 400/tonne.[5] For each export price value, we calculated the area increment (increase) in each region if

[4]The sample group comprised agricultural enterprises, which were operational during the period 2004–2007.

[5]We have considered the following 11 grain price variants (USD/tonne): 200, 220, 240, 260, 280, 300, 320, 340, 360, 380 and 400.

Table 5 Agricultural entities grouped by grain sales profitability, 2004–2006 and 2007

Groups by profitability of grain sold	Number of agricultural entities	Average profitability in group	Land area in the group, average for 2004–2006 (000 ha)	Land area in group, 2007 (ha)	Estimated coefficients		
					Land area variance (%) (4–3)/3	of profitability	
						Increased by 50 %	Logarithmated
1	2	3	4	5	6	7 = 3 + 50 %	8 = log(7)
Above 100 %	211	144.9	519,738	550,280	5.9	194.9	5.27
80–90 %	102	95.3	228,142	242,806	6.4	145.3	4.98
70–80 %	124	84.8	312,897	328,390	5.0	134.8	4.90
60–70 %	173	74.4	534,614	556,486	4.1	124.4	4.82
50–60 %	268	65.0	678,802	701,140	3.3	115.0	4.74
40–50 %	419	54.7	1,134,427	1,209,502	6.6	104.7	4.65
30–40 %	558	44.7	1,478,679	1,481,784	0.2	94.7	4.55
20–30 %	785	34.6	2,222,286	2,179,298	−1.9	84.6	4.44
10-–20 %	1057	24.8	2,740,173	2,761,954	0.8	74.8	4.32
0–10 %	1181	15.0	2,785,512	2,695,769	−3.2	65.0	4.17
−10–0 %	1136	5.2	2,547,950	2,459,668	−3.5	55.2	4.01
−20–10 %	908	−4.6	1,460,306	1,344,424	−7.9	45.4	3.82
−30–20 %	655	−14.7	898,320	772,437	−14.0	35.3	3.56
−30–40 %	455	−24.8	534,306	440,184	−17.6	25.2	3.23
Below 40 %	704	−45.9	459,297	345,091	−24.9	4.1	1.42

Source: Rosstat (2010)

Table 6 Increase of grain area and grain exports under different export price scenarios in Russia

	Increase in 1 year			Increase in 5 years			Increase in 10 years		
Export price (USD/tonne)	Area (000 ha)	% of maximum possible[a]	Grain export (000 tonnes)	Area (000 ha)	% of maximum possible[a]	Grain export (000 tonnes)	Area (000 ha)	% of maximum possible[a]	Grain export (000 tonnes)
200	368	1.5	764	1777	7.3	3599	2896	12.0	5463
220	803	3.3	1443	3705	15.3	6200	6182	25.6	9444
240	1320	5.5	2143	5850	24.2	8525	9826	40.6	13,105
260	1831	7.6	2795	7989	33.0	10,692	12,834	53.1	15,701
280	2300	9.5	3383	9748	40.3	12,418	14,861	61.4	17,370
300	2719	11.2	3902	11,179	46.2	13,785	16,074	66.5	18,456
320	3086	12.8	4323	12,392	51.2	14,863	16,962	70.1	19,325
340	3421	14.1	4709	13,401	55.4	15,719	17,703	73.2	20,050
360	3731	15.4	5065	14,191	58.7	16,389	18,335	75.8	20,666
380	4018	16.6	5397	14,806	61.2	16,929	18,863	78.0	21,155
400	4285	17.7	5706	15,327	63.4	17,404	19,254	79.6	21,482

[a]Potentially cultivable area as calculated in Table 4, which totals 24.2 million ha
Source: authors' calculations

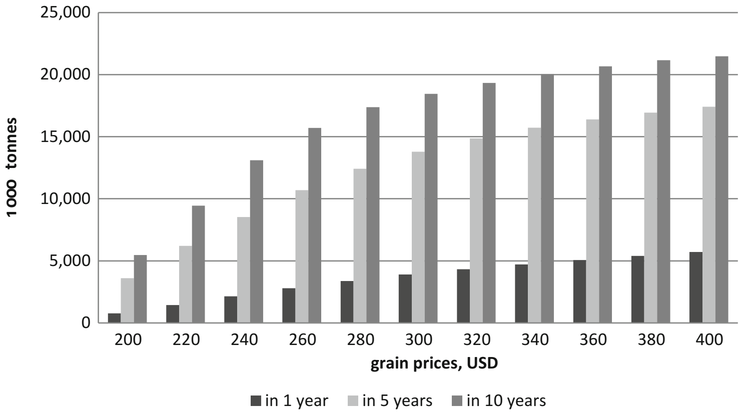

Fig. 1 Projections of grain exports under different export price scenarios (000 tonnes)

profitability of grain production (including transport costs) exceeded 40 %. If profitability in a region was below 40 %, the increment was not calculated (i.e. a zero increase in grain area was assumed). Then, the volume of potential additional grain exports was determined on the basis of area growth.

Simulation results for all price variants are reported in Table 6.[6] We calculate the area and export effects for three time points: 1 year, 5 years and 10 years. Within the 5- and 10-year intervals, the export price is assumed to stay the same. The price variation occurs only among the 11 considered price variants (scenarios). In the event that the simulated increment of grain area was above the maximum resource potential, the volume of production was calculated based only on the maximum cultivable area in the region as reported in Table 4.

The estimated results for grain area and exports for the whole of Russia are presented in Table 6 and Fig. 1. For example, at a world grain price of USD 400/tonne, the expansion of the grain area can provide for an increase of grain exports of 5.7 million tonnes within a year, of 17.4 million tonnes within 5 years and of 21.5 million tonnes within 10 years (i.e. the export volume is comparable with the value observed in recent years). That is, if we consider 20 million tonnes of Russian exports in 2010, with a grain price of USD 400/tonne, the exports will double by 2025 to reach over 40 million tonnes.

There is varying potential for crop production across the different Russian regions and, consequently, for export increases (Fig. 2).

The estimations reported in Figs. 1 and 2 show that there is potential to expand the land area given over to grain cultivation, thereby leading to higher grain exports. The increase in grain area (and thus also in exports) may increase at an average annual price of USD 200/tonne in some Russian regions. If the price remains stable

[6]The simulation results by region and for different export price variants are available in Uzun et al. (2014).

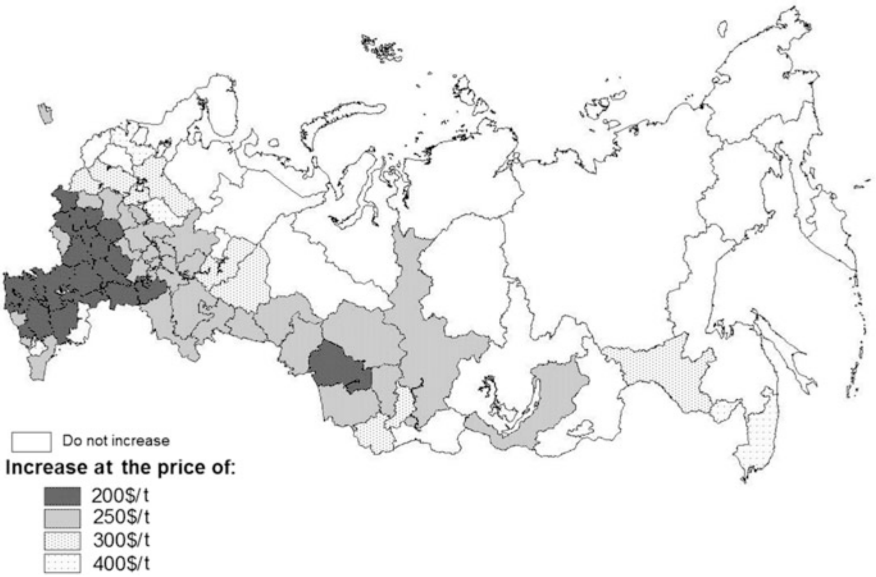

Fig. 2 Mapping of the projections of grain exports under different export price scenarios

at this level for 5 years, the increase in exports will amount to 3.6 million tonnes, and if stable over 10 years, exports would increase by 5.5 million tonnes, representing around 18 % and 27 %, respectively, of the export quantity in 2010. With more significant rises in global grain prices, exports will also grow, but there will be a gradual decrease in growth rates, as less fertile land is available for cultivation. As reported in Fig. 1, even at the price of USD 400/tonne, it will be possible to bring back into cultivation only around 80 % of all potentially cultivable land over a 10-year time horizon.

For the grain area development, Table 6 reveals that, depending on the world price and time horizon considered, the grain area can expand by between 0.4 million ha and 19.3 million ha, representing between 0.8 % and 44 %, respectively, of the total grain area in 2010. For the pessimistic world price scenarios (USD 220/tonne or lower), the grain area increase represents less than 15 % of the 2010 grain area. A large expansion of the gain area (by more than 30 %) is possible only under a high grain price scenario.

6 Conclusions

Russia has the capability to increase grain production and exports by means of reclaiming abandoned lands. However, doing so could be costly, given that such lands are usually less fertile that those already in use. If world grain prices remain at their current levels, Russia's role in the global market will be unlikely to change, at least in the short term. A significant expansion of grain exports can be realised only in the case of a sizable growth in world prices. Moreover, the problem of the relatively low loading capacity of Russian port elevators needs to be addressed.[7]

Our simulation results indicate that, depending on the world price and time horizon considered, the potential additional area than can be given over to grain cultivation represents between 0.4 million ha and 19.3 million ha accounting for 0.8 % and 44 % of total grain area (or 0.5 % and 26 % of total cropland area), respectively, in 2010. The area expansion under the pessimistic scenario of world grain prices (USD 220/tonnes or lower) may induce an increase in Russian grain exports by up to 1.4 million tonnes in a short-term period (1 year), representing around 7 % of the 2010 exports. Over a longer time period (10 years), grain exports may increase by up to 9.4 million tonnes in this pessimistic scenario, representing a 50 % rise in exports relative to the 2010 level. However, if the world price increases substantially (to more than USD 320/tonnes), grain exports may double from the current level over a 10-year time horizon.

An alternative possibility for boosting the production of grains is yield growth by adopting modern technologies on lands that are already in use rather than on abandoned lands. However, such a growth in production is possible only in the case of there being a demand for additional production both on the domestic and the world markets.

Annex 1. Cost of transport by railway from a regional railway terminal to a sea port (USD/tonne)

Russian Federation region	Sea port					Transport costs (minimum)
	Novorossiysk	Azov	St Petersburg	Vladivostok	Tuapse	
Belgorod Region	30.2	30.2	41.7	51.7	41.7	30.2
Bryansk Region	41.7	30.2	41.7	51.7	41.7	30.2
Vladimir Region	41.7	30.2	30.2	51.7	41.7	30.2
Voronezh Region	30.2	25.8	41.7	51.7	30.2	25.8
Ivanovo Region	41.7	30.2	25.8	51.7	41.7	25.8
Tver Region	41.7	41.7	13.3	51.7	46.7	13.3
Kaluga Region	41.7	30.2	30.2	51.7	41.7	30.2
Kostroma Region	41.7	41.7	25.8	51.7	46.7	25.8
Kursk Region	30.2	25.8	41.7	51.7	30.2	25.8
Lipetsk Region	30.2	25.8	41.7	51.7	30.2	25.8

(continued)

[7]The elevation capacity of Russian ports is currently 28 million tonnes (Novorossiysk: 13 million tonnes annually; Tuapse and Taman: 2.5 million tonnes each; Azovsk, Yeysk, Taganrog, Rostov-on Don: 6 million tonnes altogether; St Petersburg and Kaliningrad: 1 million tonnes each; Vladivostok, Nakhodka and other Far East ports: 2 million tonnes) (Sobolev 2013).

Russian Federation region	Sea port					Transport costs (minimum)
	Novorossiysk	Azov	St Petersburg	Vladivostok	Tuapse	
Moscow Region	41.7	30.2	25.8	51.7	41.7	25.8
Oryol Region	30.2	30.2	41.7	51.7	41.7	30.2
Ryazan Region	30.2	30.2	30.2	51.7	41.7	30.2
Smolensk Region	41.7	30.2	30.2	51.7	41.7	30.2
Tambov Region	30.2	25.8	41.7	51.7	30.2	25.8
Tula Region	30.2	30.2	30.2	51.7	41.7	30.2
Yaroslavl Region	41.7	30.2	25.8	51.7	41.7	25.8
Arkhangelsk Region	46.7	46.7	30.2	51.7	46.7	30.2
Vologda Region	46.7	41.7	25.8	51.7	46.7	25.8
Kaliningrad Region	13.3	13.3	13.3	13.3	13.3	13.3
Leningrad Region	46.7	46.7	51.7	51.7	46.7	46.7
Murmansk Region	51.7	51.7	30.2	51.7	51.7	30.2
Novgorod Region	46.7	46.7	13.3	51.7	46.7	13.3
Pskov Region	46.7	46.7	13.3	51.7	46.7	13.3
Karelia Republic	46.7	46.7	13.3	51.7	46.7	13.3
Komi Republic	46.7	46.7	41.7	51.7	51.7	41.7
Krasnodar Kray	13.3	13.3	46.7	51.7	13.3	13.3
Astrakhan Region	30.2	30.2	46.7	51.7	30.2	30.2
Volgograd Region	25.8	25.8	46.7	51.7	25.8	25.8
Rostov Region	13.3	13.3	13.3	51.7	13.3	13.3
Adygeya Republic	13.3	13.3	46.7	51.7	13.3	13.3
Kalmykiya Republic	25.8	25.8	46.7	51.7	25.8	25.8
Stavropol Kray	13.3	13.3	46.7	51.7	13.3	13.3
Ingushetiya Republic	25.8	25.8	46.7	51.7	25.8	25.8
Dagestan Republic	25.8	25.8	51.7	51.7	25.8	25.8
Kabardino-Balkariya Republic	25.8	25.8	46.7	51.7	25.8	25.8
North Osetiya Republic	25.8	25.8	46.7	51.7	25.8	25.8
	13.3	13.3	46.7	51.7	13.3	13.3

(continued)

Russian Federation region	Sea port					Transport costs (minimum)
	Novorossiysk	Azov	St Petersburg	Vladivostok	Tuapse	
Karachayevo-Cherkessiya Republic						
Chechen Republic	25.8	25.8	51.7	51.7	25.8	25.8
Nizhny Novgorod Region	41.7	41.7	30.2	51.7	41.7	30.2
Kirov Region	46.7	46.7	30.2	51.7	46.7	30.2
Samara Region	41.7	30.2	41.7	51.7	41.7	30.2
Orenburg Region	46.7	41.7	46.7	51.7	46.7	41.7
Penza Region	41.7	30.2	41.7	51.7	41.7	30.2
Perm Kray	46.7	46.7	41.7	51.7	46.7	41.7
Saratov Region	30.2	25.8	41.7	51.7	30.2	25.8
Ulyanovsk Region	41.7	30.2	41.7	51.7	41.7	30.2
Bashkortostan Republic	46.7	41.7	46.7	51.7	46.7	41.7
Mariy El Republic	46.7	41.7	41.7	51.7	46.7	41.7
Mordoviya Republic	41.7	30.2	41.7	51.7	41.7	30.2
Tatarstan Republic	41.7	41.7	30.2	51.7	46.7	30.2
Udmurtiya Republic	46.7	46.7	41.7	51.7	46.7	41.7
Chuvashiya Republic	46.7	41.7	41.7	51.7	46.7	41.7
Kurgan Region	46.7	46.7	46.7	51.7	51.7	46.7
Sverdlovsk Region	46.7	46.7	46.7	51.7	46.7	46.7
Tyumen Region	51.7	46.7	46.7	51.7	51.7	46.7
Chelyabinsk Region	46.7	46.7	46.7	51.7	46.7	46.7
Altay Kray	51.7	51.7	51.7	51.7	51.7	51.7
Krasnoyarsk Kray	51.7	51.7	51.7	51.7	51.7	51.7
Irkutsk Region	51.7	51.7	51.7	51.7	51.7	51.7
Kemerovo Region	51.7	51.7	51.7	51.7	51.7	51.7
Novosibirsk Region	51.7	51.7	51.7	51.7	51.7	51.7
Omsk Region	51.7	51.7	51.7	51.7	51.7	51.7
Tomsk Region	51.7	51.7	51.7	51.7	51.7	51.7

(continued)

Russian Federation region	Sea port					Transport costs (minimum)
	Novorossiysk	Azov	St Petersburg	Vladivostok	Tuapse	
Zabaikalsk Kray	51.7	51.7	51.7	51.7	51.7	51.7
Buryatiya Republic	51.7	25.8	51.7	51.7	51.7	25.8
Altay Republic	51.7	51.7	51.7	51.7	51.7	51.7
Tyva Republic	51.7	51.7	51.7	51.7	51.7	51.7
Khakasiya Republic	51.7	51.7	51.7	51.7	51.7	51.7
Primorsk Kray	51.7	51.7	51.7	13.3	51.7	13.3
Khabarovsk Kray	51.7	51.7	51.7	25.8	51.7	25.8
Amursk Region	51.7	51.7	51.7	41.7	51.7	41.7
Kamchatka Kray	13.3	13.3	13.3	13.3	13.3	13.3
Sakha (Yakutiya) Republic	51.7	51.7	51.7	46.7	51.7	46.7
Jewish Autonomous Area	51.7	51.7	51.7	25.8	51.7	25.8

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Kazakhstan's Wheat Production Potential

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1 Introduction

Located at the far eastern reach of the Eurasian wheat belt, the Republic of Kazakhstan is a major wheat (*Triticum* spp.) producing and exporting country. Its wheat production area ranges from 10 to 14 million ha and its average annual output is 9–22 million tonnes of grain. The main wheat production region is located in the northern/north-central regions (Fig. 1), where the topography is mainly flat and where production on rich and productive *chernozem* and *kashtan* soils accounts for roughly 70 % of the country's total wheat harvest (of which spring wheat comprises 90 %). The country's climate is typically semi-arid, with cold winters and warm summers. Droughts are frequent (occurring two years in every five, on average, predominantly during the May–August growing season when low rainfall and high temperatures often persist). Owing to the dry climate, northern Kazakhstan produces good-quality hard wheat. Some winter wheat is grown in southern Kazakhstan, but the annual harvest comprises a minor share of the country's total wheat production.

Kazakhstan's harsh winters are a cause of fluctuations in agricultural production. Large-scale irrigation does not exist. As a result, a reduced harvested area and yield

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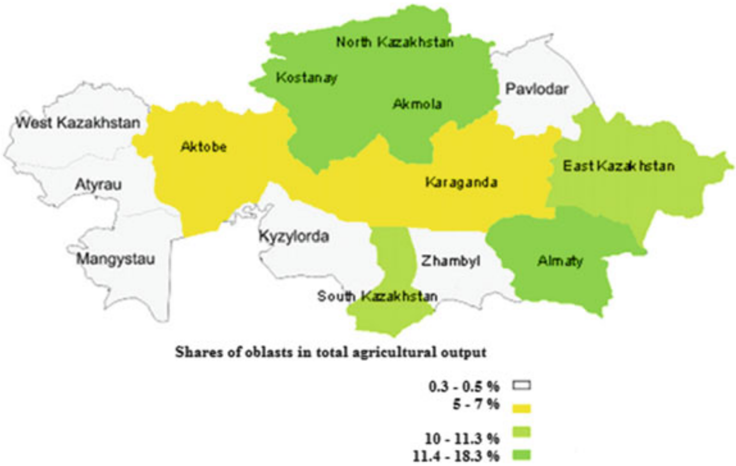

Fig. 1 Regional concentration of agriculture in Kazakhstan, 2008–2010 average. Source: Statistics Agency of the Republic of Kazakhstan (2011): Kazakhstan in Figures. Online database

losses/crop failure are not exceptional, and these lead to frequent and high year-to-year variations in yield which are a considerable source of regional food insecurity. Furthermore, although Kazakhstan is among the top ten wheat producing regions, wheat yields have varied from year to year, despite a series of agrarian reforms. The average yield of around 1 tonne/ha is low by international standards and there is a pressing need to increase the level of wheat production in the country.

The wheat sector is dominated by the private sector and is characterised by three farm types: large privately operated agricultural enterprises, especially in the north of the country; small peasant farms; and household plots with only a fragile integration into markets. In the future, the drivers of agricultural development in Kazakhstan will probably be the large-scale, privately operated, profit-oriented farms. The small and medium-size farms will have an important role in local rural economies and food security, but the key actors in wheat production will be modern (medium and large) agricultural enterprises.

Wheat is one of the world's most important crops: about 37 % of the global population relies on it as their main food staple, and it accounts for some 20 % of all food calories consumed by humans. The global agricultural system faces a rapidly growing challenge: in the coming decades it must feed a substantially larger population in an increasingly volatile and shifting climate. Increasing the production of grain crops (including wheat) will be crucial in facing the global food security challenge, both to provide sufficient food grain and to meet the demand for animal feed, especially as income growth in emerging market economies increases the demand for meat and other livestock products.

In Central Asia, cereals make up about 50 % of staple foods, although this figure differs from country to country. Because of this, food security in the region is largely dependent on cereal production, most notably wheat. Of the five Central

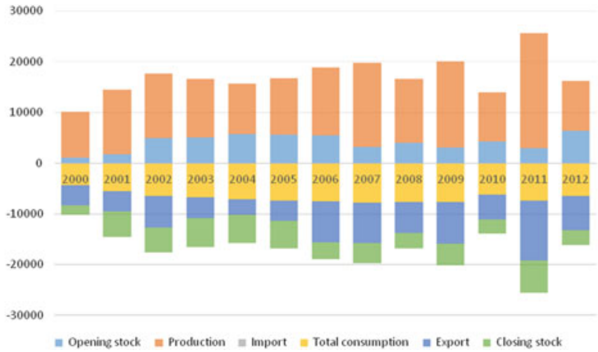

Fig. 2 The wheat balance of Kazakhstan, 2000–2012. Data source: USDA (http://www.indexmundi.com)

Asian countries, only Kazakhstan is able to meet its cereal needs (mainly wheat). In general, the food security risk has diminished significantly in Kazakhstan since 2000 and the country is now self-sufficient in many foods. Sedik et al. (2011) suggest that, unlike the other countries in Central Asia, the potential risks to food security in Kazakhstan are now mostly confined to food price volatility arising from market volatility and instability and fluctuations in weather conditions, including water scarcity. By contrast, the other four countries in the region depend heavily on imported cereals. For example, the proportion of imported cereals made up of wheat is 97 % and 95 % in Tajikistan and Turkmenistan respectively (Bravi and Solbrandt 2012).

As the largest wheat exporter in Central Asia, Kazakhstan exports wheat grain and flour (Fig. 2), mainly to Commonwealth of Independent States (CIS) countries. Of the non-CIS countries, Afghanistan and Iran are the most important destinations for Kazakh wheat. Kazakhstan therefore plays a key part in local, regional and international food security, and the development of the country as a consistent and sustainable source of global wheat supply is of strategic importance.

Although the wheat sector is privatised, the Kazakh government recognises it to be a strategic sector and exercises strong control over production, marketing and export, and utilises public stocks to keep flour and bread prices stable. In addition, every year the government sets a target for exports, but the tools to implement this target are unclear. The government subsidy programmes during the second half of the 1990s were designed to revitalise production levels through the use of improved varieties, inputs, and machinery and equipment, but access to credit and investment finance remained poor.

There are two practical ways in which agricultural output in Kazakhstan can be increased: (1) increase the area of cultivated land; or (2) improve yields on existing land. The prospects for the former are limited. Local farmers face several challenges from sowing to harvest and then to access the markets. There are three crucial challenges, which together impose the greatest constraints on production: (1) competition with weeds for nutrients and moisture; (2) pre-harvest losses caused by pests (e.g. plant diseases and herbivorous insects); and (3) insufficient water.

These challenges are exacerbated by global climate change which creates uncertainty with regard to the prospect of sustainable and continuous growth of wheat yields in the region. According to climate change scenarios based on global climate modelling, further temperature increases with no significant increase in precipitation may lead to a drier climate. In parallel, the climate zone boundaries may shift northward, and wheat yields may be reduced by more than 25 %. Such risks cannot be ignored by policymakers.

The aim of this chapter is to analyse the future development trajectories of Kazakh wheat production. We begin with an analysis of the impacts of any potential future changes in climate and weather conditions in Kazakhstan in terms of temperature, precipitation, input levels and production capacity of wheat by applying an adapted version of the Food and Agriculture Organization of the United Nations (FAO) Global Agro-Ecological Zones (GAEZ) model. We then analyse the outlook for wheat production and exports using a system-dynamic approach.

2 Methodology

The methodology aims to determine probable trends in Kazakh wheat production and exports over the next four decades. Two approaches are employed. Firstly, we apply *agro-ecological and climate scenarios* to predict the probable climate and weather conditions in terms of temperature, precipitation, input level and production capacity in Kazakhstan. Secondly, we model the outlook for wheat production and trade based on a *system-dynamic approach.*

2.1 Agro-ecological and Climate Scenarios

In order to explore the effects of climatic conditions on wheat production, we calculate the following indicators:

- average annual precipitation (mm/year), 1990–2013;
- mean annual temperature (°C), 1990–2013;
- reference evapotranspiration (ETo) between March and September (mm/growing period) for the years 2000, 2020 and 2050;
- aridity index (AI) (average annual precipitation/potential ETo) for the years 2000, 2020 and 2050;
- Fournier index (FI) for the years 2000, 2020 and 2050;
- length of growing period for the years 2000, 2020 and 2050;
- soil suitability index (SI) at low-, intermediate- and high-input levels.

The source of precipitation and temperature data was the Meteorological Service of Kazakhstan. The other indicators were obtained using the methodology developed by the FAO and the International Institute for Applied Systems Analysis

(IIASA), namely the GAEZ model, which is based on the second climate model of the Commonwealth Scientific and Industrial Research Organisation (CSIRO 2011).

The so-called reference crop evapotranspiration or reference evapotranspiration, denoted as ETo, is derived from a reference surface in the form of a hypothetical grass reference crop with an assumed crop height of 0.12 m, a fixed surface resistance of 70 s m^{-2} and an albedo of 0.23. This closely resembles a surface of green, well-watered grass of uniform height, actively growing and intercepting all sunlight. The FAO Penman–Monteith (PM) method is the standard method for the definition and computation of the reference ETo because it can be computed from just meteorological data, namely solar radiation, air temperature, air humidity and wind speed (FAO 2014).

In 1993, the United Nations Environmental Programme (UNEP 1993) defined the AI as the ratio of total annual precipitation to potential evapotranspiration (PET). PET is the rate at which evapotranspiration would occur from a large area completely and uniformly covered with growing vegetation which has access to an unlimited supply of soil water, and without advection or heat storage effects. Owing to the lack of measured PET data and other difficulties, AI has not been widely used, especially in developing countries. Agronomists and engineers mostly use the PM equation because the required weather data are easily accessible (Sahin 2012). Climate types correspond to different levels of AI and are listed in Table 1.

The FI is an erosion (soil degradation by water) indicator. The formula for calculating the index is as follows:

$$C_p = P^2{}_{max}/P$$

where C_p is the FI (mm), P_{max} is the rainfall amount in the wettest month and P is the annual precipitation (mm) (Oduro-Afriye 1996). Table 2 shows the different rainfall classes, which represent the different levels of rainfall erosion risk, and the related FI (mm) and amount of possible annual soil loss in tonnes/hectare.

The FI is an important indicator for the grain sector, as it measures soil erosion and determines attainable productivity. Highly eroded areas and fields cannot maintain their production potential because the soil will be degraded and lose its fertility potential.

As the intensity of farming should also be considered, we define the input use and management practices based on the GAEZ methodology (version 3.0). These are represented as follows:

- ***High-input advanced management:*** The farming system is predominantly market-oriented. Commercial production is a management objective. Production is based on improved high-yielding varieties, fully mechanised with low labour intensity and optimum applications of nutrients and chemical pest, disease and weed control.
- ***Intermediate-input improved management:*** The farming system is partly market-oriented. Production for subsistence plus commercial sale is a management objective. Production is based on improved varieties, on manual labour

Table 1 Scale of the Aridity index

Aridity index	Climate type
$0.05 \leq P/PE < 0.20$	Arid
$0.20 \leq P/PE < 0.50$	Semi-arid
$0.50 \leq P/PE < 0.65$	Dry sub-humid
$0.65 \leq AI < 0.80$	Semi-humid
$0.80 \leq AI < 1.0$	Humid
$1.0 \leq AI < 2.0$	Very humid

Source: Sahin (2012) and UNEP (1993)

Table 2 Rainfall classes, erosion risk, Fournier index and the amount of possible soil loss

Class No	Erosion risk class	Fournier index C_p (mm)	Soil loss (t/ha/year)
1	Very low	<20	<5
2	Low	21–40	5–12
3	Moderate	41–60	12–50
4	Severe	61–80	50–100
5	Very severe	81–100	100–200
6	Extremely severe	>100	>200

Sources: Oduro-Afriye (1996) and Aslan (2003)

with hand tools and/or animal traction and some mechanisation. Production is medium labour intensive, uses some fertilisers and chemical pest, disease and weed control, adequate fallows and some conservation measures.

- ***Low-input traditional management:*** The farming system is largely subsistence-based and not necessarily market-oriented. Production is based on the use of traditional varieties (if improved varieties are used, they are treated in the same way as local varieties), labour-intensive techniques, no application of nutrients, no use of chemicals for pest and disease control and minimal conservation measures.

Following Fischer et al. (2012), the following guiding principles form the basis for constructing the SI in the FAO GAEZ model (i.e. GAEZ 3.0), which combines soil qualities with different levels of inputs and management practices:

- nutrient availability and nutrient retention capacity are key soil qualities;
- nutrient availability is of utmost importance for low-level input farming; nutrient-retention capacity is most important for high-level inputs;
- nutrient availability and nutrient-retention capacity are considered equally important for intermediate-level input farming;
- nutrient availability and nutrient-retention capacity are strongly related to rooting depth and the soil volume available; and
- oxygen available to roots, excess salts, toxicity and workability are regarded as equally important soil qualities, and the combination of these four soil qualities is best achieved by the multiplication of the most limiting rating with the average of the ratings of the remaining three soil qualities.

We use the FAO GAEZ model to predict the probable climate and weather conditions in terms of temperature, precipitation, input level and wheat production capacity in Kazakhstan. The projections are made for the next 40 years. The model develops projections by combining information on the SI, different soil qualities and the different levels of input use and management practices described above.

2.2 Future Perspectives on the Wheat Sector in Kazakhstan: A System-dynamic Approach

Based on the analysis of agro-ecological conditions and the probable future development of the Kazakh wheat sector, we set up a stochastic system model for predicting Kazakhstan's wheat exports. We apply a relatively complex model, given that the future development of Kazakhstan wheat production and exports are influenced by a complex set of natural (e.g. global climate change), economic and social factors. The exact future values of all influencing factors are challenging to predict and are not readily available. To circumvent this problem, we employ a system-dynamic approach to analyse the future development trends of Kazakh wheat production. Sterman (2001) outlined the most important features of systems characterised by dynamic complexity of phenomena. These are: (1) a constantly changing character; (2) tightly coupled sub-systems; (3) governance by feedback; (4) non-linearity; (5) history-dependence; (6) a self-organising character; (7) an adaptive behaviour; (8) characterisation by trade-offs; (9) a counterintuitive character; (10) a policy-resistant feature. The majority of these criteria are true for Kazakhstan's wheat sector, thereby justifying the application of dynamic system modelling. When setting up a conceptual framework of an agricultural system, it is always a question as to which agricultural management system to assume. From the GAEZ 3.0 system typology we apply the high-input level option because, from our own on-site experience as well as based on literature findings (Kienzler et al. 2012), the farming system in Kazakhstan can be best characterised by this management practice. That is, the farming system is predominantly market oriented, and commercial farms dominate the wheat sector in Kazakhstan.

The structure of the system-dynamic model and the links between its different components are presented in Fig. 3. The aim of the model is to simulate the future development of the wheat sector in Kazakhstan. The model has three basic modules. This modular system offers the possibility to test different model specifications, and also allows regional downscaling of the analysis. The first component of the model represents the production module, which accounts for the average wheat yield conditions and the production area of wheat. The second module represents the food-chain of wheat sectors by interlinking production, consumption and export. The third module captures the behaviour of the domestic consumption of different wheat products.

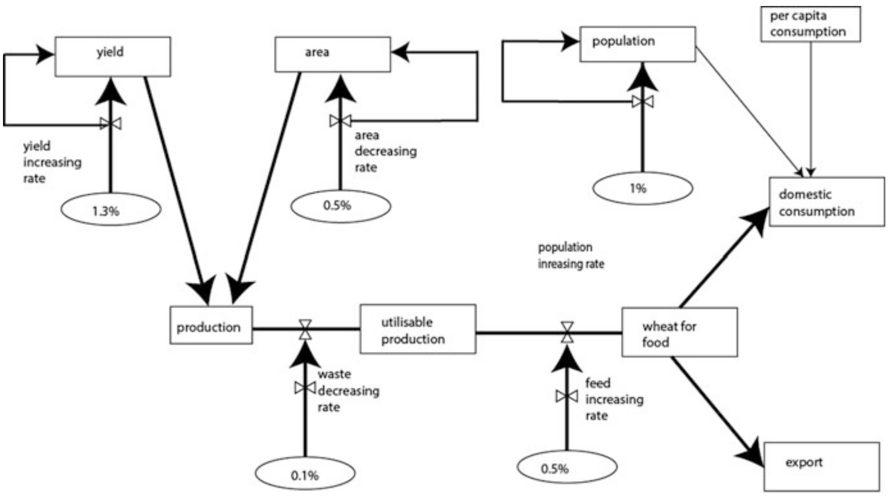

Fig. 3 Conceptual framework for a Kazakh wheat-sector model

The construction of the system-dynamic model relies on several assumptions of land and production parameters, which can be defined as follows:

1. We assume a negligible initial level of non-food (feed) wheat use (maximum 1.5 % of domestic production). However, we assume a relatively dynamic expansion of wheat use for animal feed (i.e. a 0.5 % yearly growth rate). This assumption is based on government projections, which estimate a strong growth in animal husbandry in Kazakhstan (Nakipova et al. 2012; Sharipov et al. 2013). The agro-climatic conditions are important limiting factors of wheat production expansion in Kazakhstan (Laird and Chappell 1961). According to Conradt et al. (2012), there are considerable regional differences, but in most regions the meteorological parameters were found to have a determining role for production potential. The findings of Bokusheva (2010, 2011) support the importance of weather conditions for yield growth. As a consequence of global climate change, a reduction in the agricultural land area can be expected in the future. In our model we assume a moderate decrease (0.5 % annual change) of agriculturally useable land as a consequence of global warming.
2. Time series analysis indicates that there is a weak but statistically significant positive wheat yield trend in Kazakhstan. According to Pinstrup-Andersen and Pandya-Lorch (1998), the yield increase in Central Asia is predicted to be relatively low in the next decade (Table 3). Bruinsma (2009) argues that there is a considerable gap between the actual yield of wheat and the potential yield in Kazakhstan. Between 2003 and 2007 the average yield was around 1 tonne/ha, but if high-input technology is adopted, yields of more than 3.2 tonnes/ha could be achieved by 2050. With intensive technology, the yield could reach as much as 5.9 tonnes/ha. Improvements in the biological basis of wheat production (particularly the introduction of new varieties) can be an important source of

Table 3 Increase in wheat production in different regions of the world

Region	Area	Yield	Production
Central Asia	0.25	0.88	1.13
Rest of the former Soviet Union	0.03	0.56	0.59
Eastern Europe	0.10	1.10	1.21
West Asia and North Africa	0.35	1.47	1.82
Sub-Saharan Africa	1.18	1.58	2.78
Latin America	0.55	1.54	2.10
South Asia	0.17	1.43	1.60
East Asia	0.11	1.19	1.30
South-East Asia	0.18	1.33	1.51
Developed countries	0.08	0.83	0.91
Developing countries	0.41	1.25	1.66
World	0.29	1.04	1.33

Source: Pinstrup-Andersen and Pandya-Lorch (1998)

yield growth. In Central Asia, new wheat varieties could lead to a yield increase of up to 1.5–2.5 tonnes/ha (Morgounov et al. 2009). On the basis of these considerations, we assume a moderate yearly yield increase of 1.3 % from the initial value of 1 tonne/ha.

3. Losses along the wheat production chain in Kazakhstan represent around 3 % of total production. This is the starting value in our model, and we assume a moderate reduction of this loss (i.e. a 0.1 % yearly reduction but up to a maximum loss of 1.2 % of total production).
4. Other assumptions: 1 % yearly population increase in Kazakhstan; 333 kg stable yearly per-capita domestic consumption of wheat (i.e. food, industrial processing and other uses).

We apply the system-dynamic model to simulate changes in the Kazakh wheat yield, production and exports over a 30-year time horizon (i.e. until 2050).

3 Results

3.1 Potential Agro-climatic Threats to Kazakhstan's Wheat Sector

The yield potential (production capacity) attainable for different input levels and management practices (as defined in GAEZ 3.0) is shown in Fig. 4. The figure shows the yield of wheat that could be obtained in the 2020s and 2050s when implementing good agricultural practices and adopting management practices in the optimal way and at the optimal time (appropriate fertilisation, soil tillage, irrigation etc.). Input use and management practices as well as precipitation and

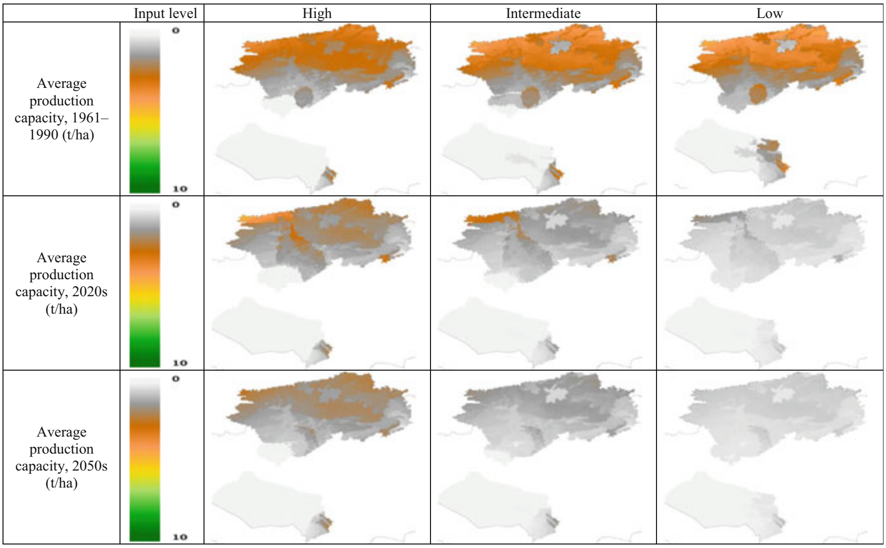

Fig. 4 Average production capacity (potential yield) in the future at different input levels in the main wheat growing areas of Kazakhstan. Source: IIASA and FAO, GAEZ version 3.0 (http://www.gaez.iiasa.ac.at)

temperature and their extreme values have significant effects on the development of the wheat yield potential.

According to the results, the average annual precipitation is projected to decrease over the simulation period in Kazakhstan. These projections are consistent both with the observed historical trends and with the scenario of the GAEZ 3.0 model.

The ETo is projected to increase significantly in the main wheat growing areas of Kazakhstan (from 715 mm to 1 260 mm per growing period in northern Kazakhstan, and from 1 250 mm to 1 460 mm per growing period in southern Kazakhstan) because the mean temperature will increase, while the amount of precipitation will fall. The implications of these changes are that crops will transpire more and that more water will evaporate from the soil surface. The consequent loss of soil moisture content will lead to more frequent droughts.

The AI is projected to increase in the main wheat producing regions in Kazakhstan (from 0.2 to 0.3 in northern Kazakhstan and from 0.4 to 0.6 in southern Kazakhstan, on a scale of 0 to 1) which means that the risk of drought periods will be high for the next 40 years. The strong impact of droughts will be particularly problematic for non-irrigated crop production.

The FI is projected to decrease (from 520 to 300 mm in northern Kazakhstan, and from 490 to 200 mm in southern Kazakhstan), driven by the fall in precipitation. A decrease in FI can be beneficial for soil protection because with less precipitation, erosion decreases, thus leading to less soil degradation. An exception would be if the distribution of annual precipitation will be extreme as a result of extreme climate phenomena. In this case, soil erosion is expected to be a serious problem, as there will be more precipitation during rainfall events, which can cause severe erosion, mainly on the slopes.

The predicted annual increase in average temperature in the wheat growing areas of Kazakhstan clearly reflects the average temperature increase, as observed in the GAEZ historical data for the period 1960–1990 (3 °C in northern Kazakhstan; 2 °C in southern Kazakhstan). The number of wheat growing days will reduce because the temperature will not coincide with wheat's optimum growing temperature. This also implies that the incidences of cereal pests and disease are likely to increase, due to the warmer and more extreme climate (Zhang et al. 2014). Based on the model simulations, the production potential of wheat was between 2 and 4 tonnes/ha in the period 1961–1990. The model predicts that this yield level can be maintained only in the main wheat growing regions by using the high-input level. If farmers use intermediate- or low-input levels, yields are projected to fall to less than 1 tonne/ha.

Overall, for the Kazakh wheat sector, the simulation results for different levels of the SI indicate that there will be large differences in productivity between the 2020s and 2050s:

- At low-input levels, these differences will be positive (i.e. higher productivity in the 2020s than in the 2050s), because the suitability index in the main wheat production sectors will increase from moderate to medium. This implies low energy use by wheat production, leading to degradation of soils relative to the current situation. This implies that wheat production will decrease over time.
- At intermediate-input levels (i.e. moderate use of agricultural inputs and the adoption of less productive varieties), the positive differences between the two periods are not as clear, because the SI will remain largely unchanged. In this case, wheat production in Kazakhstan is likely to remain at its current level.
- If farmers produce wheat at a high-input level, the input impact on soil quality will be negative. The SI will decrease due to the high energy metabolism and over-use of irrigation and the soil. This is a threat for wheat production, because the SI will decrease from moderate to marginal and this could cause significant yield losses in the long term.

It is important to note that the model does not consider adaption to climate change. That is, farmers are assumed to use conventional tillage methods (ploughing, discing) and no adaptation of soil management practices (for example, no levelling of the soil surface over time and no use of mulching). This is expected to lead to reductions in organic material and moisture content in the soil, ultimately causing yield reduction. The relaxation of this assumption (i.e. considering the adaptation of farmers' practices) may reinforce the negative effects of climate change simulated by the model (Birkás et al. 2010).

According to the GAEZ 3.0 model simulations, the suitability of soils for growing wheat will decrease (from 40 to 10 in northern Kazakhstan and from 70 to 40 in southern Kazakhstan on a dimensionless scale of 0–100) because of the variable climatic and environmental factors. This implies that the current yield levels obtained in Kazakhstan using conventional techniques cannot be sustained in the future. Farmers would need to increase their input use intensity simply to maintain current yield levels.

As farmers will have to increase their input levels (fertiliser, pesticide and water) to maintain or increase wheat yields, soil salinisation is expected to rise. The increases in fertiliser use and irrigation will cause the accumulation of soluble salts, whereas increased evaporation will lead to an accumulation of salt in the topsoil.[1] This salinisation will cause a rise in soil pH, leading to yield loss if the pH falls outside the optimum range for wheat production (Lelley and Gy 1963; Antal 2005; Csajbók 2012).

3.2 Wheat Production and Exports: A System-dynamic Approach

Figure 5 shows projections for Kazakh wheat production and exports over a 30-year time horizon using the system-dynamic model. The results indicate that wheat production will increase from 13.5 million tonnes in 2010 to 18 million tonnes in 2035 (Fig. 5a). This growth will occur despite the projected deterioration of the agro-ecological potential of wheat growing conditions. At the same time, the expansion of the domestic consumption of wheat and its use for animal feed will result in a decrease in the future Kazakh wheat export potential. Exports are projected to decrease by 31 %, from 5.2 million tonnes in 2010 to 3.6 million tonnes in 2035 (Fig. 5b).

Our results do not support the ambitious plans of the Kazakh Ministry of Agriculture, which aim to increase wheat exports to 15–20 million tonnes by 2020 (UNDP-KazAgroinnovation 2013). At the same time, they are in line with the UNDP-KazAgroinnovation (2013) forecast, which highlights that the expected weather conditions will be unfavourable for growing spring wheat in key growing regions. According to this report, although the increasing atmospheric CO_2 concentration will improve the situation, in general, production conditions will worsen.

Genetic modification of the biological base of production could be an important tool for increasing the stability of production in Kazakhstan. However, the main constraint is that, in the case of wheat, the research is in a relatively early phase of development. Moreover, the sowing of genetically modified wheat varieties, which can represent an important source of yield growth, is banned by the Government of Kazakhstan so as to avoid the risk of losing Kazakhstan's export position on the global wheat market (Kamenova 2012; Curtis and Halford 2014).

We have conducted a sensitivity analysis of the simulated effects by altering various model assumptions. We considered stochastic variation on arable land change (by 0.5 % (standard deviation 0.1 %)) and a higher rate of increase of wheat for feed use (by 0.5 % (standard deviation 0.1 %)). The impacts on exports

[1] http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053151.pdf

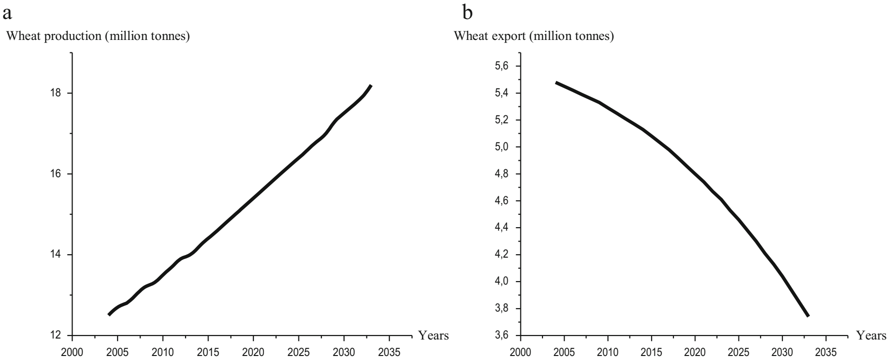

Fig. 5 Thirty-year projections for (**a**) wheat production and (**b**) wheat export in Kazakhstan

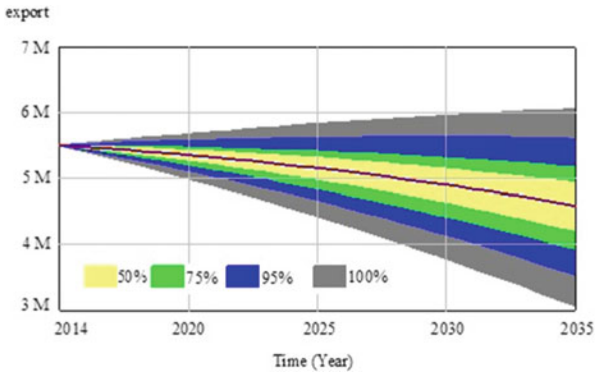

Fig. 6 Sensitivity analysis of wheat exports of Kazakhstan (million tonnes)

are shown in Fig. 6. The central line shows the most likely projections of the volume of Kazakh wheat exports. On each side of this line there are four bands, indicated by different colours. The band adjacent to the expected value shows the 50 % confidence interval, and the next two bands denote the 75 and 95 % confidence intervals respectively. The outermost bands encompass all possible variations in Kazakh wheat export projections. The main finding of the sensitivity analysis is that the volume of Kazakh wheat exports is sensitive to relatively minor changes in some parameters, such as in the development of arable land and the use of wheat for animal feeding. However, the decrease in the future export projections tends to prevail over different simulations. This is because the yield growth and the reduction in wheat losses are expected to be more than offset by the reduction of arable land and the increase in the domestic use of wheat for human and animal feeding.

4 Discussion

Our simulation results have shown that the agro-ecological status for wheat production in Kazakhstan will deteriorate over the long term. The climate will be warmer and dryer, and the frequency of drought periods and weather extremes will increase, which may enhance the agro-climatic risk to the cereal sector in Kazakhstan. Without adaptation of management practices (e.g. higher input use, new varieties), wheat yields are expected to decline.

The current low yields and low efficiency of wheat production are caused by problems in outdated technology. Technology improvement may play an important part in alleviating the effects of climate change. The use of outdated production methods and inadequate machinery and equipment prevent the development of efficient wheat production systems and have negative environmental implications (e.g. deterioration of soils). Improving knowledge and skills is another important means of increasing wheat production efficiency and productivity. The farm extension system could make an important contribution in this regard, especially if it is focused on education and professional training in the adoption of new technologies.

The agriculture of Kazakhstan has suffered a considerable capital outflow over the past two decades. The net capital stock for land development decreased from USD 41 314 billion in 1992 to USD 34 028 billion in 2007.[2] The net capital value of machinery stock decreased from USD 14 247 billion to USD 2 905 billion between 1992 and 2007. At the same time, there are some traces of technological modernisation (for example, in 2007 Kazakhstan imported nearly 4 000 tractors valued at USD 120 million. One decade earlier, the country imported just 280 tractors, valued at USD 4.6 million). Similar developments are observed for other machinery; for example, the import value of combine harvesters reached USD 183 million in 2007. Technological modernisation is strongly dependent on state support. Between 2001 and 2011, agricultural subsidies in Kazakhstan increased from USD 136 million to USD 1 620 million.

Our model results indicate that wheat production will expand in Kazakhstan despite the decreasing agro-ecological potential. The possibility to increase the wheat production area is limited, on one hand, by increasingly unfavourable climatic changes and, on the other hand, by the over-representation of wheat in the agriculture of Kazakhstan. According to expert estimates (Anon. 2013), the optimal share of wheat coverage on arable land in Kazakhstan is around 45–50 %, whereas this ratio was nearly two-thirds in 2010.

An important response to climate change with sizable environmental benefits could be the adoption of water retentive agricultural technology. Such technology is presently used on about 14 % of the wheat area, but its share is expected to increase by 80 % by 2020, by which time the application of minimum tillage, which is conducive to the water retention of soils, is expected to expand by 30 % (Anon. 2013).

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[2]Measured in constant 2005 prices (FAOSTAT 2015).

The application of fertilisers fluctuates considerably in Kazakhstan, causing high year-to-year variation in yields. For example, the annual consumption of potash fertiliser fluctuated between 200 and 3400 tonnes during the period 2002–2012 (FAOSTAT 2015). Agricultural insurance is another important strategy for the stabilisation of the income of wheat producers in Kazakhstan. Currently, the agricultural insurance system covers around 75 % of total agricultural land, and this must be maintained in order to ensure the sustainable future development of the farming sector.

The reduction of waste along the whole production chain and the improvement of the market orientation of the grain sector are important strategic prerequisites to sustain the expansion of the Kazakh wheat sector. Fundamental for this is the expansion of storage capacity. To achieve this, the Kazakh government plans to support investments in storage capacity by 3.15 million tonnes in the period 2014–2020. Improvements to the transportation infrastructure are another key prerequisite for the future development of the Kazakh wheat sector. The further development of the railway system and investment in special railway trucks are crucial components, given that Kazakhstan is a landlocked country.

Production is just one part of the problem; another is the competitiveness of Kazakh wheat. The quality of Kazakh wheat varies considerably from year to year and across production regions. In Kazakhstan, only two parameters are used to measure wheat quality for domestic purchases: vitreousness and gluten content. The quality of Kazak spring wheat is higher than that from Russia (Table 4), giving Kazakhstan a competitive edge over its closest competitor. However, although Kazakh wheat has high protein levels (14–16 %) and gluten contents (21–40 %) the gluten strength is less than that of Australian wheat (Abugalieva and Pena 2010).

The role of the state in the regulation of agricultural markets is expected to change considerably should Kazakhstan join the WTO as planned. WTO accession is expected to considerably limit state subsidies, but – at the same time – Kazakh access to the world market is likely to improve. WTO accession may expand Kazakh wheat exports to the European Union by 47 %, to Turkey by 35 % and to sub-Saharan Africa by 6 % (Burkitbayeva and Kerr 2014), The exact date of WTO accession is uncertain and thus it is hard to predict its potential effects. However, the predicted increase in domestic consumption and animal husbandry is likely to reduce considerably the raw material base for export and thereby reduce the overall wheat export potential of Kazakhstan.

Table 4 Distribution of wheat quality in Kazakhstan and Russia

	Payne quality category					
Country	10	9	8	7	6	5
Kazakhstan	8.2 %	40.4 %	2.0 %	44.4 %	1.0 %	4.0 %
Russia	5.0 %	32.5 %	12.5 %	47.5 %	2.5 %	

Source: Abugalieva and Pena (2010)

5 Conclusion

We have analysed the future prospects for wheat production in Kazakhstan by firstly investigating the future climate and weather conditions of wheat growing and, secondly, modelling the future perspectives of wheat production and trade.

Our simulation results show that the agro-ecological status for wheat production in Kazakhstan will deteriorate over the long term. The climate will become warmer and dryer, and the frequency of drought periods and weather extremes will increase. Without the adaptation of management practices, wheat yields in Kazakhstan are likely to decline. The main management practices that can attain higher yields include increases in input use intensity, the adoption of new wheat varieties and investments in modern technologies.

Despite the projected deterioration of the agro-ecological potential, the expected productivity growth suggests a positive potential for wheat production expansion in Kazakhstan. Our simulation results indicate that wheat production in Kazakhstan may increase by up to 33 % over the next four decades. The extent to which this growth potential will be achieved will be determined by both economic factors and environmental factors, including technology problems and the influence of climate change. However, Kazakhstan's export potential is likely to decline over this period as a result of the expansion of the domestic use of wheat. Exports are projected to decrease by 31 %, from 5.5 million tonnes in 2005 to 3.8 million tonnes in 2035.

To attain the wheat production potential, policy action needs to be in line with the principles of sustainability, while at the same time reinforcing the long-term competitiveness of the agricultural sector. Public resources should be allocated to eliminate significant deficiencies, mainly in transport infrastructure and storage capacities, as well as to water and land management, plant and animal health and food safety systems, research, education and knowledge sharing. Agricultural enterprises account for about 65 % of Kazakhstan's grain production and tend to be large-scale operations. However, the government's efforts to develop modern large-scale agricultural production should be accompanied by efforts to integrate small-scale producers into agricultural markets with the aim to enhance their domestic and international competitiveness.

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Future Perspectives on Regional and International Food Security: Emerging Players in the Region: Uzbekistan

Ihtiyor Bobojonov, Nodir Djanibekov, and Peter Voigt

1 Introduction

Agricultural specialisation on the basis of given comparative advantages was considered important during the Soviet era. In this regard, Central Asian countries mainly specialised in cotton production, whereas cereals mainly came from Russia, Ukraine and Kazakhstan (RUK) (Bobojonov et al. 2013). This commodity exchange mechanism collapsed in the early years of independence owing to a lack of 'hard' currency and insufficient experience with market economy mechanisms (Lorentz 2006). A lack of trust between newly established states further facilitated the need for countries to increase their production of grains for import substitution. As wheat is the major part of the caloric consumption in Central Asian countries (USAID 2011), all countries in that region increased their wheat production for domestic use.

Transformation of the wheat supply chains was thus so intensive that countries such as the Republic of Uzbekistan, which were once net importers, begun to export excess wheat to neighbouring regions. Most Caucasian and Central Asian counties (e.g. Armenia, Georgia, Azerbaijan and Kyrgyzstan) reduced policy interventions in terms of grain self-sufficiency targets, as neighbouring RUK boosted their production and emerged as reliable grain exporters.

However, a continued reliance among Caucasus and Central Asian countries on imports from RUK has created several challenges during recent food crises, when

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RUK introduced several export restrictions (Götz et al. 2013). Therefore, almost all countries reinitialised their policies of increasing self-sufficiency, mainly by means of providing several forms of subsidies to boost domestic production (Robinson 2008).

Another important reason for increasing support for domestic production is population growth and its associated food demand pressure. In fact, by 2050, the population of the Caucasus and Central Asian countries and neighbouring Afghanistan is projected to increase by over 40 %, from approximately 113 million to 160 million people (FAOSTAT 2015), which points to a significant increase in regional food demand. It is assumed that the majority of this can be satisfied by wheat products. When taking into account the average national food supply values for 2002–2011 for wheat and wheat products as reported in FAOSTAT for the nine countries in the region, and without taking into account economic development, urbanisation and price changes, the projected population growth by 2050 alone may increase the annual demand for wheat by an additional 7 million tonnes (see Table 1).

Although it is also expected that RUK may increase their exports by up to 33 % in the near future (Liefert et al. 2010), the high volatility of production in these regions remains a challenge. Apart from affecting the grain producers/exporters, this appears also to be a detriment to food security in the importing countries. The severity of this situation was observed in 2010 and 2012 when drought in RUK countries destroyed large parts of the wheat harvest (Welton 2011; Safonov and Safonova 2013).

The drought effect translated into prices shocks for wheat products across the Caucasus and Central Asian countries (ICARE 2012). For instance, the price of first-grade flour in Tajikistan increased by 50 % between June 2010 and June 2011 (UNDP 2012). These price hikes, in turn, have a detrimental effect on the regional population, given that wheat products account for 34–59 % of total food expenditures (USAID 2011).

Table 1 Main characteristics of Central Asian countries and Afghanistan

	Population (000 people)		Average wheat area, 2004–2013 (000 ha)	Average wheat yield, 2004–2013 (t/ha)	Standard deviation of wheat yield, 2004–2013	Share of wheat in food supply in 2011 (%)
	2011	2050				
Afghanistan	29,105	56,551	2350	1.70	0.32	66
Armenia	2964	2782	99	2.40	0.45	37
Azerbaijan	9202	10,492	635	2.54	0.23	53
Georgia	4374	3563	58	1.61	0.37	43
Kazakhstan	16,098	20,186	12,957	1.05	0.29	24
Kyrgyzstan	5403	7976	380	2.17	0.27	38
Tajikistan	7815	15,093	319	2.38	0.42	49
Turkmenistan	5107	6570	797	2.69	0.61	51
Uzbekistan	28,152	36,330	1421	4.45	0.35	50

Source: FAOSTAT (2015)

Central Asian countries that initially had relatively few interventions in agricultural production and trade also started to be more active in the supply chains owing to the export restrictions and uncertainties in wheat exports from RUK. For instance, Armenia—commonly known for its liberal policy and openness for trade—introduced a grain self-sufficiency policy in 2008, similarly to Uzbekistan and Turkmenistan (ICARE 2012). However, in contrast to Uzbekistan and Turkmenistan, Armenia opted to subsidise its grain producers. Furthermore, several other policy measures have been implemented in Central Asian countries to support the socially most vulnerable populations during food crisis years. Tajikistan spent USD 58 million on food subsidies in May 2008, and Kyrgyzstan distributed 600,000 tonnes of flour to low-income families in March 2011 (FAO and GIEWS 2013). Kyrgyzstan has also reduced value-added tax (VAT) for flour (Robinson 2008). Azerbaijan has eliminated import tariffs for grains and also suspended VAT in May 2008 and May 2009. The Uzbek government provided ration cards to low-income families to allow them to purchase food at lower prices from state stores.

In the light of soaring food prices and production shortfalls caused by weather extremes and export restrictions by RUK, concerns over wheat supply chains increasingly go beyond the region and include other post-Soviet countries. An investigation into the supply chains of any exporting countries is needed to obtain a detailed picture of potential production increases and the reliability of such trade partners in international markets (FAO and EBRD 2008; Liefert et al. 2010; Kobuta et al. 2012). However, recent trends in agricultural policy priorities in Uzbek wheat supply chains are not yet well documented. In particular, very few studies investigate the types of policy changes that were introduced in Uzbekistan during the transition period and their corresponding impacts. Although famous for its cotton production and exports, the recent rise of wheat production in Central Asia offers a completely new role for Uzbekistan's agriculture in contributing to regional food security.

For instance, the following questions arguably require further attention in research: What are the main export destinations of Uzbek wheat? Can Uzbekistan's wheat production in irrigated lowlands compete with rain-fed wheat production in the neighbouring countries and contribute to the regional food security? This chapter aims to instigate discussion of these topics.

2 Evolution of Wheat Production in Uzbekistan

Following independence in 1991, Uzbekistan began a transition towards a market economy, with a focus on maintaining economic and social stability. The agricultural sector went through a wide range of reforms that aimed to maintain the provision of income and food security in rural areas. Among the core pillars of these changes was the national food self-sufficiency programme, which set out plans for the expansion of wheat production and its increasing importance for the state and agricultural producers. Prior to independence, domestic production reached only 350,000 tonnes annually and supply was ensured through imports from other regions of the Soviet Union. After 1991, wheat, as well as cotton, was declared a strategic crop in Uzbekistan. The adoption of high-yield wheat varieties and increased attention via the self-sufficiency policy led to improved productivity and production of wheat. For the first 7 years after independence (Fig. 1), the wheat area in Uzbekistan tripled. In fact, in the 1980s wheat occupied about 490,000 ha (ca. 10 % of all sown area in Uzbekistan) and by 1997 it reached almost 1,500,000 ha (30 % of all sown area). In the following years, the area given over to wheat stabilised and further increases in its production were mainly attributable to the yield increases, which were also observed in other post-Soviet countries. In fact, the increase in wheat production volumes from 1997 to 2013 was mainly attributable to the increase in yield from 2.1 tonnes/ha in 1997 to 4.7 tonnes/ha in 2013, which resulted in an annual production of nearly 7 million tonnes (FAOSTAT 2015). This yield increase can be associated with the continuous increase in application rates of mineral fertilisers. According to FAOSTAT (2015), nitrogen fertiliser use in Uzbekistan has increased from 49 kg/ha in 1996 to 167 kg/ha in 2012. The yield increase was also attributed to better seed varieties and improved mechanisms of seed distribution owing to the public maintenance of agricultural research facilities (Pomfret 2008). Alongside the policy of wheat production, additional modern grain harvesters such as those manufactures by Case and Claas were imported and used in place of outdated Soviet combine harvesters. According to FAOSTAT (2015), the import value of agricultural tractors in 1994–2008 increased by a factor of 18. Beyond the national grain self-sufficiency programme,

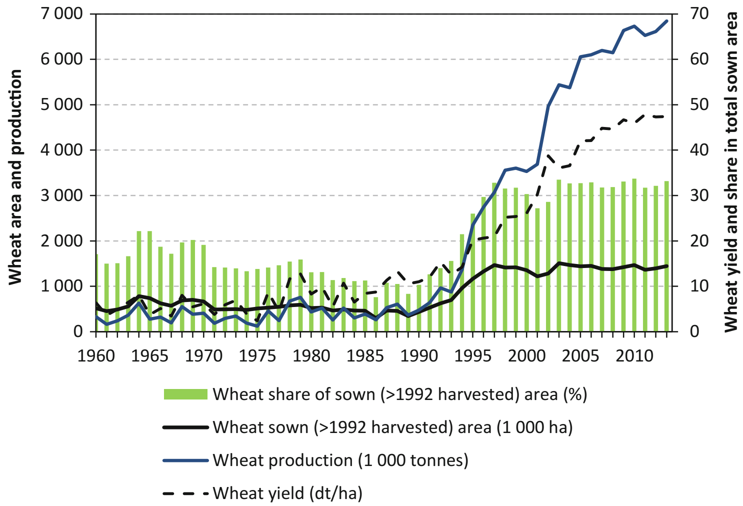

Fig. 1 Wheat production in Uzbekistan. Sources: Shend (1993) for 1960–1991; UzGoscomstat (2007, 2012) and FAOSTAT (2015) for 1992–2013

wheat production continued to be attractive as the corresponding world market prices increased.

To allow for the continuous production of cotton, the expansion of wheat production has been based on the introduction of winter wheat varieties that ensured high yields in irrigated lowlands. Particularly in areas that were under continuous cotton monoculture, winter wheat was preferred by farmers, as it reduced the food insecurity pressure and offered space for follow-up cultivation of high-value crops such as maize, rice, vegetables and potatoes after the wheat harvest in early summer (Akramov 2011). The willingness of Uzbek farmers to intensify wheat production as an alternative to cotton and as an option for the second crop harvest has been discussed in several studies (see e.g. Kienzler et al. 2011a). Higher application doses of nitrogen fertilisers under winter wheat reflect the farmers' preference for wheat cultivation. Wheat–maize and wheat–rice rotations are among the most economically attractive options for farmers in the irrigated lowlands of the Amudarya river basin (Djanibekov et al. 2013).

However, the expansion of the wheat area mainly took place on irrigated lands and occurred at the expense of area under fodder crops, particularly perennials such as alfalfa, which was previously integrated into cotton rotation for nitrogen fixation in soils (Lerman 2008). A substantial decline in the area planted with fodder crops and a lack of rotation has fostered soil degradation (Pomfret 2008). Although the introduction of cotton–wheat rotation is somewhat new in Uzbekistan, it has been practised in Australia (Constable et al. 1992) and in the Punjab region of Pakistan (Byerlee et al. 1987).

Figure 1 illustrates the expansion of the wheat area up to 1997 when agricultural production was still dominated by large-scale collective and state farms. The follow-up increase in wheat production through improved yields started with the transformation of collective and state farms into agricultural cooperatives (i.e. in 1997–2002) with the emphasis on family contracts as well as on the process of gradual farm restructuring. The latter was characterised by the transfer of land and agricultural production from large-scale farms to smaller individual farms. In 1998, with the goal of promoting the gradual individualisation of agricultural production, three types of private farms were introduced, based on their production specialisation: (1) cotton- and wheat-producing farms that also produce rice and vegetables on a small share of their farmland; (2) horticultural and gardening farms (specialising in fruit, grapes and vegetables production); and (3) livestock, poultry and other farms (Djanibekov et al. 2012). The second and third farm types are also involved in wheat production. Those farms specialising in cotton and/or wheat production are dominant and account for over half of all farms. Compared with those specialising in vegetable and fruit production with an average size of 15 ha, cotton- and wheat-producing farms cultivate about 100 ha on average (Djanibekov and Wolz 2015). In 2009–2012, almost 84 % of all wheat in Uzbekistan was produced by individual farms, whereas rural households contributed 15 % to the national wheat output. The latter remain net buyers of wheat with an annual production (e.g. in the Khorezm province) covering only around one-third of the annual consumption requirements (Djanibekov 2008).

Wheat production in Uzbekistan is coordinated by means of a system of state procurement. During the first years of transition, agricultural reforms were supplemented with the partial abandonment of the state procurement regulations for the majority of agricultural products. However, wheat production remained within the system of production targets with the state agencies controlling agricultural input supplies to produce a contracted amount of this crop (Bobojonov et al. 2010). According to the procurement contracts that wheat-producing farms conclude with the state mills, the entire harvest had to be sold at the state-determined prices, which were usually lower than the domestic market levels. Comparing both bio-physical information and socio-economic survey data with the official norms of fertiliser application, Kienzler et al. (2011a) concluded that the procurement settings defined a rather narrow crop production frame in which farmers were bound to follow the N-fertiliser recommendations to ensure that production targets were fulfilled, even at high production costs. However, at a later stage of the transition, a slight revision to the state procurement policy allowed farmers to keep the wheat harvest above the contracted amount and to sell it at domestic markets. This change in the procurement policy, permitting farmers to market a share of their wheat harvest for cash, may also explain the continuous increase in wheat yield (Pomfret 2008).

However, the explanation for increasing wheat yields from the late 1990s would not be complete without mentioning the pricing mechanism practised within the wheat procurement policy. The current pricing policy does not differentiate the quality of wheat grains, but rather reflects the quantity targets that farmers have to deliver annually. Although there is a negative relationship between wheat yield and quality, the producers' interest to fulfil the production targets without a mechanism of price differentiation leads to high yields but low quality of domestic wheat (Kienzler et al. 2011b). Therefore, despite a continuous increase in wheat production, there are growing concerns about the need to improve its quality and nutritional characteristics for production of high-quality wheat products. The proposed options for improving the quality of locally produced wheat range from pure economic incentives such as price differentials and farmers' training programmes to technical measures such as adjustments in fertiliser application schemes and the development of wheat varieties with a narrower yield–quality relationship suitable for irrigated lowlands of Uzbekistan (Kienzler et al. 2011b). To improve the quality of locally produced wheat products, Uzbekistan relies currently on imports of wheat flour of better quality from Kazakhstan which is mixed with domestically produced wheat.

3 Spatial and Temporal Development of Wheat Production

The increase in the wheat crop area mainly occurred up to 1997, as illustrated by the regional level wheat area data (Table 2). There was no sharp increase in the harvested area between 1996 and 2012. However, some increase of the wheat

Table 2 Dynamics of regional harvested area of wheat (1000 ha)

Region	1996	2000	2005	2010	2012
Karakalpakstan	33.8	38.8	60.9	66.5	62.9
Andijan	84.7	80.0	81.6	88.5	87.7
Bukhara	61.6	77.3	86.1	92.0	91.5
Jizzakh	173.0	185.9	194.8	165.5	156.5
Kashkadarya	244.1	183.6	219.3	217.2	203.1
Navoi	34.1	39.8	43.3	47.7	47.8
Namangan	83.0	83.2	84.5	88.9	87.7
Samarkand	131.5	130.3	153.3	162.3	145.8
Surhandarya	111.8	110.3	114.5	114.7	114.4
Syrdarya	93.0	91.4	92.3	93.4	92.4
Tashkent	119.7	111.8	127.9	133.5	131.7
Fergana	101.5	116.9	124.0	129.3	128.2
Khorezm	33.6	30.7	47.3	50.5	47.9
Total national	1305.8	1279.7	1428.4	1450.9	1397.9

Sources: UzGoscomstat (2007, 2012)

area still occurred in the north-western regions of Uzbekistan. In particular, the harvested area in the Autonomous Republic of Karakalpakstan almost doubled between 1996 and 2012. Slight increases were also observed in the Bukhara and Khorezm regions as well as in the Navoi region. However, in Jizzakh and Kashkadarya, wheat areas have decreased since 1996.

Although wheat area in the north-west regions has increased since 1996, the share of wheat in the total crop area in these regions is still lower than in the central regions. Figure 2 illustrates the spatial distribution of wheat share, given the total crop area in 2012. Darker green colour stands for the lower share of wheat in the total crop area and, what concerns the central regions, is mainly due to relatively favourable climate conditions. However, it should be noted here that much of the land in the central regions (i.e. in Navoi, Bukhara and Kashkadarya regions) is uncultivated, and the size of the province in Fig. 2 does not reflect the actual contribution to national wheat production.

As outlined above, improvements in wheat yields were crucial for the increase in total wheat production in Uzbekistan from 1996. In fact, although the wheat area has been stable at the national level since 1996, wheat production continued to increased and almost doubled by 2012. This pattern is observed across all regions. The highest production increase was observed in Karakalpakstan owing to the combined effect of increased area and improved yields (Table 3).

However, yields per hectare differ significantly across the regions in Uzbekistan (Table 4). Although considering data for yields at regionally aggregated levels might arguably be somewhat misleading, farm level yields estimated from household surveys tend to confirm the figures (Bobojonov 2012). The highest yields are observed in the Andijan, Bukhara and Fergana regions. The lowest yields are observed in Karakalpakstan and Jizzakh regions. Two columns in Table 4 present

Fig. 2 Spatial distribution of area allocation for wheat in 2012, in % from total arable land. Source: own presentation based on UzGoscomstat (2012)

Table 3 Changes in regional production of wheat for the selected years (1000 tonnes)

Region	1996	2000	2005	2010	2012
Karakalpakstan	18.9	89.2	162.1	196.3	156.6
Andijan	410.6	504.9	486.3	511.7	567.5
Bukhara	159.5	311.6	500.9	546.3	553.6
JIzzakh	160.9	299.3	496.8	456.8	442.8
Kashkadarya	302.7	275.4	813.7	920.8	852.9
Navoi	63.5	115.5	194.1	231.7	235.1
Namangan	263.9	277.9	410.8	441	441.9
Samarkand	242	336,1	634.7	756.1	781.5
Surhandarya	298.4	241.5	542.9	595.2	594.8
Syrdarya	147	181.8	349.8	397.1	444.3
Tashkent	276.4	327.6	497.4	617.9	580.7
Fergana	337	418.4	633.6	739.8	751.2
Khorezm	61.4	152.8	204.7	246.6	209.3
Total national	2742.2	3532	5927.8	6657.3	6612.2

Sources: UzGoscomstat (2007, 2012)

the statistical means and coefficients of variation (CVs) in terms of wheat yields (1996–2012).

The availability of irrigation water is often discussed as the main risk source for agricultural production in the downstream regions (Bobojonov and Aw-Hassan 2014). However, interestingly CVs in downstream regions such as the Khorezm region and Karakalpakstan, which are prone to more desert climates and water scarcity, are within the same range as in the upstream regions such as Surkhandarya and Samarkand. This can mainly be explained by the seasonal character of water availability. Wheat is mainly produced as a winter crop and is usually affected less

Table 4 Regional level wheat yields for the selected years (tonnes/ha)

Region	1996	2000	2005	2010	2012	Mean	CV (%)
Karakalpakstan	0.56	2.3	2.66	2.95	2.49	2.5	30.9
Andijan	4.85	6.31	5.96	5.78	6.47	6.1	7.8
Bukhara	2.59	4.03	5.82	5.94	6.05	4.8	27.1
Jizzakh	0.93	1.61	2.55	2.76	2.83	2.2	35.1
Kashkadarya	1.24	1.50	3.71	4.24	4.20	3.0	40.4
Navoi	1.86	2.90	4.48	4.86	4.92	3.9	27.7
Namangan	3.18	3.34	4.86	4.96	5.04	4.3	18.2
Samarkand	1.84	2.58	4.14	4.66	5.36	3.8	33.8
Surhandarya	2.67	2.19	4.74	5.19	5.20	4.0	29.5
Syrdarya	1.58	1.99	3.79	4.25	4.81	3.1	35.2
Tashkent	2.31	2.93	3.89	4.63	4.41	3.6	22.4
Fergana	3.32	3.58	5.11	5.72	5.86	4.7	21.0
Khorezm	1.83	4.98	4.33	4.88	4.37	4.3	18.6
National average	2.10	2.76	4.15	4.59	4.73	3.7	26.0

Sources: UzGoscomstat (2007, 2012)

in water-scarce years, because water shortages in the region are mainly observed in the summer months (June, July). More detailed discussion of the seasonal characteristics of water availability is provided in Sect. 5.

4 Supply-Chain Developments

Both individual farms and households are involved in wheat production. However, households are not addressed by the state procurement mechanisms and have a traditional supply chain (Fig. 3). They mainly produce for their own consumption and sell the surplus to local markets or village mills. They buy required inputs from local markets and hire agricultural services such as machinery based on cash payments. Similarly, individual farms may also have similar forms of supply chains when they produce wheat outside the state procurement contracts. The state joint-stock company Uzdonmahsulot is the main purchaser of grain, processor and seller of wheat products. About half of the wheat produced under the state production target is sold to Uzdonmahsulot at fixed prices, which are below the domestic market prices. For the other half, the farmer can decide either to sell at the local markets or to small-scale mills at market prices or to distribute among farm workers as payment equivalent. Uzdonmahsulot has its own mills and can process about 3 million tonnes of wheat annually, which covers almost half of the grain demand in Uzbekistan. The company operates 44 processing companies covering all regions in Uzbekistan and has responsibility for buying and processing all wheat produced, in accordance with the state procurement contracts (Robinson 2008). The processing companies operate 55 mills and 116 bakeries.

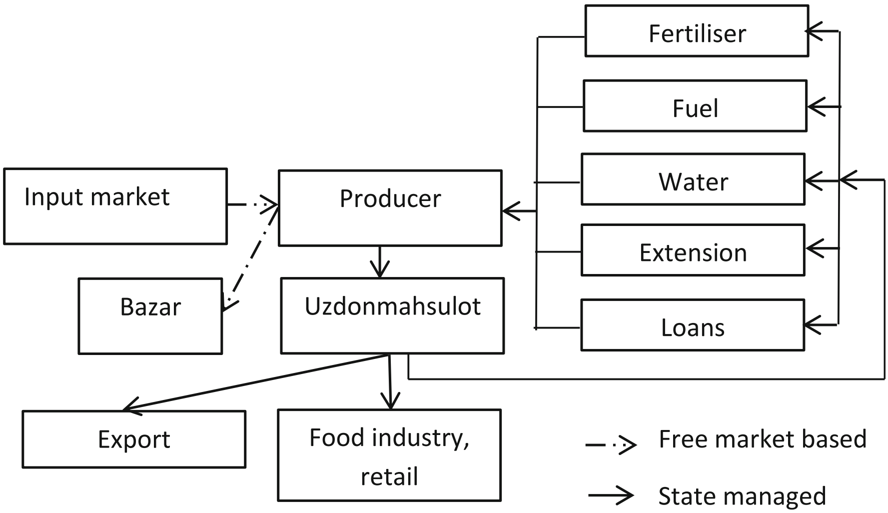

Fig. 3 Simplified representation of supply chains. Source: authors' representation

The price at which Uzdonmahslot purchases wheat is roughly half the domestic market price. In return for the procurement contract, the farmers have access to subsidised inputs for wheat such as fertiliser, diesel and machinery services and access to cheaper loans (Goletti and Chabot 2000; Robinson 2008). However, the price margin between subsidised and market prices has narrowed during recent years and became very close to the input prices observed in other CACs (Bobojonov and Aw-Hassan 2014). Figure 3 shows that farmers growing wheat under state procurement obtain inputs from state input suppliers. One of the main advantages of this kind of input provision mechanism is that farmers are able to obtain input when needed and pay just after the harvest period.

The state procurement policy also determines minimum hectares for wheat per farms as well as the amount of fertiliser to be applied per hectare (Kienzler et al. 2011a). Therefore, input use in Uzbekistan is usually higher than in neighbouring countries (see Table 5). Uzbekistan also produces fertilisers locally which may explain better availability in general compared with other CA countries, which results in wheat yields usually being higher in Uzbekistan than in other CA countries (see Table 1). Nevertheless, in the light of discussing efficiency of resource use, a more careful interpretation of the policy mix and especially issues of its sustainability need to be considered. Bobojonov (2012) demonstrated that technical efficiency in wheat production in Uzbekistan is lower than in other Central Asian countries and that this needs to be addressed in order to increase the competitiveness of wheat production in Uzbekistan.

Uzdonmahsulot also imports wheat under the state-assisted schemes to increase the production output and quality of local wheat products. It operates silos for the state reserve stocks of wheat (Robinson 2008). By means of fixing the purchase price of wheat from farmers, the Uzbek government is able to control the price of

Table 5 Mean fertiliser use for wheat in different provinces (kg/ha)

Region	Nitrogen (N)	Phosphorus pentoxide (P_2O_5)	Potassium (K)
Kazakhstan			
Kostanay	2.0	7.9	
Kyrgyzstan			
Chui	54.4	63.8	
Tajikistan			
Khatlon	99.8	26.7	56.0
RRP	127.7	55.6	
Sugd	176.6	61.2	31.1
Uzbekistan			
Andijan	164.0	68.7	
Karakalpakstan	132.7	78.5	28.0
Kashkadarya	119.5	38.9	18.1
Tashkent	113.8	43.2	25.5

Source: Bobojonov and Aw-Hassan (2014)

basic bread products as part of its social support programme (Bobojonov and Lamers 2008). However, the price of bread on the local markets is freely determined based on supply and demand.

Furthermore, small-scale private mills as well as simple village mills are also available. Recently, the number of village mills has declined and the number of private mills has increased. To lobby the Uzbek millers' interests in the domestic as well as global markets, the private mills have established an Association of Private Grain Milling Enterprises (USDA 2013). The private mills buy domestic wheat from traders and farms at negotiated prices and import higher quality wheat (to be mixed with local wheat). Compared with Uzdonmahsulot, the private mills sell flour at the market prices. Therefore, private entrepreneurship and state-managed supply chains operate in parallel. However, further investigation of this dual system is needed to explore issues such as market power of state companies in import export transactions and constraints of private mills.

Owing to the importance of the wheat sector, the state runs several (semi-public) services which do not exist in most of the Central Asian countries, such as crop insurance, which exists only in Uzbekistan and Kazakhstan. Uzbekistan subsidised premiums during the period 1997–2001 but abolished this practice in 2002. Nowadays, insurance penetration in Uzbekistan is nevertheless the highest in CIS after Kazakhstan (where the insurance sector is still publicly subsidised). About one-third of the wheat area is insured under voluntarily multiple peril crop insurance.

It is usual for about 60 % of locally produced wheat to be used for food and the remaining part to be exported or used as animal feed. The export destinations for Uzbek wheat are mainly Afghanistan, Azerbaijan and Iran. About 450,000 tonnes of wheat were exported to these destinations during the marketing year of 2013–2014 (USDA 2013). Demand for Uzbek wheat is affected by a number of

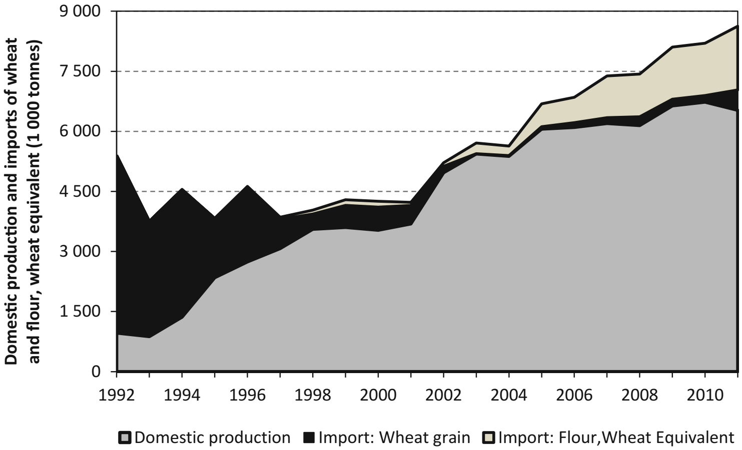

Fig. 4 Structure of wheat supply in Uzbekistan (1992–2011). Source: FAOSTAT (2015)

key factors, such as its low quality and, thus, its limited applicability for baking. First, wheat production in Uzbekistan is less volatile than in RUK. Its production is not correlated with production in these countries[1] (i.e. Uzbekistan may still be able to offer lower price wheat when other countries reduce exports or increase the prices associated with reduced production). Specific examples could be provided from Uzbek wheat exports in 2008, 2010 and 2011 when RUK have introduced export quotas and export bans. Afghanistan imported about 110,000 tonnes of wheat flour from Uzbekistan in 2008 and 2009 when an export ban from Kazakhstan was in place (TradeMap 2015). Between October 2010 and June 2011, Uzbekistan exported about 300,000 tonnes of wheat to Azerbaijan and Georgia (Global Trade Atlas 2013). However, it is important to mention that during those years Uzbekistan still imported high-quality wheat.

Figure 4 demonstrates that before 2003, most wheat was imported to Uzbekistan as wheat grain, whereas after 2003 most wheat was imported as wheat flour. Despite the increasing domestic production of wheat, Uzbekistan's imports in the form of high-quality wheat have been increasing since 2002 from ca. 250,000 tons to 2.1 million tons in 2011. The wheat imports come almost entirely from Kazakhstan (Table 6). There is also some wheat imported from Russia and Ukraine, as seen in Table 6. Overall, about 20 % of wheat required for domestic uses is imported from those countries to mix with local wheat. Although wheat grain is imported through official channels by milling companies, wheat flour is mainly imported through private channels (Robinson 2008).

The data presented in Fig. 4 show that imports of flour have increased rapidly over the past 5–6 years. However, it is important to mention that flour data presented above also contain a certain amount of flour re-exported to Afghanistan

[1]The correlation of yields between Kazakhstan and Uzbekistan is less than 0.3.

Table 6 Wheat and wheat flour imports to Uzbekistan (1000 tonnes)

Exporters		2008	2009	2010	2011	2012	2013
Kazakhstan	Wheat	182,209	163,654	225,106	487,522	614,272	737,428
	Wheat flour	696,890	925,020	1,052,690	1,098,620	1,242,930	977,430
Russia	Wheat	20,708	1314	1987	20,610	578	916
	Wheat flour	64,530	9320	550	45,410	700	400
Ukraine	Wheat	15,553	543	720			
	Wheat flour	4470	1210				
Total	Wheat	218,470	165,511	227,813	508,132	614,850	738,344
	Wheat flour	766,080	935,580	1,053,280	1,144,290	1,243,630	977,830

Source: TradeMap (2015)

via Uzbekistan, that is, the total amount of flour sold in the domestic markets should be corrected (lowered), given the trade flows to Afghanistan.

5 The Price Insulation Effect of the Self-sufficiency Policy

Based on weekly market survey data covering the period 2002–2010, Mori Clement et al. (2014) studied the evolution of the real wheat prices in the Khorezm province of Uzbekistan. Corresponding trends are illustrated in Fig. 5. Despite the increasing production of wheat, its domestic price follows an upwards trend during the entire analysed period, with a significant hike during 2007–2008. The increase was significant (factor of > 3), especially during the period Q1 2006 and Q2 2008. Before 2006, the average monthly increase was 2.6 %, whereas during 2006 and 2007, prices increased monthly by 5 % and 8.3 %, respectively. The price peak for wheat was observed in 2008. This high price level could be associated with the transmission of the international wheat prices as well the drought in 2008 in Khorezm and in general in Central Asia. After 2009, the wheat prices dropped monthly by 5.1 %.

The CV of wheat prices increased from 0.34 in 2002–2006 to 0.38 in 2007–2009, thus reflecting the increased price volatility. The latter can be attributed to the price trends in world markets, to the drought in the region (in 2008) and to the fact that Uzbekistan imports large quantities of wheat flour from Kazakhstan (Kienzler et al. 2011b). Mori Clement et al. (2014) argue that the fluctuations in wheat prices were sensitive to external factors such as their respective international prices and oil prices. The authors observe the price transmission between international and local wheat markets in Uzbekistan, which depends on imports of high-quality wheat flour from Kazakhstan. Moreover, oil prices were found to have a significantly positive

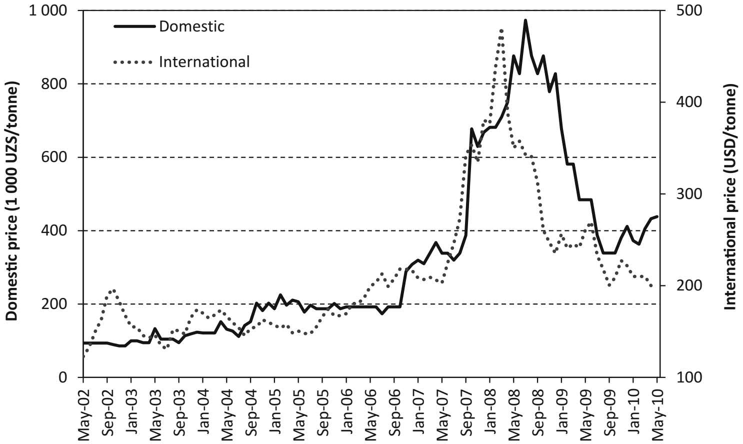

Fig. 5 Real domestic wheat price (1000 UZS/tonne) in Uzbekistan and international wheat price (USD/tonne). Source: Mori Clement et al. (2014)

effect on wheat prices owing to the large share of fuel, machinery service and fertiliser costs in wheat production.

In contrast to the findings for other crops, Mori Clement et al. (2014) did not observe a direct link between exchange rate and wheat price. This can be explained by the fact that the governmental control over the prices of domestically produced wheat and flour as part of the national food security policy was successful in reducing the impact of exchange rates on wheat prices (Al-Eyd et al. 2012). For instance, in 2008, the grain distributed through the state organisation at subsidised prices (USD 500 or less) made up 39 % of the total flour sold in Uzbekistan, whereas imports accounted for 20 % (Robinson 2008).

6 Impact of Climate Change on Wheat Production

The impact of climate change on agricultural production in Uzbekistan has rarely ben investigated in the past (Christmann and Aw-Hassan 2011; Aleksandrova et al. 2014). However, the need for research in this field was acknowledged by many national and international institutes, and a wide range of international articles and reports have emerged during recent years. These studies have investigated, for instance, the impact of climate change on crop productivity and income volatility and have tried to identify the coping mechanisms (Lioubimtseva and Henebry 2009; Kato and Nkonya 2012; Sommer et al. 2013; Bobojonov and Aw-Hassan 2014; Djanibekov and Khamzina 2014). The corresponding findings vary depending on the observed region and crop. Table 7 summarises the impact of climate change on yields of two strategic crops in arid and semi-arid regions of Uzbekistan.

Table 7 Impact of climate change on cotton and wheat yields in Uzbekistan (% change)

Agro-ecological zone	Crop	A1b (2010–2040)	A1b (2070–2100)	A2 (2010–2040)	A2 (2070–2100)
Arid	Cotton	17.2	18.3	15.3	−33.9
	Wheat	13.3	29.1	13.6	26.1
Semi-arid	Cotton	9.3	−38.9	16.9	−54.9
	Wheat	2.9	15.4	3.7	29.9

Source: authors' presentation based on Kato and Nkonya (2012) and Sommer et al. (2013)

Table 7 provides projected yield changes under two emission scenarios (A1b and A2) of the Intergovernmental Panel on Climate Change (IPCC) for two time horizons (IPCC 2007). As can be seen from the table, wheat yields are expected to increase in the future, whereas cotton yields may decline. Increased wheat yields may be explained by the positive effect of temperature increases in the late autumn period (Sommer et al. 2013). Using these projections, Bobojonov and Aw-Hassan (2014) simulated crop allocation and input use under these climate change scenarios. The simulations showed that farm income may increase in the near future (2010–2040) but will decrease in the long-term (2070–2100) scenarios under the current state policy conditions. The same study mentioned above showed that allocation of farmland to wheat production may increase if irrigation water availability will decline in the future. The main reasons for this are outlined in Fig. 6.

Figure 6 illustrates the historical monthly water intake in two regions of Uzbekistan located in the Amudarya river basin. The Samarkand region (Fig. 6a and b) is selected as an example of a region located in the upper stream, and the Khorezm region (Fig. 6c and d) in representative of downstream regions. November, December, January and February are not presented because no irrigation (except leaching) is needed in those months. In turn, water availability in March, April, September and October (Fig. 6a and c) is important for winter crops and in May, June, July and August is crucial for summer crops. Figure 6a and c shows that there are some increases in fluctuations in water availability. However, it is difficult to see a clear trend. In turn, a clearly declining trend can be seen in Fig. 6b and d. Mori Clement et al. (2014) found that wheat in Uzbekistan (i.e. mainly winter wheat) depends less on water variability, which is highest in the summer season and more on world prices. Hence, this supports the argument that winter wheat may become even more attractive in the future if the current trends in water availability continue. Furthermore, the change in operational modes of hydropower dams in the upstream countries may increase water releases in winter at the expense of reduced water flow in summer. Such changes may further motivate switching to winter crops such as (winter) wheat. However, the environmental sustainability of changes in the cropping portfolio requires further investigation.

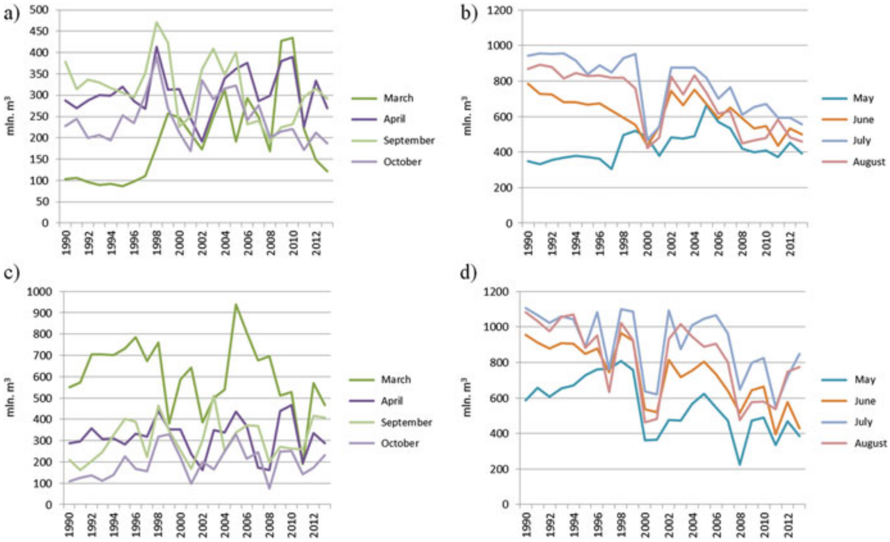

Fig. 6 Monthly water intake in the Samarkand (a and b) and Khorezm (c and d) regions. Source: Bekchanov (2014)

7 Conclusions

Commodity exchange between the former Soviet Union countries collapsed in the early years of independence and most of the Central Asian countries introduced food self-sufficiency policies. One of the main policies in this regard in Uzbekistan was to increase wheat production in order to reduce import dependency. The increase in wheat production was achieved by expanding the areas of wheat cultivation and thereby increasing yields in all regions of Uzbekistan. To that end, Uzbekistan can be seen as a unique example for the whole Central Asian region.

State and government institutions still have a decisive role in food supply chains but at the same time allow private entrepreneurship in all stages of the supply chains. Publicly governed and privately operated supply chains coexist. One of the main challenges in both forms of supply chain is the lack of incentives for agricultural producers to improve the quality of their products, which is particularly relevant in terms of the flour supply chain. In fact, management practices are geared towards maximising quantities. Hence, improving the supply chains and allowing price differentials to drive market mechanisms, which could ultimately motivate farmers to invest in quality-improvement measures, would arguably have the potential of making locally produced wheat competitive with imported wheat from Kazakhstan. Although this may imply a decline in wheat yields and/or total production volumes as argued above, the gains from exporting higher quality wheat may compensate for this.

A comparative advantage of Uzbekistan's (lower quality) wheat production compared with that of RUK is the fact that production risks are not correlated (or only to a limited extent) and in some aspects are attributable to the expected climate change. In fact, Uzbekistan could still export in a years when RUK are inclined to reduce their exports owing to weather extremes. Policy intervention is required with regard to improving storage capacities.

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Wheat Production in Turkmenistan: Reality and Expectations

Ivan Stanchin and Zvi Lerman

1 Introduction[1]

Turkmenistan is a large Central Asian country, which is fourth in land area among the Commonwealth of Independent States (CIS) countries, after Russia, Kazakhstan and Ukraine. The country's area of 491,200 km^2 is just a little smaller than that of Spain (504,700 km^2) or France (547,000 km^2). Turkmenistan extends 650 km from north to south and 1100 km from east to west. It borders Kazakhstan in the north, Uzbekistan in the north and north-east, Iran in the south and Afghanistan in the south-east. Turkmenistan's western border is the Caspian Sea. The total length of its borders is 14,300 km. Amudaria (or Amu Darya), one of the largest rivers in Central Asia, flows through Turkmenistan for 1200 km of its total 1437 km. Some 80 % of Turkmenistan's territory is an arid lowland, namely the Karakum Desert. Turkmenistan's remoteness from oceans, generally low elevations above sea level and southern location are the main factors responsible for its hot and arid continental climate. The natural climatic conditions in Turkmenistan are, on the whole, favourable for growing various cereals, but only with irrigation. Wheat and rice are the main food crops.

[1]The data in this chapter derive mainly from official statistical publications as listed in the References section. Specific references to sources are given only for data from other sources.

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2 Wheat and Cotton Production: Long-term View

An analysis of agricultural production in Turkmenistan over the past 100 years shows that two crops—cotton and wheat—vary in anti-phase and their shares of the sown area fluctuate over time (Fig. 1).

Cotton for industrial uses began to be produced in Turkmenistan only at the end of the 1880s. Areas sown with cotton were expanded to supply sufficient raw material to the Russian textile industry. The low-grade local variety was replaced with better and more costly American and Egyptian varieties, as well as long-staple cotton. Cotton areas and production grew steadily. During 1889–1916 the area given over to cotton increased a hundred-fold and in the Trans-Caspian Region (the part of modern-day Turkmenistan within the administrative borders of the Mary, Akhal and Balkan Velayats), cotton replaced wheat as the dominant crop. Cotton was in fact responsible for the commercialisation of Trans-Caspian agriculture, and in 1911 cotton accounted for 29 % of the sown area.

An analysis of cotton and wheat cropping patterns over the past 100 years (Fig. 1) shows that the share of cotton in sown areas decreased between 1914 and 1920 (World War I and the Russian Civil War) and also between 1940 and 1945 (World War II). The wars disrupted economic relationships between agricultural producers in Turkmenistan and cotton buyers in Russia, and imports of grain in exchange for cotton practically ceased. Food shortages in wartime encouraged the substitution of wheat for cotton, with a corresponding increase in wheat areas (Fig. 1).

Another phase of increasing the share of wheat in the sown area began in the 1990s, when Turkmenistan became an independent state. The disruption of economic relations among the former Soviet republics created difficulties with wheat supply and led to a worsening food-security situation, as was the case in wartime. The government implemented measures that dramatically increased the area of wheat (from 60,000 ha in 1990 to 860,000 ha in 2013), while moderately reducing the area of cotton (Fig. 1, Table 1).

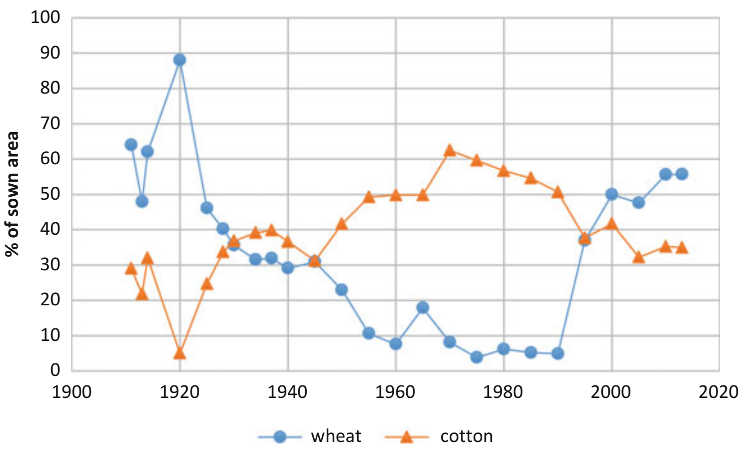

Fig. 1 Shares of wheat and cotton in sown areas in Turkmenistan, 1911–2013

Table 1 Structure of sown land in Turkmenistan, 1960–2013

Year	Total sown area (000 ha)	Wheat (000 ha)	Cotton (000 ha)	Structure of sown area (%)	
				Wheat	Cotton
1960	446	34	222	8	50
1970	636	52	397	8	62
1980	895	55	508	6	57
1990	1231	60	623	5	51
2000	1484	741	619	50	41
2005	2002	953	644	48	32
2013	1600	860	550	54	34

In retrospect, we can see that wheat areas increase in periods when food supply difficulties arise owing to the disruption of regional economic relations and foreign trade links. Food supply difficulties are compensated as a rule by an increase in domestic food production, and primarily the production of wheat on enlarged sown areas. Once the economic and trade relations return to normal, the area sown with wheat is reduced and cotton areas are increased again. This was indeed the pattern in the two wartime periods (1914–1920 and 1940–1945), which present complete 'increase–decrease' cycles lasting 5–10 years. In the mid-1940s, after World War II, cotton became the dominant crop. Its dominance persisted for 50 years, and it was only in the mid-1990s that the share of wheat again exceeded the share of the area sown with cotton. The current phase of increasing the wheat share has now lasted for almost 25 years, but, so far, we have not observed a return to cotton dominance and a corresponding decrease in wheat areas. Areas sown with wheat have stabilised at 860,000 ha annually, with cotton stable at 550,000 ha.[2]

3 Agricultural Reform in the Context of Wheat Policy

What is the future path for wheat production in Turkmenistan? In the early 1990s, Turkmenistan's first president, Saparmurat Niyazov, initiated the *Zerno (Grain) Programme* with the intention of achieving food security through complete self-sufficiency in wheat production.[3] In general, all measures for development,

[2]The relative stability of the cotton and wheat areas harvested indicates that areas of strategic crops are determined by government planning, not by price incentives. Cotton procurement prices were raised between 2007 and 2009 from below those of wheat (per ha) to 3–4 times above those of wheat. In a market economy, such a change would cause a substantial increase in the sown area of cotton area at the expense of wheat, whereas in Turkmenistan the portions of these two crops in the overall harvested area remained constant (see **Fig.** 1).

[3]In 1999 the National Presidential Programme 'Strategy of social-economic change in Turkmenistan to 2010' stipulated that wheat production should achieve 4 million tonnes by 2010, a 10-fold increase from 1992 levels. This was an incredibly ambitious target, given that it would imply a doubling of wheat yields in 10 years, without the appropriate investment in agricultural research and development.

restructuring, institutional, managerial and other reforms in the country were motivated by the task of achieving food security and were thus assigned to the *Zerno* programme.

Wheat production became a top-priority government tool for resolving the food security problem, and the government of Turkmenistan designated wheat a strategic commodity—one of the major agricultural crops in the country. Wheat was protected by high customs barriers and its export required government licenses. Changes in wheat/cotton areas were determined by government fiat, not by producers' responses to market signals.

The entire farming system was restructured. The government assumed the role of buyer and production regulator. The production functions were entrusted to leaseholders operating intra-farm leasehold plots. Presidential decrees specified the areas for wheat production and the target harvest in each region for each year. All aspects relating to wheat production were decided by the government. This included the choice of biological wheat varieties grown, the supply of seeds, land, water, fertilisers and herbicides, technical services, bank credits, cost of inputs and services and, ultimately, the procurement prices.

The development of the grain sector required substantial capital investments. Land areas sown with wheat increased substantially, leading to larger production, and networks of grain-processing enterprises were established. Most of the investments came from the government and the share of private investment in this development was minuscule.[4] To this day, the flour and bread industry is completely dominated by the state, with hardly any private investment—domestic or foreign.

The investments in the *Zerno* programme between 1992 and 2013 amounted to USD 5.5 billion. Most of this amount went to agriculture: 40 % to the development and rehabilitation of the land and 47 % to the purchase of farm machinery (Table 2). The remaining 13 % was used for the construction of grain storage capacities, flourmills and bakeries. The investments brought large areas of virgin land into irrigated cultivation and helped to rehabilitate deteriorating irrigation networks.[5] The purchase of farm machinery was essential for the effective cultivation of new lands, and storage capacities were needed to accommodate increased quantities of grain. Eight large elevators with a total capacity of 360,000 tonnes were constructed with government investment. The new elevators created 352 jobs.

Areas sown with wheat increased faster than the total irrigated area. Furthermore, the expansion of irrigation stopped in 1994, after three decades of rapid

[4]At the beginning of 2009, the milling industry had 14 state-owned enterprises and only two private enterprises – both mini-mills. Of 257 bakeries at that time, only three were small, privately owned bakeries and one was owned by foreign investors. Of the 40 enterprises in the pasta sector, only one was a small private enterprise (Lerman *et al*. 2012).

[5]Government investments increased the irrigated area by 473 100 ha, from 1 369 200 ha in 1990 to 1 842 300 in 2013. This was achieved at a cost of USD 4 560 per additional hectare. The expanding irrigation has kept up with population growth, both roughly tripling between 1965 and 2007, and thus has ensured a generally adequate food supply per capita. However, it inevitably has had serious environmental implications, which are manifested in increased soil salinity and a rising groundwater table. Budgetary constraints have prevented the government from ensuring adequate maintenance of the expanding irrigation system.

Table 2 Investments in the *Zerno* programme, 1992–2013 (million USD)

Use of investments	1992–1999	2000–2008	2009–2013	Total	Structure
Development and rehabilitation of land	1100	500	600	2200	40 %
Purchase of grain combines, tractors, other machinery	700	960	900	2560	47 %
Construction of flourmills, storage capacities, bakeries	300	140	280	720	13 %
Total	2100	1600	1780	5480	100 %

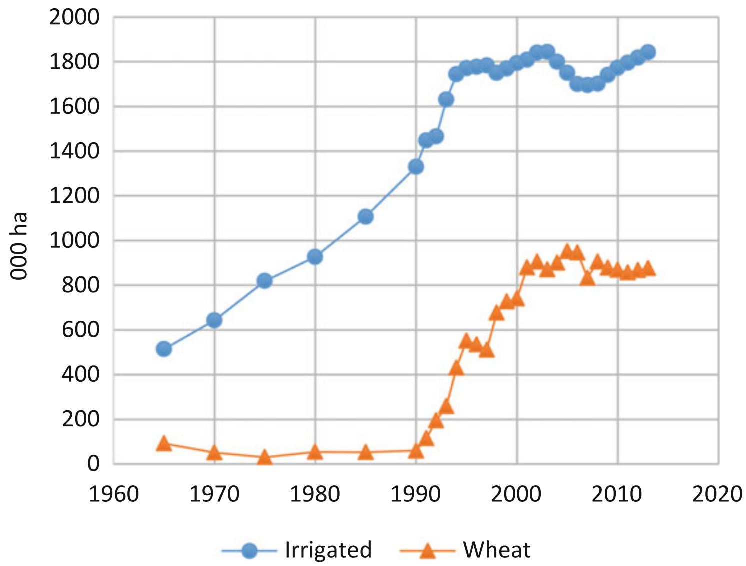

Fig. 2 Irrigated area and area sown in wheat in Turkmenistan, 1965–2013

growth since 1965, whereas the wheat area continued growing unabated (Fig. 2). This was the outcome of the high priority assigned by the government to the development of the grain sector from 1991. In 1990, wheat occupied 60,000 ha and 4.4 % of irrigated land; in the period 1991–2013, the wheat-sown area grew massively, reaching 860,000 ha and 46.7 % of irrigated land (Table 3, Fig. 2).

The emphasis on the grain sector radically altered the use of irrigated land. In 1990, cotton dominated, with 45 % of the irrigated land, whereas wheat occupied only 5 % (the remaining 50 % was sown with other crops and perennials). By 2013, however, wheat had gained dominance. The area given over to wheat could be expanded as a result of the expansion of irrigated land (by 473,100 ha), the contraction of areas sown with cotton (by 73,400 ha) and the contraction of the area sown with all other crops, especially feed crops (253,500 ha). Table 4 shows the transformation of irrigated land use between 1990 and 2013.

The expansion of the irrigated area made it possible to increase the area sown with grain and in particular wheat. The wheat area increased from 60,000 ha in 1990

Table 3 Growth of irrigated land and wheat area in Turkmenistan, 1990–2013

Years (as of January 1)	Irrigated land		Area sown with wheat	
	000 ha	% of 1990	000 ha	Irrigated area (%)
1990	1369.2	100.0	60.0	4.4
1995	1768.5	129.2	552.2	31.2
2000	1792.2	130.9	741.0	41.3
2007	1695.5	127.6	832.9	49.1
2010	1772.2	129.4	860.0	48.5
2011	1794.9	131.1	860.0	47.9
2012	1817.5	132.7	860.0	47.3
2013	1842.3	134.6	860.0	46.7

Table 4 Changing use of irrigated land in Turkmenistan, 1990–2013

	1990		1990–2013 (+, −)	2013	
	000 ha	%	000 ha	000 ha	%
Irrigated land—total area	1369.2	100	+473.1	1842.3	100
Wheat	60.0	5	+800.0	860.0	47
Cotton	623.4	45	−73.4	550.0	30
Other crops and perennials	685.8	50	−253.5	432.3	23

to nearly 900,000 ha in 2013 (Table 3, Fig. 3, orange curve). Wheat production also showed an upward trend in response to area changes, but official statistics grossly exaggerated wheat-production figures after 1998 in an attempt to demonstrate the success of President Niyazov's grain policy (Fig. 3, grey curve).[6] Wheat-production numbers were artificially inflated from 1.2 million tonnes in 1998 to 3.5 million tonnes in 2006, whereas the sown area increased by only 35 % (from 700,000 ha to 950,000 ha). In the absence of any investments in the research and development infrastructure and the total collapse of the scientific institutions in Turkmenistan during Niyazov's tenure, such technological change was simply impossible.

Gurbanguly Berdymukhamedov, the President of Turkmenistan since 2006, ordered in 2007 that the wheat-production statistics (as well as the grossly inflated population numbers) be cleaned up and brought down to sane levels (Berdymukhamedov 2009a, b). The adjustment in 2007 reduced the official wheat-production figures from 3.5 million to just 1 million, effectively rolling wheat volumes back to below the 1998 level. Since 2007, official wheat-production figures have increased from 1 million tonnes to 1.6 million tons in 2013. Throughout the period of Niyazov's presidency, during which statistics were inflated, the United States Department of Agriculture Production, Supply and Distribution

[6]Discrepancies between the optimistic grain production statistics and the true situation became apparent in 2006, during the last months before Niyazov's death. Press reports in May 2006 focused attention on shortages of flour and bread in the country and Niyazov was reported saying that 'in 2007, there won't be enough bread for everyone' (EurasiaNet 2006).

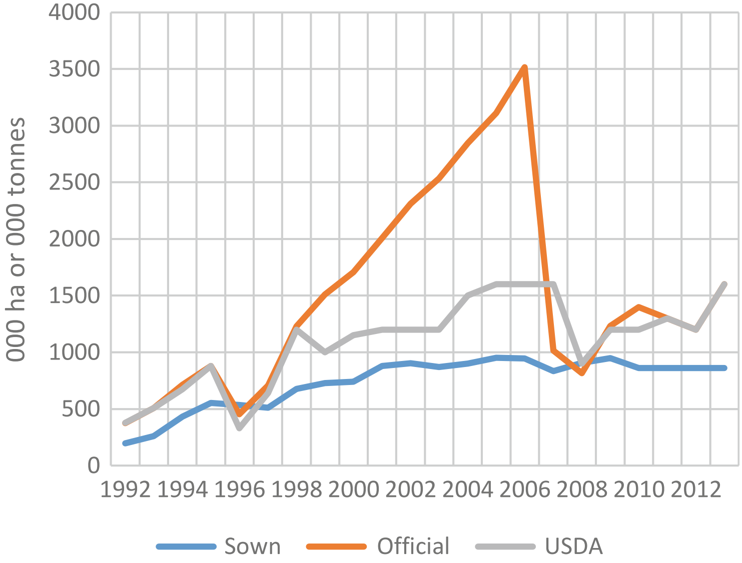

Fig. 3 Wheat production and area sown in wheat in Turkmenistan, 1992–2013: blue line, wheat area, official statistics (000 ha); orange line, wheat production, official statistics (000 tonnes); grey line, wheat production, USDA PSD estimates (000 tonnes)

Online (USDA PSD 2015) continued to publish its own estimates of wheat production, based on reasonable yield figures. The USDA PSD estimates are shown by the grey curve in Fig. 3, which effectively truncates the 'Niyazov pyramid' in 1998–2007 and closely matches the official statistics since 2008.[7]

4 Wheat Yields

During the years of the 'Niyazov pyramid' (1998–2007), the reported wheat production increased much faster than the wheat area (compare the blue and orange curves in Fig. 3). This affected the reported wheat yields, which are determined as wheat production (in tonnes) divided by wheat area (in hectares). The result is reflected in Fig. 4, where official wheat yields (green line) practically replicate the 'Niyazov pyramid' in wheat production (see Fig. 3, grey line). The fabricated grain yields increased to 3.7 tonnes/ha in 2006, rising to 1.5 times the 1990–2002 levels of 2.5 tonnes/ha and, astonishingly, surpassing Eastern European and US wheat yields (3.45 and 2.77 t/ha, respectively; averages for 2000–2005 from FAOSTAT (2015); see Table 5).

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[7]USDA PSD Online (https://apps.fas.usda.gov/psdonline/) is accessible to the public. Turkmen official statistics are not, but many can be found in Lerman *et al*. (2012).

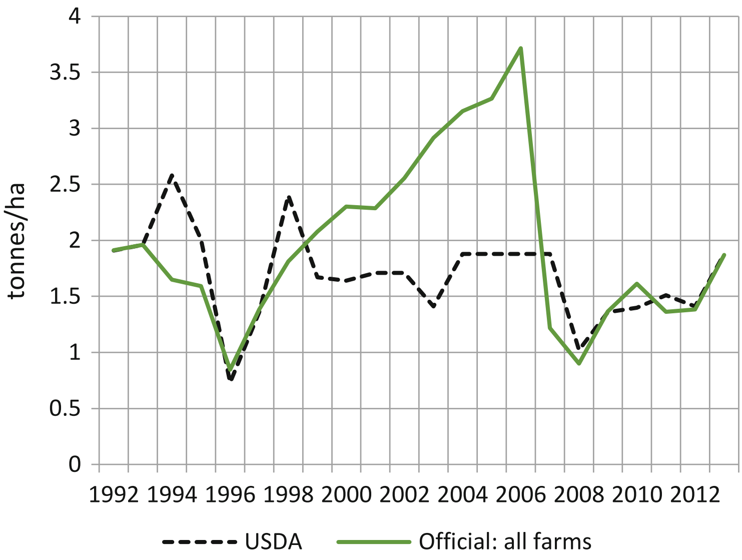

Fig. 4 Turkmenistan: wheat yields, 1992–2013 (official figures and USDA estimates). Source: USDA PSD (2015) and Turkmenistan statistical yearbooks

Table 5 Wheat yields: comparison of Turkmenistan with selected countries

Wheat-producing countries	Wheat (tonnes/ha), 2000–2005 averages
EU-15	5.81
Eastern Europe	3.45
USA	2.77
Developed Africa	2.45
Canada	2.28
New Independent States	1.87
Sub-Saharan Africa	1.62
Turkmenistan (2007–2013)	**1.51**

Source: Cotton lint yields from Cotton Advisory Committee (2002); wheat yields for Turkmenistan from USDA PSD (2015) and official yearbooks; all other countries from FAOSTAT (2015)

Figure 4 shows a large difference between official wheat yields (green line) and USDA yield estimates (black line) for the period 1998–2007, whereas for 1992–1998, the difference was small. After 2008, the two curves are virtually identical. The incredibly high yields according to official data, combined with the abrupt decline in yields in 2007, as well as similar changes observed in other series (e.g. the population data), provide a substantial argument in favour of applying the USDA estimates for production and yields to truncate the 'Niyazov pyramid' (Figs. 3 and 4).

After the post-Niyazov adjustment, the wheat yields dropped to 1.5 tonnes/ha, the second lowest among the countries selected in Fig. 5. Kazakhstan's wheat yields are even lower, at about 1.1 tonnes/ha, but all wheat in Kazakhstan is rain-fed,

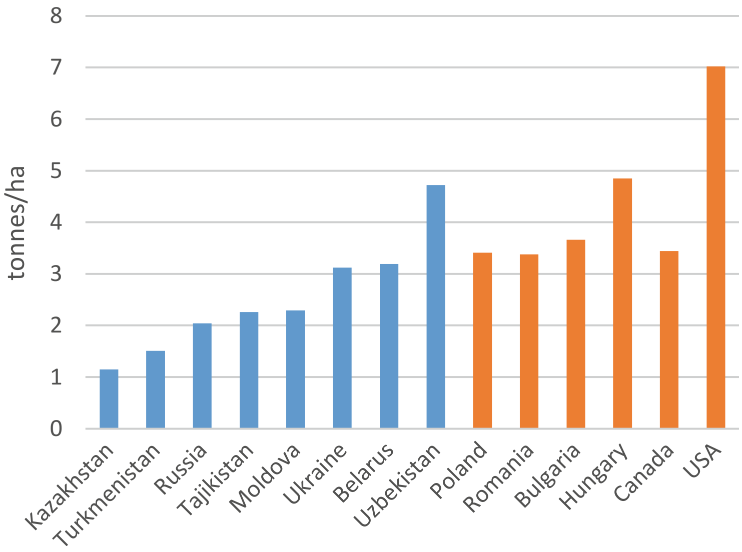

Fig. 5 Grain yields in former Soviet republics (blue bars), Eastern Europe and North America (orange bars), averages for 2007–2013 (Turkmenistan), 2009–2012 (other former Soviet republics), 2009–2011 (rest of the world). Source: see Table 5

whereas Turkmenistan grows wheat under irrigation. Shortages of fertilisers and chemicals during the transition and the collapse of the research and development and extension services in independent Turkmenistan are among the factors responsible for such low yields.

5 Wheat and Cotton Returns

Because of the hot climate, the wheat grown in Turkmenistan is low in gluten (with the exception of wheat from the northernmost regions of the Dashoguz Velayat). It is primarily suitable as animal feed, which was priced in Russian markets at a steady USD 100–110/tonne before 2010, rising to USD 140/tonne in recent years (Veneta Ltd 2014). The total volume of wheat production during 1991–2013 (after correcting for statistical exaggerations in 2004–2006) was 21,500 tonnes, or 11,700 tonnes less than the official figures. Valued at an average price of USD 125/tonne, this sets the cumulative value of wheat produced between 1991 and 2013 at USD 2.7 billion, whereas the capital investment in the grain sector during the same period reached USD 5.5 billion (see Table 2). Directing these funds to wheat imports, Turkmenistan could have imported double the quantity that it produced domestically.

It is thus clear that the policy of ensuring self-sufficiency in wheat by increasing domestic production, and certainly wheat exports, was a loss-making endeavour. Based on the data for 2007–2013 (Table 6), the obvious conclusion is that wheat

Table 6 Returns per hectare for cotton and wheat 2007–2013, in local currency and in USD

	2007	2008	2009	2010	2011	2012	2013
Cotton							
1. Sown area (000 hectares)	642.7	570.4	545.0	550.2	556.4	550.8	550.6
2.Yield (tonnes/hectare)	1.48	1.76	1.77	2.34	1.97	2.24	2.17
3. Cotton production (000 tonnes)	949.8	1001.8	966.2	1286.3	1096.5	1234.9	1194.0
4. Value of raw cotton at state procurement prices (million manat)	1032.0	1077.3	1039.2	1372.1	1174.7	1317.4	1271.1
5. Value of output per hectare (manat/hectare)	1605.7	1888.7	1906.8	2493.8	2111.3	2391.8	2308.6
6. Converted to USD[a]	219.5	378.0	364.6	481.4	412.2	462.2	446.0
7. Value of output (USD/hectare)	341.6	662.7	669.0	874.7	740.8	839.2	810.0
8. Employed in production (000 people)	292.1	285.2	272.5	275.1	278.2	275.4	275.3
Wheat							
1. Sown area (000 hectares)	832.9	905.6	878.5	868.6	857.8	867.0	877.0
2. Yield (tonnes/hectare)	1.22	0.90	1.40	1.61	1.36	1.38	1.87
3. Wheat production (000 tonnes)	1013.6	815.7	1231.4	1400.0	1168.2	1200.1	1640.5
4. Value of wheat at average state procurement prices (million manat)	162.2	130.5	332.5	560.0	467.3	480.0	656.2
5. Value of output per hectare (manat/hectare)	194.5	144.1	378.5	155.1	544.8	553.6	748.2
6. Converted to USD[a]	56.9	45.8	116.7	196.5	164.0	168.4	230.2
7. Value of output (USD/hectare)	41.4	50.6	132.8	54.4	191.2	194.2	262.5
8. Employed in production (000 people)	166.6	181.1	175.7	173.7	171.6	173.4	175.4

[a]Conversion to USD uses official exchange rates (4.70 manat/USD for 2007 and 2.85 manat/USD for 2008–2013)

Source: authors' calculations based on official statistics. Cotton and wheat prices from Presidential Decrees (2007, 2008, 2009)

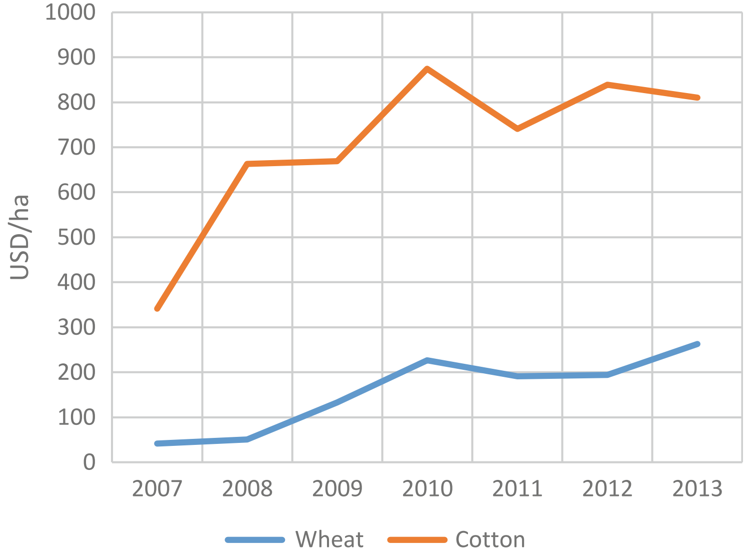

Fig. 6 Return in USD/hectare of sown area from cotton and wheat, 2007–2013. Data are from Table 6

production under Turkmenistan's conditions is economically inefficient. The area sown with wheat in 2013 was 1.6 times greater than the area sown with cotton, whereas the value of wheat produced was only 55 % of the value of cotton.

The return per hectare from wheat was consistently much lower than the return per hectare from cotton over the period 2007–2013 (see Table 6). The wheat returns averaged a mere 20 % of cotton returns during the entire period. Other studies also establish that the profitability of wheat production is substantially lower than the profitability of vegetables or grapes, as well as cotton (Stanchin 2014). Figure 6 shows the gap in returns per hectare between wheat and cotton in terms of US dollars; the picture in local currency (manat/hectare) is essentially the same (Table 6). Furthermore, wheat, unlike cotton, is not a labour-intensive crop and it is much less attractive as a creator of jobs for rural people: wheat production employed about 175,000 workers compared with cotton's 280,000 workers (averages for 2009–2013; see Table 6). This suggests that wheat production in Turkmenistan is not economically efficient and that the whole issue of domestic wheat production is motivated mainly by political considerations.

6 Wheat Exports

Despite the lower returns and the smaller job-creation opportunities, there has been no change in the policies developed in line with the *Zerno* programme in the early 1990s. Wheat continues to dominate the cropping structure (see Fig. 1).

President Gurbanguly Berdymukhamedov announced at the government meeting broadcast on state television on 25 February 2011 that in 2010 Turkmenistan had achieved a realistic possibility of exporting wheat to the world market for the first time in its history. Turkmenistan thus joined the club of food-wheat exporters.

Turkmenistan started exporting food grain in 2010. Of the total 2010 gross harvest of 1.4 million tonnes, 150,000 tonnes of wheat were exported through the state-controlled commodity exchange (another 30,000 were sold domestically through the exchange). No exports were initially attempted in 2011 owing to concerns about the effect of drought in that year, but in 2012 the Turkmengalloanumleri State Grain Association was allowed to export 300,000 tonnes of wheat from the 2011 stocks that exceeded domestic consumption needs.

In 2010, Turkmenistan adopted the *National Programme of Socio-Economic Development of Turkmenistan for 2011 2030*. The programme envisages systematic increase of wheat production up to 1.9 million tonnes in 2030, accompanied by steady increases in potential exports (Table 7).

The programme anticipates an increase of 29.5 % in flour production from domestic wheat during 2013–2030. The population is estimated to increase by 29.5 % in this period. Taking the flour-production projections for 2013–2030 as optimal normative demand (about 110 kg/year per capita), we estimated the volume of wheat required for domestic consumption as flour (Table 7). In addition, 198,000 of wheat were reserved annually for seed. If the projections set by the national programme are attained, Turkmenistan should be able to export about 400,000 of wheat annually after 2013, regardless of economic efficiency considerations. Based on recent updates, the actual exports of wheat in 2015 will be more modest, at a level of 200,000 tonnes (UkrAgroConsult 2015).

Table 7 Projected wheat production in Turkmenistan, 2010–2030

Years	Production (000 tonnes)		Flour produced (000 tonnes)	Wheat used for domestic consumption (000 tonnes)			Export potential (000 tonnes)
	Planned	Actual		Milling	Seeds	Total	
2010	1600	1400	573.9	820	198	1018	382
2011	1625	1168	633.2	905	198	1103	65
2012	1639	1200	660.6	944	198	1142	58
2013	1654	1640	691.6	988	198	1186	454
2014	1669		709.0	1013	198	1211	458
2015	1685		750.3	1072	198	1270	415
2020	1810		849.1	1213	198	1411	399
2025	1849		872.7	1247	198	1445	404
2030	1896		895.7	1280	198	1478	418

Source: National Programme 2011–2030 (2010), statistical yearbooks and authors' calculations

7 Conclusion

Food security considerations acquired special significance following Turkmenistan's independence, when supply chains with other former Soviet republics collapsed. The policy measures to increase wheat production that were announced in the early 1990s led to the rapid expansion of sown areas from 60,000 ha in 1991 to 860,000 ha in 2013, with production volumes rising from 133,800 tonnes to 1.6 million tonnes during the same period. However, wheat production in Turkmenistan is much less profitable than cotton production (and vegetable and grape production). The government wheat expansion policy was obviously not guided by economic considerations; the main driving force was the political desire to maintain independence in decision-making.

Turkmenistan's wheat production and exports are small compared with those of Kazakhstan, Russia and Ukraine. However, the fact that this traditional wheat importer has reached self-sufficiency and started exporting is a major achievement in itself. World experience shows that domestic production is the best guarantor of food security. This is particularly clear in a political environment prone to sanctions and counter-sanctions. This chapter shows that the accumulation of national wealth through the efficient exploitation of natural resources is secondary to political considerations and international relations in Turkmenistan.

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Part IV
A Neighbouring and Global Perspective

The Development of the Eurasian Livestock and Grain Economies

William M. Liefert and Olga Liefert

1 Introduction

The major agricultural countries of Eurasia (Russia, Ukraine and Kazakhstan (RUK)) began their transition from planned to market economies with independence in 1991. The systemic and policy changes that drove this transition substantially altered the volumes and mix of their agricultural production, consumption and trade.

During the Soviet period, the regime expanded the livestock sector and imported large volumes of grain, soybeans and soybean meal needed for animal feed. The agricultural restructuring that took place during transition reversed these policies, which generated the following major changes: the livestock sector contracted severely; grain production fell substantially; the large imports of grain (as well as of soybeans and soybean meal) ended; and Russia became a big importer of meat and other livestock products.

From around 2000, the Eurasian livestock sectors began to rebound. However, high gross domestic product (GDP) and income growth drove such a big increase in consumer demand for livestock goods that imports of meat and dairy products, in particular by Russia, rose. In 2008 (immediately before the world economic crisis hit the region), RUK accounted for 16 %, 22 % and 18 % of total world imports of beef, pork and poultry, respectively (excluding trade between the three countries). Russia's share alone equalled 16 %, 18 % and 14 %. Another major development since 2000 is that grain production in the three countries has increased substantially,

The views expressed in this chapter are those of the authors and may not be attributed to the Economic Research Service or the United States Department of Agriculture.

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generating large surpluses for export. During the period 2011–2013, these three countries as a region supplied 19 % of total world grain exports and 21 % of wheat exports, supplanting the USA as the world's biggest wheat exporter (United States Department of Agriculture (USDA) Foreign Agriculture Service (FAS) Production, Supply and Distribution (PSD) online database; see http://www.fas.usda.gov/psdonline/).

This chapter examines the driving forces behind these major commodity developments, in both the 1990s and since 2000. More generally, the chapter analyses the evolution of these countries' livestock and grain sectors. For both sectors, we use supply, demand and trade analysis to examine the market for a 'typical' livestock product and a grain product. We examine the market for each product during the central planning period, after the move to a market economy in the 1990s and during the 2000s, and then use that analysis to provide an outlook for the product (sector). Given that we are studying the development of two major agricultural sectors that have multiple sub-products for three different countries, the analysis by necessity must be general and broad. In particular in the graphical market analysis, we present only the main developments, inevitably omitting much of the country- and product-specific detail.

The chapter focuses on RUK, and this is the order of interest and emphasis followed in the graphical market analysis and presentation of country-specific experiences, information and detail.

2 The Livestock Sector Before and After Reform in the 1990s

The main objective of Soviet agricultural policy during its last two decades was to expand the livestock sector, in order to improve the population's standard of living by increasing their consumption of meat and dairy products. Between 1970 and 1990, the regime succeeded in raising meat production by over 60 %. The government further increased supplies of livestock goods available for domestic sale by means of imports. Table 1 shows that during the period 1989–1991, RUK imported a net 1.2 million tonnes of meat a year (annual average), excluding trade with each other. By 1990, Soviet per capita consumption of meat and other livestock products was close in volume to that of many rich developed countries, despite Soviet per capita GDP being, at most, half the level of those countries (Sedik 1993).

The left side panel of Fig. 1 gives the 'market' for a typical Soviet livestock product in the late 1980s. D^1 is the demand curve. Given that planners rather than price-generating markets determined what goods were produced in the Soviet Union and at what volume, S^1 is not a market supply curve; rather, S^1 is the economy-wide marginal cost of production curve for the product. We assume that the planned economy produced Q^5 of the product at a marginal cost of P^6 and that

Table 1 RUK meat and grain production and trade

Period	Meat		Grain	
	Production (million tonnes)	Net trade (million tonnes)	Production (million tonnes)	Net trade (million tonnes)
Total RUK[a]				
1989–1991	11.9	(1.2)	160	(16.2)
1992–1995	8.7	(1.1)	138	(2.1)
1996–2000	5.7	(2.5)	100	4.0
2001–2005	5.6	(2.9)	126	20.9
2006–2010	7.3	(3.6)	139	35.7
2011–2014	9.4	(2.5)	161	58.9
Russia				
1989–1991	7.2	(1.9)	95	(20.9)
1992–1995	5.4	(1.4)	84	(7.9)
1996–2000	3.6	(2.5)	63	(3.0)
2001–2005	3.7	(2.8)	76	8.1
2006–2010	4.9	(3.1)	82	14.2
2011–2014	6.7	(2.3)	86	22.8
Ukraine				
1989–1991	3.7	0.4	43	0.1
1992–1995	2.5	0.1	35	0.0
1996–2000	1.6	0.1	26	2.7
2001–2005	1.4	(0.0)	35	8.2
2006–2010	1.6	(0.3)	39	14.1
2011–2014	2.0	(0.1)	57	27.6
Kazakhstan				
1989–1991	1.1	0.2	21	4.6
1992–1995	0.9	0.1	19	5.7
1996–2000	0.5	(0.0)	11	4.3
2001–2005	0.5	(0.1)	14	4.6
2006–2010	0.7	(0.2)	17	7.4
2011–2014	0.7	(0.2)	18	8.4

[a]Figures are average annual values during the period identified in the first column. Figures for grain are for the marketing year (July–June), and for meat are for the calendar year. Grain production and trade exclude rice, buckwheat, sorghum and pulses. Meat covers beef, pork and poultry broilers. For grain production and trade, the first row for each country and the total RUK covers 1987–1991, not 1989–1991. Trade values in parentheses are net imports and those without parentheses are net exports. Imports and exports are net of trade among RUK, and net vis-à-vis the rest of the world

Source: USDA FAS PSD online database

net imports equalled Q^6–Q^5. S^2 gives the total supply of the product made available for domestic sale from domestic production and net imports, at the volume Q^6.

A feature of the Soviet economy is that consumer prices for many foodstuffs (especially livestock goods) were set below the market-clearing price, which generated excess demand and market shortages (Davis and Charemza 1989). This

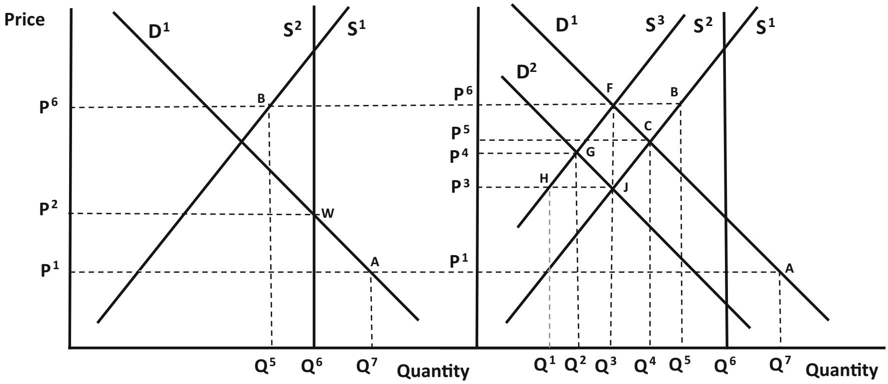

Fig. 1 Livestock sector before and after reform in the 1990s

led to the misconception in both the country and the West that the USSR suffered from food shortages in a more basic material sense. Figure 1 assumes that the government sets the price for the good at P^1 rather than the market-clearing price of P^2, such that excess demand for the good exists equal to Q^7–Q^6.

In the Soviet economy, producer prices were cost-based. Soviet price-setting for livestock products resulted in large gaps between producer and consumer prices. In 1986, the ratio of producer to consumer prices for Soviet beef, pork and poultry equalled 2.24, 1.41 and 1.21, respectively (Liefert et al. 1993). These price gaps (P^6–P^1in Fig. 1) required large state budget subsidies, which were typically paid to food processors.

The move from planned to market economies that began with the RUK countries' independence in 1991 substantially contracted their livestock sectors. Table 1 shows that average annual meat production in all three countries during the period 1996–2000 was half (or even less) than during the period 1989–1991. Output of dairy products, as well as animal inventory levels, fell by equally large percentages.

The main reason for the sector's contraction was that the economic reforms and government budget austerity that began in the early 1990s eliminated the heavy state support, both direct and indirect, that had driven the sector's expansion during the Soviet period. The Soviet regime had supported the agricultural sector, and in particular the livestock industries, in three ways. First, state budget subsidies were used, and in 1990 these equalled about 10 % of Soviet GDP. Second, prices for agricultural inputs were set low relative to their production costs and to agricultural output prices. Third, output prices for many agricultural products, in particular livestock goods, were set high relative to world prices (called market price support). Liefert et al. (1993) found that in 1986, Soviet producer prices for beef, pork and poultry were about one-quarter, one-sixth and two-thirds above world prices, respectively (using an economically meaningful exchange rate between the rouble and US dollar).

Owing to the collapse in state revenue during the first years of reform, the large Soviet-era budget subsidies to Russian agricultural producers and consumers were largely eliminated. Price liberalisation also terminated the indirect subsidies that producers had received from the Soviet price system. When domestic prices changed to reflect the real costs of producing goods, agricultural input prices rose relative to output prices, such that agricultural producers' terms of trade (output versus input prices) worsened dramatically. Trade liberalisation then resulted in domestic prices for many agricultural goods moving downwards towards world prices, further exacerbating producers' terms of trade vis-à-vis their domestic input suppliers.

From 1991 to 1997, the domestic terms of trade of Russian agricultural producers fell by about 75 % (OECD 1999). Higher relative prices for inputs generated a severe drop in their purchase and use. Compared with 1990 levels, the volume of tractor deliveries to farms and the use of mineral fertiliser, oil-based fuel (gasoline and diesel fuel) and electric power by Russian agricultural producers in 2000 were down by 30 %, 75 %, 78 % and 55 %, respectively (Russian Statistical Yearbook). The large drop in agricultural input use resulted in lower production.

In Fig. 1, the right side panel reproduces and expands on the left side panel, and shows how these policy changes drove the market for livestock goods. In the new market economy, S^1 becomes the supply curve. Elimination of all budget subsidies had the isolated effect of moving the market to point C, as determined by the intersection of D^1 and S^1. Production fell from Q^5 to Q^4. Price liberalisation, which increased the costs of inputs relative to output, shifted the supply curve from S^1 to S^3, with the isolated effect of output falling further from Q^4 to Q^3. Trade liberalisation, which moved the domestic price to the world price of P^3, decreased output even more, from Q^3 to Q^1.

The move to a market economy also shifted the demand curve for livestock products from D^1 to D^2. The massive restructuring of the entire economy during the 1990s along market lines substantially reduced GDP and consumer income, as resources had to be reallocated to new uses. From 1990 to 1999, GDP in both Russia and Kazakhstan fell at an average annual rate of about 5 %, and in Ukraine by about 9 % (Economic Research Service macroeconomic database). The drop in consumer income decreased demand for all foodstuffs, and in particular for livestock goods, with high income elasticity of demand. The isolated effect of the shift in the demand curve (assuming no trade liberalisation) was a drop in the quantity purchased from Q^3 to Q^2.

Market 'equilibrium' during the 1990s from all these changes occurred with the world price of P^3 setting the domestic price, with Q^1 domestically produced (compared with Q^5 pre-reform), Q^3 domestically purchased/consumed and Q^3–Q^1 imported. In the market figures, certain price or quantity levels may be associated with two points within the figure, simply to avoid cluttering. For example, Q^3 is the quantity domestically purchased at final market equilibrium (associated with point J), as well as the quantity that would be produced and purchased only after the termination of budget subsidies and domestic price liberalisation that worsens producers' terms-of-trade (associated with point F). These two volumes are not identical. In addition, the figures are not always drawn to scale, that is, the relative magnitudes of production, consumption and trade do not necessarily represent their historical size. Rather, the figures are drawn to highlight the direction, rather than the magnitude, of market changes.

Although livestock producers lost out as a result of trade liberalisation, consumers benefited from the drop it generated in domestic producer prices. Trade liberalisation had the isolated effect of increasing purchases/consumption from Q^2 to Q^3. Rather than producing high-cost livestock products, as was the case during the Soviet period, Russia expanded its average annual net imports of meat from 1.9 million tonnes during 1989–1991 to 2.5 million tonnes during 1996–2000. Over this period, RUK increased its aggregate annual net imports of meat (excluding trade with each other) from 1.2 to 2.5 million tonnes (see Table 1).

3 The Grain Sector Before and After Reform in the 1990s

The rapid expansion of the Soviet livestock sector from 1970 to 1990 required a large amount of animal feed, which the domestic economy could not fully provide. Consequently, from the early 1970s, the USSR became a big importer of feed grain, as well as of soybeans and soybean meal. Table 1 shows that in the period 1987–1991, RUK average annual net imports of grain equalled 16.2 million tonnes. (For grain production and trade in the table, the first row for each country and total RUK covers 1987–1991, not 1989–1991.)

Figure 2 gives the ‘market’ for a typical grain product (which in this section we simply call ‘grain’) during the Soviet period, and also shows how the market adjusted to the move from a planned to a market economy. S^1 is the marginal cost of grain production. We assume that the country produced Q^4 at a marginal cost of P^3. D^1 is the planners’ demand for grain, as determined by their overall plan for the agricultural and food economy. The planners want Q^5 of grain for the economy, and they make up the shortfall by importing Q^5–Q^4. The grain is sold to consumers/users at P^2, and the gap between the producer and consumer price of P^3–P^2 is covered by state budget subsidies. Liefert et al. (1993) show that the ratio of Soviet producer to consumer prices for wheat, maize and other coarse grains in 1986 equalled 1.12, 1.20 and 1.18, respectively.

With the move to a market economy, S^1 becomes the grain market supply curve and D^2 the demand curve. As with the livestock sector, the move from a planned to a market economy ended most state budget subsidies to the new RUK grain economies. Figure 2 shows that the market adjustment from this change alone is determined by the intersection of D^2 and S^1 at point C, with output dropping from Q^4 to Q^3. However, grain producers also suffered from a major deterioration in their terms of trade stemming from domestic price liberalisation, as input prices rose substantially relative to output prices. For example, in 1992, Russian wheat producers had to sell, on average, 0.3 tonnes of output to purchase one tonne of nitrogen fertiliser, whereas by 1997 they had to sell 1.4 tons of wheat (Russian Statistical Yearbook). This change is represented in Fig. 2 by the shift to the left in the supply curve from S^1 to S^2, which further reduces output from Q^3 to Q^2.

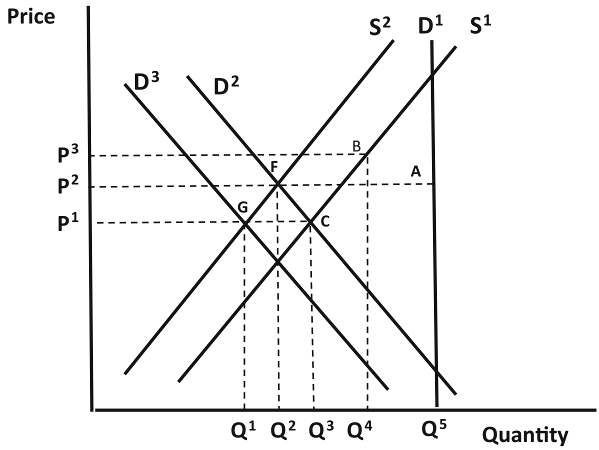

Fig. 2 The grain sector before and after reform in the 1990s

Falling consumer income lowered demand for food grain, whereas the severe contraction of the livestock sector in RUK during the 1990s decreased demand for feed grain. In the figure, the demand curve shifts left from D^2 to D^3, reducing output even more from Q^2 to Q^1. The final market equilibrium occurs at point G. Production falls in total from Q^4 to Q^1, sold at P^1. Table 1 shows that total RUK grain production declined from 160 million tonnes during 1987–1991 (average annual) to 100 million tonnes during 1996–2000, with large drops seen in each country.

The contraction of the livestock industry in the 1990s ended the large Soviet-era imports of grain. The average annual net grain imports of 16.2 million tonnes for RUK during 1987–1991 changed to average annual net exports of grain of 4.0 million tonnes during 1996–2000. Ukraine and Kazakhstan were small exporters, whereas Russia was a small importer. Given these minor trade magnitudes, Fig. 2 does not show any grain trade (which means that the domestic price of P^1 equals the world price).

The analysis reveals that the RUK economies' move from planned to market economies in the 1990s fundamentally restructured the volumes and mix of their agricultural production, consumption and trade. The major changes were a huge contraction of the livestock sector; growth in imports of meat and other livestock products; a substantial drop in grain output; and termination of the large Soviet-era imports of grain, soybeans and soybean meal.

4 The Livestock Sector Since 2000 and Outlook

Figure 3 presents the market for livestock products since 2000. The demand curve D^2 and supply curve S^3 are the same as in Fig. 1. The analysis begins with the post-reform market equilibrium of the 1990s identified in Fig. 1, where the domestic

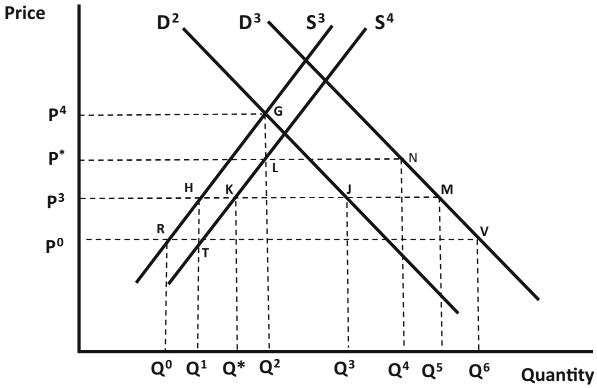

Fig. 3 The livestock sector since 2000

price of the livestock good (sector) is determined by the world price of P^3, Q^1 is domestically produced, Q^3 domestically purchased, and imports equal Q^3–Q^1.

Starting in the early 2000s, the livestock sector in RUK began to rebound. Total RUK meat production rose from an average annual output during 2001–2005 of 5.6 million tonnes to 9.4 million tonnes during 2011–2014 (see Table 1). Poultry production in Russia and Ukraine has boomed, and it is rising in Kazakhstan as well, whereas pork output in Russia and Ukraine is also increasing. However, in all three countries, the beef industry is yet to experience a turnaround after more than two decades of steady decline.

The rise in poultry and pork output appears to be driven by farm- and enterprise-level changes that are improving productivity. Bokusheva et al. (2012) calculate that during the period 1999–2008, total factor productivity (TFP) in Russian agriculture grew by about one-quarter, whereas Swinnen et al. (2012) compute that during 2000–2007, Russian agricultural TFP rose by an even more substantial 54 %. Although many RUK farms remain virtually unchanged in operational terms from the Soviet period, since 2000 a superior class of producers has arisen called 'new operators', some of which are very large vertically integrated agro-holdings (Rylko et al. 2008). These new producers have brought investment, advanced technology and improved managerial practices into the agricultural sector.

Another likely reason for the revival of the RUK livestock sectors is favourable state policy. In 2005, the Russian government identified agriculture as a national priority area that would receive increased funding (along with health, education and housing). From 2005 to 2013, total state support to agriculture rose by 230 % in real roubles (Russian Statistical Yearbook). The Russian government stated that the main goal of agricultural policy was to expand the livestock sector, which has received the bulk of the new subsidies (Interfax various years).

In Ukraine and Kazakhstan, agricultural subsidies have been increasing since 2000. In 2010, Ukrainian agricultural subsidies were about three times higher in real terms than in 2000, whereas over the same period, Kazakh agricultural subsidies were about seven times higher in real terms (Statistical Yearbook of Ukraine; Kazakhstan Statistical Yearbook).

In addition to budget subsidies, the Russian government also helped its livestock sector with trade protection. In 2003, Russia established restrictive tariff rate quotas (TRQs) for meat imports. Russia also began imposing many sanitary-based restrictions, and often complete bans, on imports of meat (especially poultry) and dairy products (Liefert and Liefert 2012).

Figure 3 shows that productivity growth in the livestock sector shifted the supply curve from S^3 to S^4, with the isolated effect of increasing output from Q^1 to Q^*. The TRQ established in 2003 raised the domestic price from P^3 to P^*, with the isolated effect of expanding output further to Q^2.

Since 2000, RUK demand for livestock products has also increased, initially faster than output. There were two main reasons for the rise in demand. The first is that these countries had high GDP growth during most of the decade. During 2000–2008, before the world economic crisis hit, RUK enjoyed an average annual GDP growth of 7.0 %, 6.9 % and 8.9 %, respectively (Economic Research Service macroeconomic database). The second reason for the demand increase was strong appreciation of the RUK currencies in real terms. From 2000 to 2008, the Russian rouble, Ukrainian hryvnia and Kazakh tenge appreciated vis-à-vis the US dollar in real terms at the average annual rates of 10.7 %, 7.5 % and 7.4 %, respectively (Economic Research Service macroeconomic database). The main cause of the real appreciation is that these countries had higher inflation than their main (non-RUK) trading partners, which decreased the prices of imported goods relative to competing domestic output (Liefert et al. 2009).

Given this large demand stimulus, RUK imports of meat and other livestock products rose during the 2000s. From the period 1996–2000 to 2006–2010, RUK total meat net imports increased from an average annual volume of 2.5 million tonnes to 3.6 million tonnes, with imports over this time growing in each country (see Table 1).

In Fig. 3, we assume again that the world price of P^3 initially set the domestic price, that income growth shifted the demand curve from D^2 to D^3 and that currency real appreciation lowered the world price of the product expressed in domestic currency from P^3 to P^0. The isolated effects of these demand-stimulating developments (assuming none of the supply-increasing impacts examined earlier) were to increase the quantity of the product demanded domestically from Q^3 to Q^6, and the volume imported from Q^3–Q^1 to Q^6–Q^0. The large growth in Russian imports of meat as depicted in the figure helped to motivate the country's protectionist import TRQ policy.

The short-term outlook for RUK agriculture, including both the livestock and grain sectors, depends strongly on the duration and effects of the geopolitical and economic crises facing Russia and Ukraine. The deterioration in the relationship between the two countries, centring on the conflict in Crimea and eastern Ukraine that began in 2014, has affected their agricultural economies to some degree (for the impact specifically on Russia, see Liefert and Liefert 2015). In response to economic sanctions that the USA, the European Union (EU) and certain other countries imposed on Russia in the summer of 2014, Russia banned imports of many agricultural and food products from the USA, the EU, Canada, Australia and

Norway. The banned list includes meat and dairy products, and Russian livestock producers should benefit from this increased protection from foreign competition.

The geopolitical crisis has led to substantial depreciation of both the Russian and Ukrainian currencies. Compared with January 2014, by January 2015 the Russian rouble had fallen in value vis-à-vis the US dollar, euro and other major foreign currencies by about half, and the Ukrainian hryvnia had plunged in value by even more. Both countries are suffering from large-scale capital flight, while Western sanctions against Russia have cut off the country from foreign capital inflows (lending and investment). These events have reduced foreign demand for the national currency and have increased domestic demand for foreign currencies.

Another reason for the rouble's drop in value is the severe decrease in the world oil price in late 2014 and early 2015. About 70 % of Russia's exports (in value terms) are oil, oil products and natural gas, and the oil price decline has substantially reduced demand for the rouble. By raising domestic prices for traded goods, currency depreciation will stimulate production, reduce consumption and thereby lower imports, including for livestock products.

However, the long-term outlook for the RUK livestock sectors (after the current geopolitical and economic crises have passed) looks positive. The sector should benefit from further technological upgrading and productivity growth that began in the 2000s. Perhaps the biggest question is whether or not the beef industry can follow the poultry and pork industries in modernising and expanding. The Russian government is assisting this modernisation by helping the livestock sector to improve the quality of its animal stock, mainly by importing superior live animals (cattle as well as hogs).

The RUK livestock sectors are also likely to continue to receive strong state support, and Russian producers' trade protection from the country's meat import TRQ regime will persist. In January 2015, the Russian government said that because of the country's economic crisis, most areas of state expenditure would get a 10 % cut, whereas agriculture would receive a 30 % increase.

Russia joined the World Trade Organization in 2012. Although we lack the space to examine Russia's accession in any detail, the negotiated conditions concerning both budget subsidies and trade protection (market price support) will not require substantial reduction in subsidies or trade border measures (Sedik et al. 2013). The one exception is that Russia agreed that by 2020 it would replace the TRQ for pork imports, which has an out-of-quota tariff of 65 %, with a flat 25 % import tax.

When the geopolitical and economic crises facing Ukraine and Russia wind down, their currencies might rebound in value to some degree, to correct for the extreme depreciation that occurred during these crises. Nonetheless, we suspect that some of the depreciation will continue. Any permanent decline in the currencies' value will strengthen domestic production for traded goods and weaken imports, including for livestock products.

On the negative side for agricultural producers, the currency depreciation will raise prices for imported inputs, such as live animals for the livestock sector and machinery and seeds for the crop sector. In addition, a possible long-term effect of the geopolitical and economic crises is that foreign entities will be less inclined to invest in the Russian and Ukrainian agricultural and food economies. However, these negative points notwithstanding, we believe that, in the long term, the RUK livestock economies will continue to modernise and expand.

RUK domestic demand for livestock products, however, will probably not grow as fast as during the 2000s. Although these countries all resumed GDP growth in 2010 after the world economic crisis of the preceding year, their average annual GDP growth rates from 2010 to 2014 were only about half as high as during 2000–2008. Notwithstanding the geopolitical and economic crises of 2014–2015, macroeconomic forecasters (such as Oxford Economic Forecasts and IHS Economics and Country Risk) were projecting that RUK GDP growth rates would continue to decline over the next 5–10 years. If this is the case, the growth in consumer demand for livestock products will slow down. Moreover, as mentioned before, by raising domestic prices for traded goods, currency depreciation will have the isolated effect of reducing consumer demand for livestock goods.

With livestock product output projected to grow faster than consumer demand for livestock goods, we predict that RUK imports of livestock products will decline over the long term. The import drop has, in fact, already begun. Table 1 shows that RUK meat imports fell from 3.6 million tonnes during 2006–2010 (average annual) to 2.5 million tonnes during 2011–2014, the same volume as during 1996–2000, with meat imports by Russia decreasing over this time from 3.1 to 2.3 million tonnes (average annual).

5 The Grain Sector Since 2000 and Outlook

Figure 4 presents the market for grain products since 2000. The demand curve D^3 and supply curve S^2 are the same as in Fig. 2. The analysis begins with the post-reform market equilibrium identified in Fig. 2 at point G, where the domestic price (which equals the world price) is P^1 and Q^1 is domestically produced and consumed, such that there is no foreign trade.

Since 2000, RUK grain production has grown substantially. From the period 1996–2000 to 2011–2014, RUK output rose from an average annual 100 million tonnes to 161 million tonnes (see Table 1). Wheat is the main RUK grain product, and between the two periods just identified, RUK production increased from 57 to 87 million tonnes (average annual output) The growth came mainly from a rise in yields rather than area. Table 2 shows that between the two periods identified above, the grain area in Kazakhstan expanded moderately, and in Russia fell slightly. Only Ukraine experienced a substantial rise in grain area, from 11.9 to 14.6 million ha over the period.

However, grain yields in all three countries rose considerably, in Russia from 1.54 tonnes/ha during 1996–2000 (average annual) to 2.22 tonnes/ha during 2011–2014, and in Ukraine even more substantially from 2.18 to 3.85 tonnes/ha (Table 2). The progressive new operators discussed earlier have apparently

Fig. 4 The grain sector since 2000

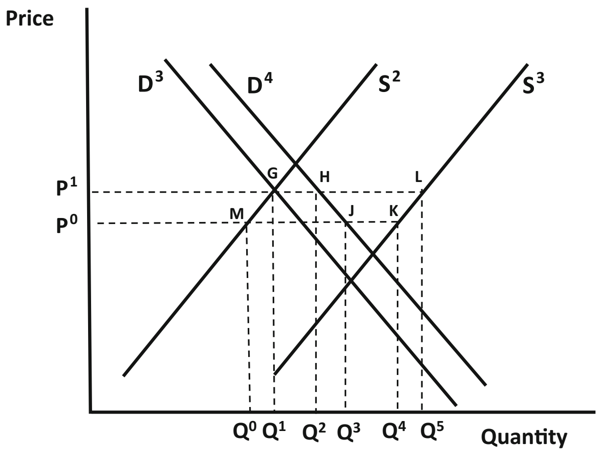

Table 2 RUK grain yield and area

Period	Yield (tonnes/hectare)[a]			Area (million hectares)[a]			
	Russia	Ukraine	Kazakhstan	Russia	Ukraine	Kazakhstan	RUK total
1987–1991	1.64	3.27	0.89	58.5	13.3	23.3	95.1
1992–1995	1.62	2.91	0.90	51.3	12.2	20.6	84.0
1996–2000	1.54	2.18	0.84	40.6	11.9	13.3	65.7
2001–2005	1.91	2.62	1.06	40.0	13.0	13.6	66.6
2006–2010	2.10	2.81	1.11	38.9	13.9	15.1	68.0
2011–2014	2.22	3.85	1.22	38.7	14.6	14.9	68.2

[a]Figures are average annual values during the period identified
Source: USDA FAS PSD online database

improved management and productivity within the grain as well as the livestock sector, thereby raising yields. The grain economy has also benefited from imports of high-quality Western machinery and seeds.

In Fig. 4, the rise in grain output shifted the supply curve from S^2 to S^3, with the isolated effect of increasing production from Q^1 to Q^5 (assuming the world price, which determines the domestic price, remains at P^1). However, real appreciation of the RUK currencies since 2000 reduced the grain domestic price from P^1 to P^0, with the isolated effect of lowering output from Q^1 to Q^0 (or, alternatively, from Q^5 to Q^4).

The revival of the RUK livestock sectors during the 2000s increased domestic demand for feed grain. In Fig. 4, this shifted the demand curve from D^3 to D^4. By lowering domestic grain prices, the appreciation of RUK currencies in real terms furthermore raised the domestic demand for grain. In the figure, these two demand effects result in the quantity of grain demanded/purchased domestically increasing from Q^1 to Q^3.

Nonetheless, since 2000, the growth in grain output has dominated the growth in domestic grain demand, such that exports have risen substantially (to the volume

Q^4–Q^3 in the figure). From the period 1996–2000 to the period 2011–2014, RUK net (average annual) grain exports increased from 4 million tonnes to 59 million tonnes, with wheat exports rising from 3 to 33 million tonnes (see Table 1). From 2011 to 2013, RUK as a region supplied 19 % of total world grain exports and 21 % of wheat exports, supplanting the USA as the world's biggest wheat exporter.

The geopolitical and economic crises in Ukraine and Russia are also impacting their grain economies. Currency depreciation is generating increased exports, while the ensuing domestic inflation has motivated domestic producers to withhold selling for domestic use in expectation of higher future prices. The Russian government responded in early 2015 with various grain export restrictions, including a wheat export tax.

In the longer term, after these crises have subsided, the RUK grain economies are likely to continue expanding production. Despite the rise in yields since 2000, RUK grain yields remain well below those in the major grain-producing countries of the developed West. For example, a study by the European Commission (EC) (Uzun et al. 2013) found that in the period 2007–2009, grain yields in southern European Russia (the country's best grain-producing region) were 2.9 tonnes/ha, compared with 6.8 tonnes/ha in grain-producing regions of the USA with similar soil and agro-climatic conditions. Another EC study (Acs et al. 2013) concluded that Ukraine has the potential to increase grain yields by 10–40 % (depending on the region), based on soil and agro-climatic conditions.

The probable continued expansion in numbers and influence of progressive agricultural 'new operators' in the RUK grain economies should drive even more improvement in the sector's managerial and technological practices, such that input productivity and yields continue to rise. Producers will also benefit from the increase in domestic grain prices ensuing from any permanent currency depreciation that might follow the crises of 2014–2015. The sector should also profit from likely growth in state budget subsidies, although the livestock sector will probably continue to be favoured over the grain sector in terms of allocation.

However, some developments are likely to mitigate the grain sector's future expansion. Currency depreciation will increase the prices of imported inputs, such as machinery and seeds. The sector would also suffer from any permanent reduction in Western investment resulting from the current crises.

In terms of demand, the continued expansion of the livestock sector will increase domestic requirements for animal feed. However, any improvements in RUK animal feed efficiency will have the isolated effect of reducing domestic feed demand.

We believe that the factors driving continued growth in RUK grain production will dominate those driving growth in domestic grain demand. If so, RUK grain exports should continue to increase, with the region becoming an even more important player in world grain markets. However, much of the exported RUK grain is medium-quality wheat sold to countries in North Africa and the Middle East which could be used alternatively as domestic animal feed. The development of the RUK livestock sectors, in particular the demand for feed, will thereby influence the future magnitude of RUK grain exports.

6 Conclusion

The restructuring of production and trade in the RUK livestock and grain sectors during the transition from planned to market economies appears to have been consistent with the region's underlying cost competitiveness, or comparative advantage, vis-à-vis world agricultural markets (Liefert 2002). Rather than importing large amounts of animal feed to maintain an over-expanded and expensive livestock sector, these countries contracted their sectors, stopped feed imports and increased imports of meat and dairy products. Although the RUK livestock sectors began to rebound in the 2000s, growth in consumer income and demand generated even higher imports (especially by Russia). From around the year 2000, grain output began to rise, creating surpluses for export, with the RUK region soon becoming a major supplier of grain, and especially wheat, to the world market.

However, the RUK governments viewed the downsizing of their livestock sector during the 1990s as a disaster, and from 2000 took steps to reverse it. Russia was also displeased with its growing overall deficit in its agricultural and food trade. In the 2000s, all three RUK governments increased budget subsidies to agriculture, with the livestock sector being favoured. In 2003, Russia also established a regime of TRQs for meat imports and began using sanitary measures extensively to restrict imports of livestock goods.

The RUK countries have curbed grain exports when harvests are low or world prices high, such as during the surge in world agricultural prices of 2006–2008 when the three countries imposed a mix of grain export taxes, quotas and complete bans. Facing a poor harvest, in August 2010 Russia banned all grain exports for a full year. The country also curbed grain exports in early 2015, the main restriction being an export tax. These policies were intended to help consumers and livestock producers by keeping more grain within the country and thereby mitigating the rise in domestic grain prices. However, these policy actions in the 2000s involving both the livestock and grain economies countered the RUK countries' growing integration into world agricultural markets based on comparative advantage.

The RUK livestock sectors are likely to maintain their post-2000 expansion. The continued technological improvement and modernisation of the sector will increase production, aided by state budget subsidies and, in the case of Russia, trade protection. Any permanent depreciation of the Ukrainian and Russian currencies from the current crisis period will also help to stimulate production. The increase in livestock product output should dominate rising consumer demand, such that we anticipate a decline in RUK imports of livestock goods over the long term.

RUK grain production should also continue to increase over the long term, for the same general reasons as for the livestock sector, although state subsidies to agriculture favour livestock over grain producers. Rising grain output will generate higher exports. However, the expansion of the RUK livestock sectors will act to reduce the grain surpluses that are available for export.

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Eurasian Grain Markets in an Uncertain World: A Focus on Yield Variability and Harvest Failures in Russia, Ukraine and Kazakhstan and Their Impact on Global Food Security

Sergio René Araujo-Enciso, Thomas Fellmann, Fabien Santini, and Robert M'barek

1 Introduction

Commonwealth of Independent States (CIS) countries have increasingly become major players on international agricultural markets, especially regarding grain exports from Russia, Ukraine and Kazakhstan (RUK). By the end of the 2000s, Russia had a share of around 12 %, Ukraine of about 8 % and Kazakhstan of about 5 % of global wheat exports (i.e. aggregated wheat exports from RUK accounted for about one-fifth of total wheat traded on the world market). Regarding coarse grains,[1] Ukraine in particular is a significant exporter, with a share of about 10 % of total world exports, whereas Russia and Kazakhstan have shares of about 3 % and 0.3 %, respectively. Main destinations for RUK grain exports are countries in North Africa and the Middle East, for example Egypt, which is the biggest wheat-importing country in the world (Comtrade 2015). RUK grain exports help to improve global grain availability and, therefore, also contribute to global food security.

According to the OECD-FAO (2014) agricultural outlook, the importance of RUK for global grain markets will further increase, and aggregated RUK wheat exports are projected to account for more than 25 % of total world wheat exports by 2023. For coarse grains, Russia's and Kazakhstan's share in global exports is projected to remain stable, whereas Ukraine is projected to increase its share to about 12 % (cf. OECD-FAO 2014; Table 1).

[1] Coarse grains are defined as barley, maize, oats, sorghum and other coarse grains in all countries except Australia, where the definition includes triticale, and in the European Union, where it includes rye and other mixed grains (OECD-FAO 2014).

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Table 1 Share (%) of wheat and coarse grains exports in total world trade (projections for 2023)

Region	Commodity	Projected 2023 (000 tonnes)	Share in total exports (%)
Russia	Wheat	22,059	14.2
	Coarse grains	5420	3.2
Ukraine	Wheat	9740	6.3
	Coarse grains	20,652	12.1
Kazakhstan	Wheat	8650	5.6
	Coarse grains	44	0
RUK	*Wheat*	*40,449*	*26.0*
	Coarse grains	*26,115*	*15.3*
USA	Wheat	28,003	18.0
	Coarse grains	52,270	30.6
Canada	Wheat	22,290	14.3
	Coarse grains	5612	3.3
European Union	Wheat	20,231	13.0
	Coarse grains	9616	5.6
Australia	Wheat	18,671	12.0
	Coarse grains	4162	2.4
Argentina	Wheat	10,729	6.9
	Coarse grains	31,816	18.6
Brazil	Wheat	2471	1.6
	Coarse grains	23,805	14.0
WORLD	*Wheat*	*155,540*	*100*
	Coarse grains	*170,638*	*100*

Source: OECD-FAO (2014)

However, during the past 15 years, RUK grain production displayed a high degree of variability, especially because production was repeatedly hit by serious harvest failures, which were in part attributable to droughts. These harvest failures resulted in substantial decreases in RUK's grain exports (see Fig. 1). Figure 1 shows that in the years of harvest failures, RUK grain exports were further diminished by the implementation of temporary export restrictions by the governments of the RUK countries, which increased the adverse effects on global food security (Dollive 2008, Headey 2011, OECD 2013a, b, Fellmann et al. 2014).

The fluctuations in RUK's grain production and associated exports indicate that the development of RUK grain production and exports is subject to a great deal of uncertainty. In this chapter we assess how yield variability and harvest failures could affect the future development of grain production in the RUK countries and how this may impact global food security with respect to grain availability and prices on the world market. For the empirical analysis we use the stochastic version of the AGLINK-COSIMO model.

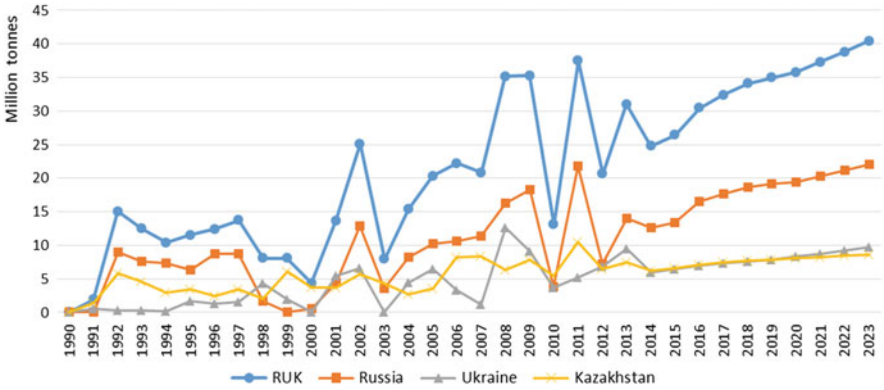

Fig. 1 Past and projected development of RUK's wheat exports. Data for 2013 are provisional; values for 2014–2023 are projected. *Source:* OECD-FAO (2014).

2 Modelling Approach to Quantify Arable Crop Yield Uncertainty

To quantify the impact of RUK grain yield uncertainty on global markets, we employ AGLINK-COSIMO, a global recursive-dynamic, partial equilibrium, supply-demand model. The model was developed by the Organisation for Economic and Cultural Development (OECD) secretariat[2] and the Food and Agriculture Organization of the United Nations (FAO), with the purpose to prepare medium-term agricultural market outlooks and to conduct policy analyses. AGLINK-COSIMO covers major regions and countries in the world, annual supply, demand and prices for main crops and agricultural outputs as well as agricultural and trade policies relevant for agricultural markets. The model calculates endogenously annual prices and market balances for domestic and world markets over a 10-year projection period. An outlook for the development of agricultural markets and prices is provided annually in a joint publication of the OECD and FAO. The outlook is built on the basis of specific assumptions on the development of exogenous macro-economic indicators (such as gross domestic product (GDP) growth, exchange rates, population growth and crude oil prices), which at the moment of preparing the projections seem plausible, given the global environment. The 'standard' outlook projections with AGLINK-COSIMO also assume normal weather conditions (OECD 2007; OECD-FAO 2014).

The outlook for agricultural market developments is always conditional to the assumptions made on the exogenous variables, in particular as regards weather

[2]The results of any analysis based on the use of the AGLINK-COSIMO model by parties outside the OECD are outside the responsibility of the OECD Secretariat. Conclusions derived by third-party users of AGLINK-COSIMO should not be attributed to the OECD or its member governments.

conditions and macro-economic developments. To provide alternative development paths when uncertainties related to the exogenous variables are accounted for, the European Commission (JRC and DG AGRI) has developed a partial stochastic analysis tool as a complement to the deterministic AGLINK-COSIMO baseline. The analysis is partial because it does not cover all sources of exogenous uncertainties (e.g. animal disease outbreaks or climate change) (Burrell and Nii-Naate 2013). The current version of the partial stochastic analysis covers the uncertainty coming from yield variation and macro-economic indicators (OECD-FAO 2014). In this chapter, we single out and quantify the potential effects of crop failures on the general developments in grain markets, and, therefore, we do not account for uncertainties surrounding the macro-economic environment in the analysis in question. The yield variations considered derive from historical data starting in 1996, and the approximation of past uncertainty is based on the difference between the predicted yield in AGLINK-COSIMO and the actual yield for the period 1996–2013. For the approximation, regional blocks are created, representing the Black Sea region (RUK), the European Union (EU-15 and EU-N13), North America (Canada, Mexico and the USA), South America (Argentina, Brazil, Paraguay and Uruguay), South East Asia (Indonesia, Malaysia, Thailand and Vietnam), Australia, China and India. The crop yield fluctuations are assumed to be correlated within each regional block (owing to similar weather patterns), but they are not correlated across regional blocks and across years (Burrell and Nii-Naate 2013; OECD-FAO 2014).

3 Scenario Results and Analysis

First, we analyse the impact of general grain yield uncertainty in all regions in the world and specific uncertainty in RUK grain yields on the world markets. Second, we specifically focus on RUK harvest failures and assess their potential impact on national and international grain markets. Our analysis focuses on analysing the changes in the variables for production, consumption, exports, imports and producer prices. For this, the coefficient of variation (CV) is used (which can be interpreted as the change in percentage) (Burrell and Nii-Naate 2013).

As a first step, the AGLINK-COSIMO model is run 600 times under two scenarios. The first scenario considers yield uncertainty in all regions in the world; the second scenario considers yield uncertainty in the RUK countries only. Figure 2 shows the CV in the year 2023 for both scenarios.

Not surprisingly, scenario results show that the effect of the overall uncertainty on grain markets is bigger than the effect of uncertainty coming from the RUK countries only. However, for wheat the RUK yield uncertainty can indeed have a major impact on global grain markets. Projections for world wheat production deviate by about 1.3 % when the uncertainty from yield variation in all regions is considered, and by 0.8 % if yield uncertainty in only the RUK countries is accounted for. Owing to the variation in yields, world grain exports deviate by

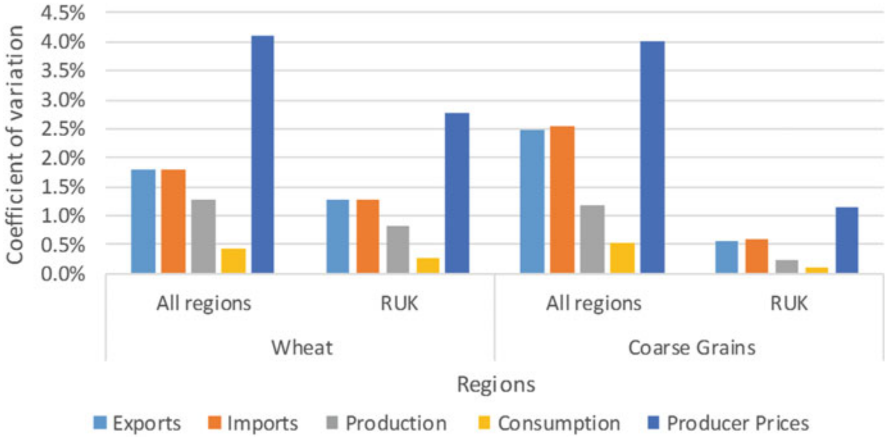

Fig. 2 Effects on wheat and coarse grains world markets of yield uncertainty in all world regions and yield uncertainty only in RUK (CV), 2023

1.8 % considering yield variability in all regions and by 1.3 % if accounting for variability in the RUK countries only. Producer prices are most affected by the yield variation, and deviate by 4.1 % considering yield variability in all regions and by 2.8 % if accounting for variability in the RUK countries only. It has to be noted that one of the reasons why the impact of overall and RUK yield variability does not differ more is that in the scenario 'all regions' part of the uncertainty in one region (e.g. RUK) can be offset by uncertainty in other regions, that is, negative impacts of one region (e.g. bad harvests in RUK) could be compensated by positive impacts in another region (e.g. higher yields in the EU or in North America). For coarse grains the impact of RUK yield variation on world markets is generally less than for wheat, which is mainly attributable to the smaller share of RUK exports in total coarse grains trade. Nonetheless, coarse grain prices may vary by 1.2 % owing to the variability in RUK production and associated exports.

To assess the impact of RUK harvest failures on global markets, we analyse a sub-sample (sub-set) of observations for which the wheat and coarse grains yields are below the deterministic projection values. The range corresponding to the yield values below the deterministic projection goes from the 0th to the 40th percentile, that is, between the 0th and 40th percentile, observations of wheat yields in all three RUK countries and coarse grains yields in Ukraine[3] are below the deterministic average yields. Therefore, for the analysis of harvest failures in RUK, wheat yields in Russia range from 1.70 to 2.48 tonnes/ha, in Ukraine from 0.83 to 2.72 tonnes/ha and in Kazakhstan from 0.51 to 1.08 tonnes/ha, whereas coarse grains yields in Ukraine range from 2.31 to 3.54 tonnes/ha (Table 2).

[3]Regarding coarse grains, we focus only on Ukraine, because coarse grains exports from Russia and Kazakhstan are negligible.

Table 2 Selection criteria for the simulations with below average yield (t/ha), 2023

Commodity	Region	Baseline	0th percentile	40th percentile
Wheat	Russia	2.63	1.70	2.48
	Ukraine	3.10	0.83	2.72
	Kazakhstan	1.21	0.51	1.08
Coarse Grains	Ukraine	3.83	2.31	3.54

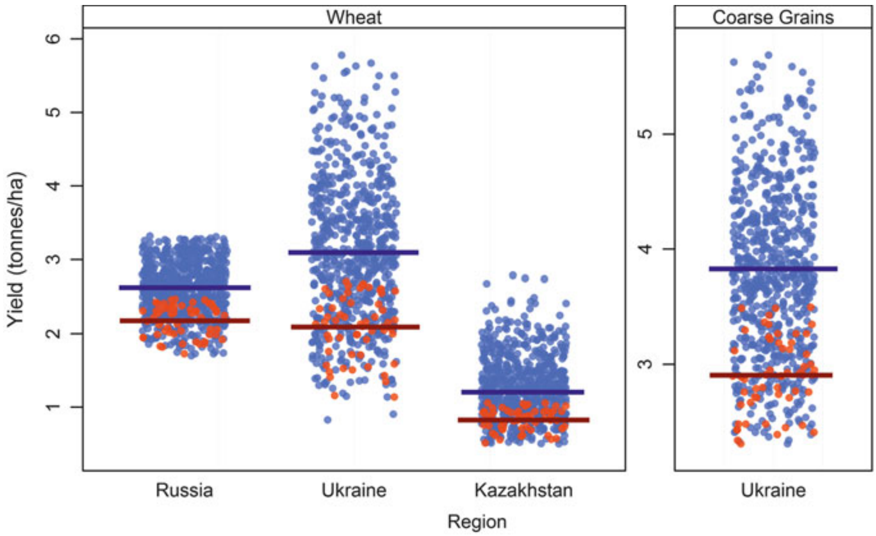

Fig. 3 RUK yield variability for wheat and coarse grains in 2023

Based on the selection criteria (Table 2), Fig. 3 depicts the spread of the yield uncertainty accounted for in the model for the projection year 2023. The blue line is the baseline projection, whereas the red line represents the average of the sub-set. Accordingly the red dots are those belonging to the sub-set and the blue dots represent the remaining simulations.

Table 3 presents the market balances in the baseline projections and the average difference of the sub-set sample compared with the baseline values. Simulation results show the substantial impact of lower RUK yields (i.e. harvest failures) on world markets. In the sub-set reflecting lower yields in RUK, wheat production is, on average, 9 % lower in Russia and 18 % in both Ukraine and Kazakhstan compared with the baseline. In total, the fall in RUK wheat production implies a decline in world production of 2 %. However, the actual impact on world markets is greater than this. The harvest failures lead to substantially lower RUK exports, with Russian wheat exports being 15 %, Kazakh exports 30 % and Ukrainian wheat exports 38 % below the projected exports in the baseline. This decline translates into an overall reduction in world exports of 3 % and results in an increase of the wheat world market price by 7 %. It has to be noted that the immediate effect of

Table 3 Average differences for the sub-sample (simulations with below average yield) compared with the baseline, 2023

		Baseline (million tonnes; producer price in USD/tonne)						Average difference to the baseline (%)					
		QP	EX	QC	IM	ST	PP	QP	EX	QC	IM	ST	PP
Wheat	RUS	68	22	46	0	0	177	–9	–15	–2	20[*]	0	8
	UKR	24	10	14	0	0	260	–18	–38	–2	4	0	15
	KAZ	18	9	9	0	0	264	–18	–30	–2	3	0	13
	WLD	*778*	*156*	*774*	*156*	*223*	*269*	*–2*	*–3*	*–1*	*–3*	*–4*	*7*
Coarse grains	RUS	39	5	34	0	0	197	0	–2	1	2	0	3
	UKR	38	21	18	0	0	224	–13	–24	0	3	0	7
	KAZ	3	0	3	0	0	289	0	6	0	–1	0	2
	WLD	*1418*	*171*	*1412*	*167*	*268*	*225*	*1*	*–1*	*0*	*–1*	*–1*	*3*

KAZ, Kazakhstan; RUS, Russia; UKR, Ukraine, WLD, World
QP = Quantity produced, QC = Quantity consumed, EX = Exports, IM = Imports, ST = Stocks, PP = Producer price
[*]Although the percentage increase in Russian wheat imports is rather large, it concerns only a very small amount in absolute terms

RUK harvest failures on world market exports and prices could be even more severe, but the higher world market prices attract other countries (such as the EU and the USA) to export more, which diminishes the impact on total wheat exports and prices.[4] For coarse grains, where we specifically account for harvest failures in Ukraine only, the Ukrainian coarse grains production is about 13 % lower than in the baseline projection. This leads to a decrease in Ukrainian coarse grains exports of 24 %, resulting in a 3 % price increase for coarse grains on the world market.

As shown in Table 3, there is an overall negative impact on world market prices with lower RUK yields. However, these results are based on the average of the sub-set, and it is important to pay attention also to the range that prices might take in the projections (i.e. in addition to the average, one also has to identify the distribution or allocation of the simulations belonging to the sub-sets). The box plots in Fig. 4 present the possible spread of producer prices accounting for RUK yield uncertainty. The blue lines represent the baseline prices and the red lines represent the average producer prices in the sub-set. The red dots are the prices belonging to the sub-set and the blue dots represent the prices in the remaining simulations.

Figure 4 indicates that for coarse grains the impact of Ukrainian yield uncertainty on world markets is limited. Although the simulations in the 'low yield' sub-set are concentrated in the top of the distributions (meaning high prices) for all the regions, the gap between the sub-set average and the baseline is considerable only for Ukraine, whereas for the other regions this gap remains small. This means that the negative impact on Ukraine coarse grains yields mostly affects the domestic markets and that its transmission to other RUK countries and the world markets is

[4]This could also be observed for example in 2010, when the USA exported 35 million tonnes of wheat instead of the 26 million tonnes average for 2008 and 2009.

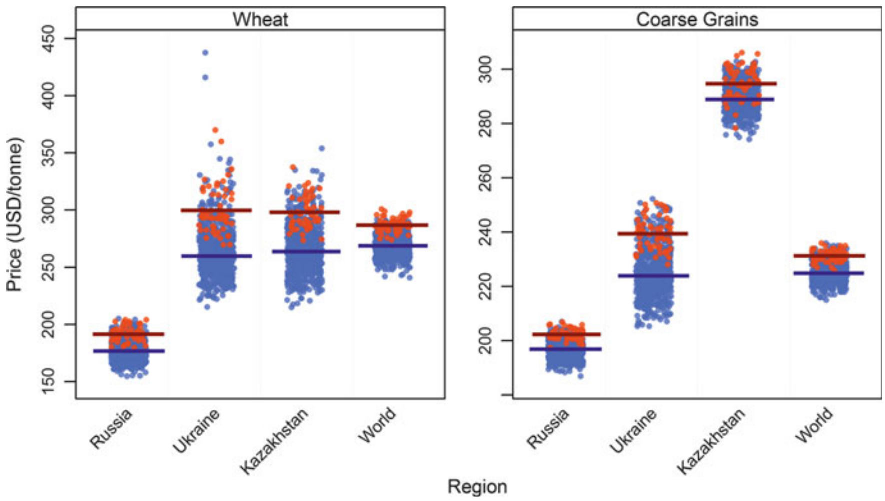

Fig. 4 RUK and world producer price variability for wheat and coarse grains in 2023

rather limited. The CV figures confirm these findings, with values of 2 %, 4 % and 2 % for Russia, Ukraine and Kazakhstan, respectively, and 2 % for the world. Therefore, regarding coarse grains, Ukraine is rather a price taker, and coarse grains yield uncertainty from Ukraine is not entirely transmitted to the world markets or other regions.

Concerning wheat, Fig. 4 indicates that the impact of RUK yield uncertainty is mainly driven by Russia. Although all the prices belonging to the 'low yield' sub-set are concentrated at the top part of the distribution, the gap between baseline and sub-set is substantial for Ukraine and Kazakhstan, whereas it is less pronounced for Russia and the world. This is because Russia is one of the biggest exporters of wheat, not only within the RUK but also in world markets. Consequently, most of the uncertainty in Russia is passed on to the world markets. The CVs are 5 % and 4 % for Russia and the world wheat markets, respectively, whereas they are 8.5 % for Kazakhstan and 9.5 % for Ukraine. These figures confirm that Russia, as a big exporter, is a price maker on international wheat markets and transmits its uncertainty to world markets.

4 Conclusion

The RUK countries have become major players in international grain markets, with their exports helping to improve global grain availability and, hence, food security. The OECD-FAO (2014) projects that the importance of RUK for global grain markets will further increase, and by 2023 aggregated RUK exports may account for 25 % of total world wheat exports and 15 % of total world coarse grains exports.

However, over the past decade RUK's grain production and associated exports have shown high fluctuations and were repeatedly diminished by harvest failures. When past yield variability and harvest failures are taken into account, simulation results with the stochastic version of the AGLINK-COSIMO model show that international grain markets are considerably affected by yield uncertainty from RUK. Projections for world wheat production deviate by about 0.8 % when the uncertainty from yield variation in RUK countries only is considered. Owing to the variation in yields, world grain exports also deviate by 1.3 %, resulting in a deviation of 2.8 % in world prices. For coarse grains, the impact of RUK yield variation on world markets is generally less than for wheat, but prices still may vary by 1.2 % owing to the variability in RUK production and associated exports.

The analysis of a sub-sample (subset) of observations for which wheat and coarse grains yields are below the deterministic projection values reveals the substantial impact of lower RUK yields (i.e. harvest failures) on world markets. In the sub-set reflecting lower wheat yields in RUK, wheat production is, on average, 9 % lower in Russia and 18 % lower in both Ukraine and Kazakhstan compared with the baseline. The harvest failures lead to substantially lower RUK wheat exports (–15 % in Russia, –30 % in Kazakhstan and –38 % in Ukraine) and result in an increase of the wheat world market price by 7 % compared with the baseline projections. Regarding coarse grains, the analysis of lower yields in the sub-set shows that harvest failures in Ukraine may lead to a decrease in Ukrainian coarse grains exports of 24 %, causing an increase in the world market prices of 3 % compared with the baseline projections in 2023.

Our results highlight the importance of RUK grain production for the world markets and their impact on global food security with regard to food availability and prices. Concerning prices, it must be stressed that the AGLINK-COSIMO model uses yearly price averages (i.e. monthly and weekly price fluctuations and spikes are not reflected). Therefore, it is likely that the short-term price effects of RUK grain production variability are greater than the ones depicted in our analysis, although stocks might serve as buffer. Accordingly, in the event of RUK grain harvest failures, the monthly and weekly price spikes may be significantly higher than the ones measured in our analysis, increasing the pressure on global food security. Regarding price fluctuations, Kornher and Kalkuhl (2013) reveal that international price volatility significantly impacts domestic price volatility, thus greatly impacting domestic price stability in developing countries. Moreover, FAO et al. (2011) point out that the short-term shocks of substantial price fluctuations, even if they are tolerable on average, make both smallholder farmers and poor consumers more vulnerable to long-term poverty traps. Furthermore, it is more difficult for smallholder farmers to invest if price changes are rather unpredictable (FAO et al. 2011).

The high variability in RUK yields over the past decade is obviously directly related to weather conditions. However, this raises the question why grain production in RUK is so vulnerable to weather conditions. It is often argued that the vulnerability is closely related to a lack of general investment in the agricultural sector (e.g. infrastructure, machinery or irrigation capacity) and lower levels of fertiliser use. The lack of investment seems to be at least partially attributable to a rather unstable policy environment for RUK's crop producers. Over the past decade, the RUK countries have repeatedly implemented temporary export restrictions (bans, quotas, taxes) as a reaction to harvest failures. The measures were taken to limit grain exports with the aim of keeping domestic consumer prices low. Indeed, the measures might have effectively helped to keep domestic grain prices at a lower level than they would have been following the harvest failures (see Fellmann et al. 2014). However, it is also reported that the implementation of such measures creates a high degree of uncertainty among domestic producers, as they are uncertain if they will be able to benefit from higher world prices in the future. As a consequence of this uncertainty, temporary export restrictions act as a disincentive for domestic producers with respect to input use (fertiliser and plant protection) and general investments (Langrell et al. 2015; Salputra et al. 2013; Fellmann and Nekhay 2012; Kobuta et al. 2012; Leeuwen et al. 2012). Götz et al. (2013) for example found empirical evidence that the export restrictions implemented in Ukraine in 2007–2008 indeed reduced incentives for farmers and traders to invest. As pointed out in Fellmann et al. (2014), when producers hold back investments and use less fertilisers and plant protection this has at least two implications. First, without the fear of temporary export restrictions, producers in RUK would be likely to invest more and increase production and exports, which would have positive effects on global food security with regard to both food availability and the price aspect of food access. Second, less fertiliser use and plant protection makes grain production in RUK more vulnerable to weather conditions (i.e. variability in RUK's grain production and exports would probably be lower than the one experienced over the past decade and the ones depicted in our analysis, which in turn would also have positive effects on global food security). Therefore, it can be expected that both domestic and global grain markets would considerably benefit if RUK governments would completely renounce the use of temporary export restrictions and create a more reliable policy environment for RUK's domestic grain producers and private investors.

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China's Role in World Food Security

H. Holly Wang and Kim Ha

1 Introduction

China is the world's most populous country, with 1.36 billion people, and it is also the world's largest food consumer. Over the past three and half decades since 1980, the Chinese economy has been growing at record speed and has become the world's second largest economy. This fast economic development has included a significant growth in agricultural productivity and a tremendous growth in nationwide income. The latter has had both positive and negative effects on food security.

Providing sufficient food for its enormous population has always been a major challenge for China, which its government recognised long ago and to which it has given high policy priority. This challenge comes from several sources: growth in the population, growth in nutrition and energy needs and dietary transition. The Chinese government has been targeting a high self-sufficiency rate for food commodities, which gives it a degree of food security. For example, a 90–95 % food self-sufficiency rate for China has been frequently referenced, although this is a subjective level that has not been scientifically verified.

The exact meaning of food security in China has not been clearly defined. The Food and Agriculture Organization of the United Nations (FAO) uses a daily per capita caloric intake level of 1800 calories as the cut-off for malnutrition, whereas many nutritionists recommend a level of 2100 calories per capita per day to maintain a healthy, active lifestyle (Bassett and Winter-Nelson 2010). China has far surpassed that level with its current average intake of 3073 calories per day (*National Geographic* 2014). However, as incomes rise, the Chinese population is, in general, eating more and eating better tasting ingredients. This makes meeting

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demand for food a moving target. Satisfying people's appetite is, therefore, another dimension of the Chinese food security goal.

Previously, China's definition of food commodities included wheat, rice, maize, soybeans, other coarse grains and even tubers. Now, it has gradually removed coarse feed grains, oilseeds such as soybeans and maize, and focuses only on rice and wheat, which are the major food grains. This allows for policy for the import of grains, soybeans and maize, without compromising its food security goal. In 2014, China imported 74 million tonnes of soybeans and 2.5 million tons of maize. Although the importing volumes amounted to only a small percentage relative to China's huge domestic market, it was a significant shock to international grain trade and affected both major exporting and importing countries.

The rest of this chapter discusses issues of supply and demand as regards China's grain market, describes the situation of Chinese trade for major grains, presents Chinese policy that will influence production, and highlights implications for world food security.

2 Grain Demand Growth

2.1 Population Growth

In response to rapid growth in the population, in 1979 the Chinese government adopted a One Child Policy, which restricted urban families to only one child and imposed a similar policy on rural families. The policy has been quite successful, with the annual population growth rate declining from a high of 1.6 % in 1987 to 0.5 % at present, as reported by the World Bank, which is low compared with average annual population growth rates for low- and middle-income countries (2.2 % and 1.1 %, respectively) as well as the USA (0.7 %). Nonetheless, the Chinese population is growing annually by a sizeable 6.7 million people.

As a result of this low growth rate, an ageing population and a gender imbalance have become two severe demographic problems for China. As a result, from 2014, China relaxed its 35-year-old One Child Policy by allowing each couple to have two children as long as one parent is an only child. This policy is predicted to increase the urban birth rate from the current 1.18 ‰ to 1.51 ‰ in 2018, and the total birth rate from 1.45 ‰ to 1.66 ‰ at the same time, which will result in an additional 1.6 million new babies being born annually in the next few years (Ma et al. 2014). China's projected population increase is illustrated in Fig. 1. This rapid population growth will put tremendous strain on the demand for food.

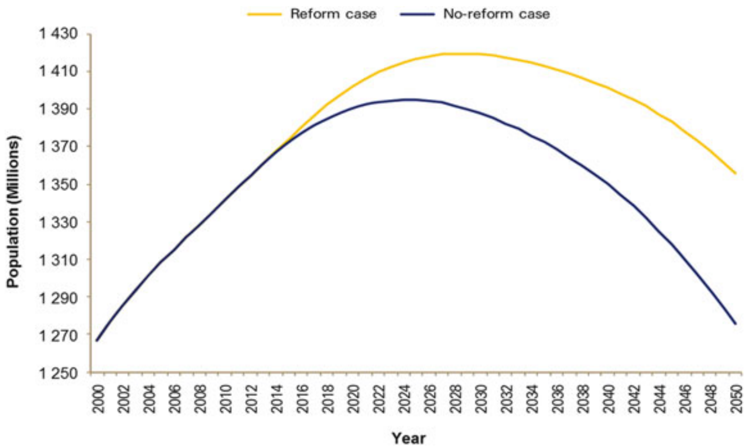

Fig. 1 Chinese population forecast with and without the reform of its One Child Policy. *Source:* Ma et al. (2014)

2.2 Nutrition and Energy Need Growth

China has experienced high gross domestic product (GDP) growth, with an annual growth rate of nearly 10 % in the first decade of the 2000s. Although this rate has dropped to 7–8 % in recent years, it is still phenomenal given China's size. Figure 2 shows the GDP levels of the world's four largest economies in the past 5 years. China ranks second after the USA and is significantly ahead of Germany and Japan. In addition, given the upwards trend in terms of its growth, China has been rapidly closing the gap between the size of its economy and that of the USA.

As incomes grow, people tend to consume more food calories. This is especially true for people at a relatively lower income level, because food calories are still a normal good. Chinese per capita income is currently at a low but fast-growing rate. Figure 3 shows the historical and projected per capita caloric intake patterns over time in the world, as recorded by the World Health Organization (WHO). There are upwards trends for all categories of countries. The sub-Saharan African countries are at the bottom, which reflects their income levels, and the industrialised countries are at the top. East Asian countries, including Japan and South Korea, have experienced periods of rapid growth as well as slow growth as they approach the income levels of industrialised countries. Among the transitional economies, China's growth is similar to that of East Asian countries. The increasing per capita caloric-intake, together with population growth, generates an increasing need of food volume.

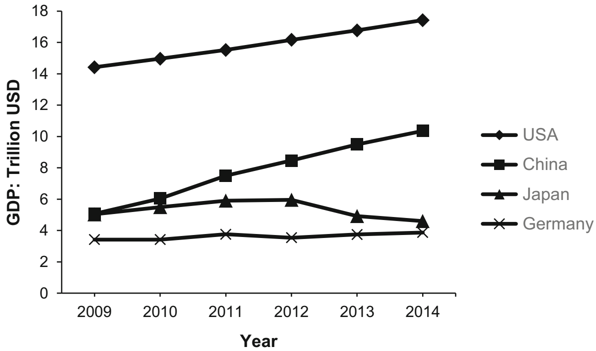

Fig. 2 Gross domestic product levels for several world major economies. *Source:* Word Bank (2015)

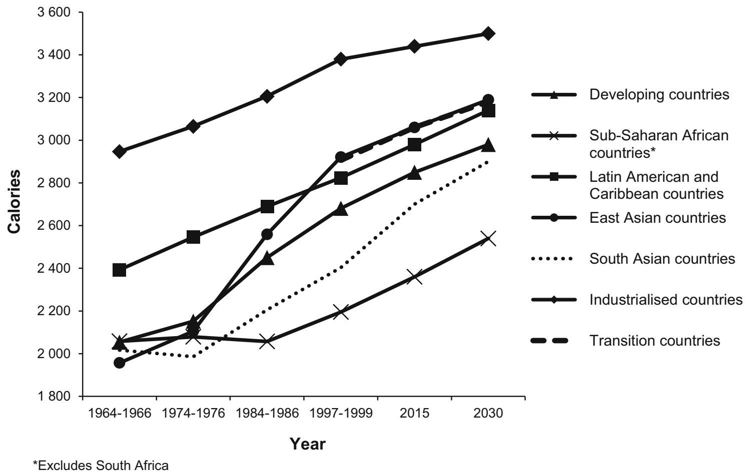

Fig. 3 Historical and projected per capita calorie intake. *Source:* WHO (2003)

2.3 Diet Transition

As people get richer, the food commodity required to support each calorie also increases. It is very common for people to replace the calories generated from plant-based foods with calories generated from animal-based protein-rich food, such as meat, poultry, eggs, dairy, and fish, and China is no exception. As reported by *National Geographic* (2014) (Fig. 4), the percentage of China's calories generated by meat, poultry, dairy and eggs of the total number of calories increased from 2 % in the 1960s to 22 % in 2010, which is very close to US level of 26 %, as representative of developed counties. Given the expected income gains for

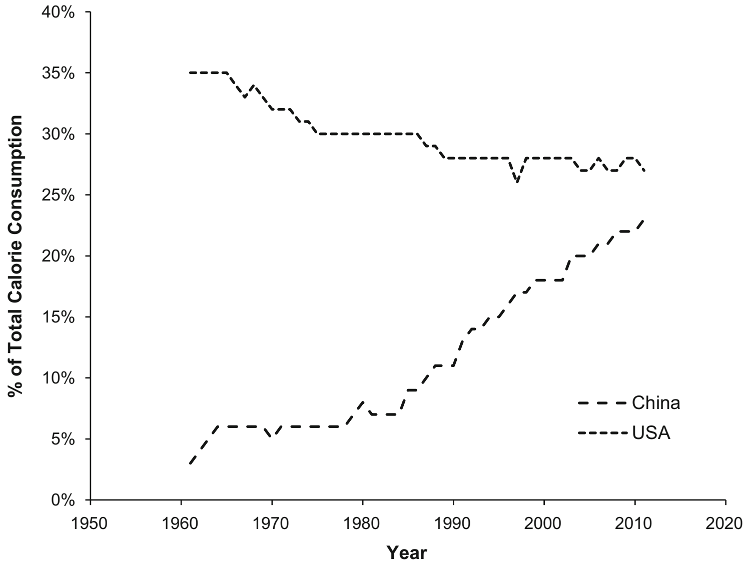

Fig. 4 Comparison of the calorie percentage from meats, poultry, dairy and eggs of the total calorie consumption for China and the USA. *Source: National Geographic* (2014)

China's large portion of low-income rural residents, this momentum is likely to be maintained as China continues to develop.

Although one unit of protein provides the same number of calories as one unit of carbohydrates, it costs several times the units of grains to produce one unit of meat through livestock production. This is because the calories contained in grains used as feed are not fully converted to edible animal protein, thereby causing an energy loss, and also because of the additional non-feed costs needed to raise the animals. For example, one kilogram of chicken may need 2 kg of feed grain, whereas this number increases to 3 kg for hogs, and 8 kg for cattle.

3 Challenges to the Grain Supply

China has realised a 10-year continuous increase in grain harvest since 2003, reaching a total output of 602 million tonnes (Chen 2014). However, several factors exist that prevent Chinese agricultural production from sustaining this continued rate of growth. First, land availability is very limited and is decreasing as a result of urbanisation, desertification and the release of marginal land which was over-cultivated in the past. Second, the quality of land also poses a challenge owing to degradation, especially from heavy metal pollution. Third, demand growth induced by rapid income gains has exceeded supply and, therefore, the import of food and feed grain from the world market is necessary.

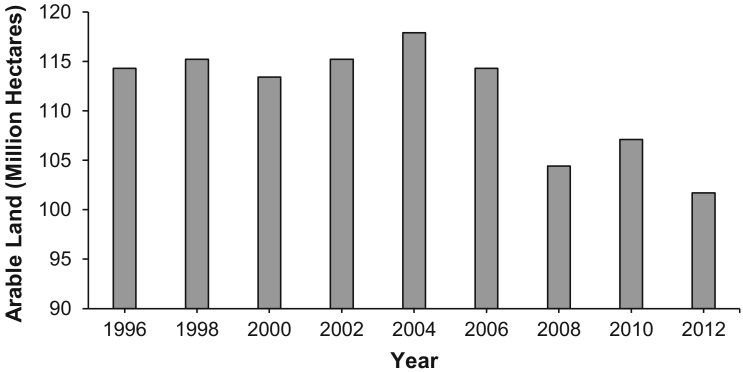

Fig. 5 Arable land in China. *Source:* World Bank

3.1 Arable Land

Figure 5 shows China's arable land acreage in recent years. In the past decade, a severe loss of land has occurred, primarily as a result of urbanisation, whereby agricultural land has been converted to non-agricultural use. Furthermore, owing to farmers' profit motives, agricultural land has been increasingly converted to produce higher value livestock, aquaculture, poultry and horticultural products like vegetable, fruits and ornamental crops, which leaves even less acreage for grains.

3.2 Soil Degradation

Soil quality degradation is another factor that reduces land productivity. Chen et al. (2010) showed the statistics of the average natural grade of land from each province over the two land survey periods in 1998 and 2006. All arable land is graded on a scale of 1–15 (with 1 being the best and 15 the worst), based on many factors such as slope, texture, water availability and other agronomic factors. Although several provinces were observed as having improved, as indicated by the reduction in the values owing to land-improvement activities and removing marginal land from crops to trees and pasture, many are small provincial regions such as the four municipalities. Meanwhile, the major grain-producing provinces, which account for half the number of all provincial level regions, saw a deterioration, as listed in Table 1. Liaoning, Jilin and Heilongjiang, the three provinces in which maize and soybean are produced, saw the worst degradation.

The authors of the survey acknowledge that their calculation did not take heavy metal pollution into consideration. Heavy metal pollution in soil has become a serious issue in China (Chen 2014), because food crops grown from polluted soil

Table 1 Changes of natural grades of cultivated land in China

Province	Average natural grade	Land weighted natural grade*	
		1998	2006
Liaoning	10	0.321	0.335
Heilongjiang	11.4	1.036	1.090
Jilin	9.9	0.426	0.449
Jiangsu	6	0.234	0.236
Anhui	7.7	0.354	0.362
Fujian	7.1	0.077	0.079
Jiangxi	9	0.207	0.211
Shandong	6.8	0.403	0.419
Henan	7.1	0.443	0.461
Hubei	5.4	0.206	0.207
Hunan	5	0.152	0.156
Guangxi	8.1	0.274	0.282
Yunnan	10.6	0.524	0.529
Xinjiang	10.9	0.340	0.363
Xizang	11.8	0.033	0.035

*Calculated as the product of the average natural grade of a province and the percentage of the arable land area of that province in the country. Larger provinces are given more weight
Source: Chen et al. (2010)

tend to contain poisonous metal elements, making them unsafe for human consumption. One-sixth to one-fifth of Chinese land is polluted (MOEP 2014).

3.3 Water Scarcity and Desertification

Irrigated land can yield more than twice the volume of crops than rain-fed land, and over 50 % of China's arable land is under irrigation (FAO 1996). However, the potential for more irrigation resources is very limited. The North China Plain is the primary wheat production area, which heavily depends on irrigation through underground water extraction. Over-extraction has long been a problem. In 2014, Heibei, the country's third largest wheat-producing province, announced a reduction in wheat irrigation for 2 % of its acreage, the first of such policies in China (Bi 2014). This suggests that underground aquifer protection and diverting water to better economic use in non-agricultural sectors will further restrict the grain output in China.

Desertification is another real threat to farmland in the western part of China. It threatens 2 million ha of farmland and nearly 5 million ha of pasture land (FAO 1997). The crop or pasture land loss caused by desertification can also reduce production capacity.

Nevertheless, China has had over 10 years of good harvest, despite the aforementioned challenges. Maintaining this good harvest will depend by and large on yield improvements as a result of biotechnological advancements and better economic allocation decisions as a result of the market liberalisation of both inputs and outputs. Government policies to support grain production through financial subsidy and the control of farmland conversion to non-agricultural use will also have a crucial role. Nonetheless, efforts to intensify domestic supply will not be able to keep pace with demand growth.

4 Grain Trade

The shortfall between domestic demand and supply has been supplemented by the world market. China was a net exporter of grains until 2007 (Hansen and Gale 2014), and became a net importer for most grains (Fig. 6). Wheat, rice, maize, barley, sorghum, and distillers' dried grains with solubles (DDGS), a high-protein-content by-product of the production of maize ethanol for feed, were all net imported to China in 2013 at quantity levels of multi-million tonnes. Soybean trade is reported in a separate chart (Fig. 7), as its vast volumes mean that it is disproportionate to compare it with the trade of other grains.

4.1 Soybeans

China is the world's fourth largest producer of soybeans. However, the rapid growth of China's economy has spurred food consumption, turning the country into the world's leading soybean importer. In 2014, China imported 74 million tonnes of soybeans (a 5 % increase from 2013 levels). Changes in China's agricultural and trade policies have greatly influenced world oilseed markets. As a result of China's World Trade Organization (WTO) accession, which reduced import tariffs and quota restrictions to its oilseed market (Ash 2012), China's imports of soybeans, primarily from the USA and Brazil, have been constantly increasing and this trend is projected to continue (Fig. 7).

4.2 Maize

Importing soybeans allows Chinese farmers to focus on producing maize, which provides higher yields and net returns than soybeans. Maize became China's largest single crop in 2013. However, China's combined use of maize and soybean meal for animal feed is expected to rise from 200 million tonnes to over 300 million tonnes over the 10-year projection period. China has switched from being a maize exporter to a consistent importer of 3–5 million tonnes annually since 2009 (Hansen and Gale 2014).

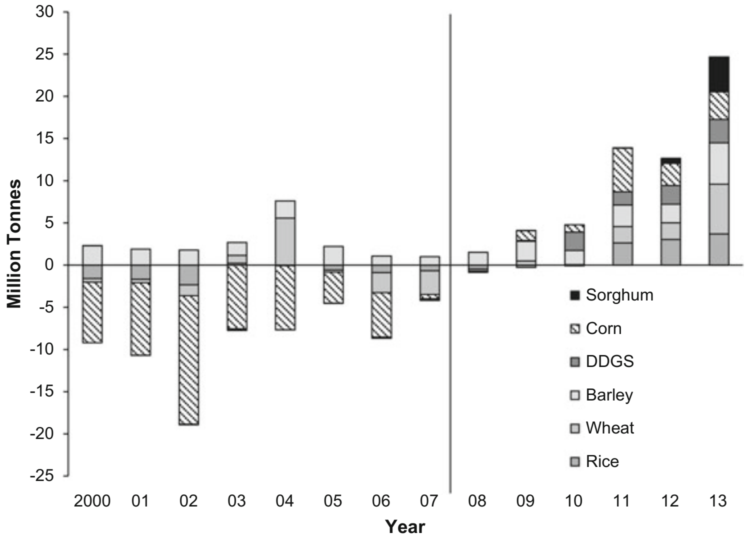

Fig. 6 Net importing volumes of China's major grains. Net imports = imports – exports. Data are for market years. *Source:* Hansen and Gale (2014)

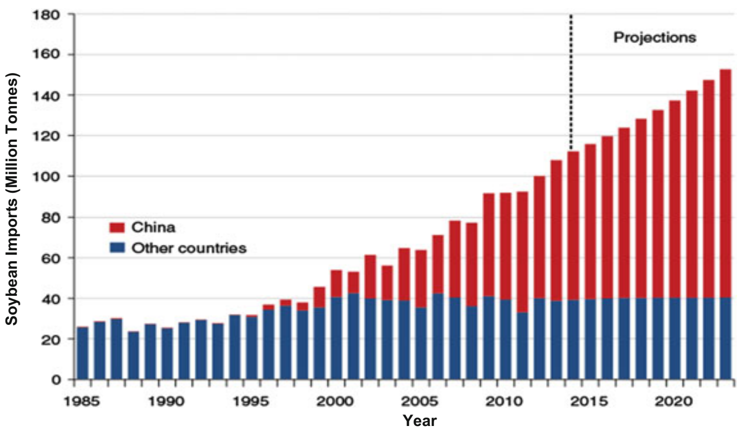

Fig. 7 China's dominant importing position in the world soybean market. *Source:* Hansen and Gale (2014)

China is expected to account for 40 % of the rise in the global maize trade over the coming decade, which the United States Department of Agriculture (USDA) estimates will make China the leading importer of maize by 2023–2024 (Fig. 8). The USA is likely to be the main supplier of China's imported maize, but other countries including Laos, Myanmar, Russia, Ukraine, Argentina and Brazil will also have a role. China's WTO regulation allows a Tariff Rate Quota (TRQ) for 1 % for a quota of 7.2 million tonnes and 50 % for over the quota (ERS 2012). The trade

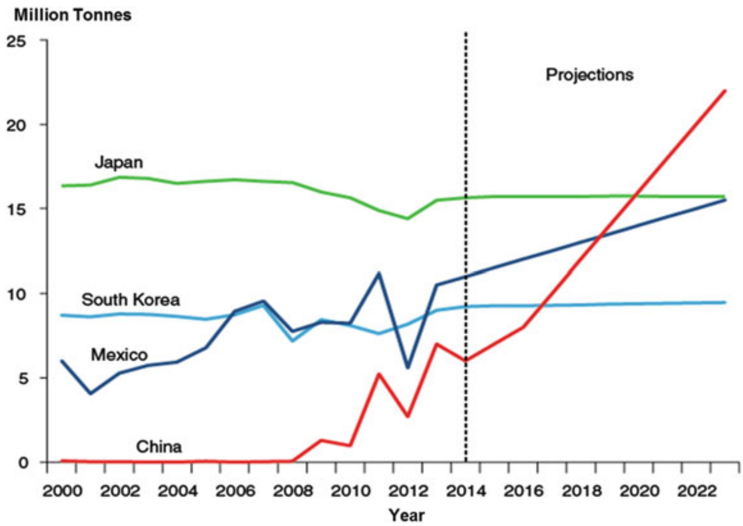

Fig. 8 The world's largest maize importers, historical record and USDA projections. *Source:* Hansen and Gale 2014

policy may prevent the importing of maize from growing too fast, and the USDA projection should be considered with caution.

4.3 Rice

China is the largest producer and consumer of rice in the world, with a forecasted production of 144.5 million tonnes in 2015, an increase of 1.97 million tonnes from 2014, of which only 400,000 tonnes will be exported (Childs 2015). In 2012, China's imports increased sharply as production growth was unable to keep pace with consumption. Since 2013, China has been the world's largest rice importer. The USDA forecasted that in 2015 China would import a record 4.3 million tonnes of rice, an increase of 0.3 million tonnes from 2014. The major exporter to the Chinese market is Vietnam, followed by Pakistan and Thailand. WTO TRQs are about 5.2 million tonnes for combined long- and short-/medium-grain rice at a 1 % tariff, and at 50 % over that level (ERS 2012). There is room for the Chinese market to absorb more rice imports.

4.4 Wheat

China is also the world's largest wheat producer and consumer. Its import accounts for a small share of its national consumption. However, as wheat can be used as a feed substitute in years in which maize prices are higher, China has imported a few million tonnes of wheat over the past few years, although its domestic production has also increased (Korves 2013). Its major importing origins are, at present, Australia, the USA and Canada, with increasing imports from Kazakhstan. The wheat TRQ is set at 9.6 million tonnes for a 1 % tariff, then 68 % when above that (ERS 2012). The 5 million tonnes imported in 2013 shown in Fig. 6 is far below the high-tariff ceiling. Further increases in wheat imports depend on the domestic supply and demand dynamics as well as on the global market price.

4.5 Sorghum

Sorghum is a substitute in feed for maize, barley and other grains. Unlike soybeans, which are causing problems for China in terms of the genetically modified product from the USA, sorghum is attractive to feed compounders in China because feed grain prices are high. Sorghum can be imported without import quotas (unlike maize), and border authorities in China do not appear to be rejecting sorghum shipments (Capehart et al. 2015). A significant volume of sorghum was imported in 2014. Australia and the USA both export barley to China.

5 Agricultural Policy

Since its economic reform in 1979, the Chinese government's first policy document of the year, often referred to as the No 1 Document, has focused on agriculture, indicating that it takes agriculture very seriously (Communist Party of China Central Committee 2014). The policies have gradually moved the agricultural sector from a centrally planned system to a market system. Currently, almost all agricultural inputs and outputs are market-based, with a few exceptions: land is not owned by individual farmers nominally; rural labourers have not gained full access to urban sectors; and access to import quotas is not equal to all private players. As a result, the agricultural sector is still characterised by low productivity, low profitability and low income for farmers. Since 2004, the policies have focused on more subsidies from the government. The subsidy policies are not only targeted at improving farmers' incomes but also at encouraging production. For example, the government provides subsidies for seed, fertiliser, fuel and other chemicals, as well as subsidies for machinery, breeding stock, the conservation of irrigation water, agricultural insurance, among other things. These subsidies will help farmers to adopt better inputs as a result of the development of new technologies and to adopt new biotechnologies that may be more risky but that have greater potential to increase production. In addition to these subsidies, the government is increasing investment in science and technology research and development by research institutes and industry. Since 2000, the Chinese government budget for agricultural research has increased by over 10 % annually (Hu et al. 2011). The subsidies have had a positive effect on China's domestic production and supply in general, alleviating the increasing pressure of food demand.

The Chinese government can also use its power to influence the economic sector allocation, either through economic measures such as subsidies, loans and direct investment in state-owned enterprises, or through executive power. Similarly to its role in developing proactive industrial polices to promote a global automobile industry, the government has played a major part in the development of China's dairy and livestock sectors. For example, the shift from crop to animal agriculture to meet Chinese consumers' food demands needs to be supported by increasing the volumes of grain imported. Other policies, such as export tax and quotas for certain commodities, land user right transferability, rural social benefits and urbanisation are also influencing agricultural production.

Policy adjustments in China make it difficult to forecast the country's demand for imports. China's price supports contributed to the surge of grain and oilseed imports during 2012–2013 because domestic prices were boosted above world prices. In early 2014, officials announced that price supports for soybeans and cotton would be eliminated, a move that may motivate more farmers to abandon these crops in favour of maize. During the 2012/2013 and 2013/2014 crop years, record maize harvests and a fall in demand put downwards pressure on Chinese maize prices. Large reserves of maize built up as the government supported prices, and these large domestic supplies could slow China's demand for imported maize for several years. The recent build-up of grain inventories was not anticipated in the baseline projections made by economists outside China and could slow China's future maize imports, similarly to the situation in the late 1990s (Hansen and Gale 2014). In fact, there are constant discrepancies between trade projections made by the Chinese government, by the European-based FAO and by the USDA.

The Chinese government directly controls many firms, which means that these so-called state-owned-enterprises can produce, process, invest, import and export, and directly carry out the government's policies. It has been observed that Chinese enterprises have started to invest in farms and agro-business firms in North and South America and Africa (Gooch and Gale 2015). In addition to the normal motivations for accessing foreign direct investment (FDI), such as access to low-cost resources, technology and markets, these FDIs from large Chinese firms may also function to supply food to China and thereby secure food resources for the country.

6 China and World Food Security

Currently, China's production of wheat, rice and maize accounts for 17 %, 30 %, and 22 %, respectively, of the total world production of each grain. Its net imports account for only a single-digit percentage for each crop. The net import of rice and wheat has shown a slight increase since 2011. The only crop that has had its

Table 2 World major grain production and trade and Chinese shares

Year	World production (million tonnes)	China production (%)	World trade (million tonnes)	China imports (%)
Maize				
2011–2012	888.2	21.7	103.7	4.9
2012–2013	868.0	23.7	100.5	2.6
2013–2014	989.0	22.1	129.7	2.5
Soybeans				
2011–2012	240.5	6.1	92.8	63.8
2012–2013	268.8	4.9	98.2	61.0
2013–2014	283.7	4.3	111.6	63.1
Wheat				
2011–2012	695.8	16.9	153.8	1.2
2012–2013	658.5	18.4	147.1	1.4
2013–2014	716.1	17.0	162.1	3.6
Rice				
2011–2012	467.0	30.1	39.9	6.5
2012–2013	472.0	30.3	39.4	7.6
2013–2014	477.1	29.9	42.9	8.6

Source: USDA Foreign Agricultural Service

domestic production cut significantly is soybeans, the import of which is several times the volume of its domestic production. Over 60 % of soybeans from the world market go to China, which amounts to about one-quarter of world soybean production (Table 2).

Since 2011, the increasing import of soybeans by China did not show any crowding out effect on other major crop supplies, as all these crops listed in Table 2 show an overall increase in world production. According to recent data China's moderate imports of wheat, rice and maize and its significant import of soybeans do not represent a food security threat to the world.

However, China's wheat imports doubled from the 2012–2013 crop year to the 2013–2014 crop year. The 3.77 million tonnes of additional demand in the world market may represent a good opportunity for wheat-exporting countries and for price boosts in the market. Overall, China imports less than 5 % of the volume of its total domestic production of wheat, which means that it may import more when the world supply and demand is favourable to China, on account of prices being lower than domestic prices.

7 Conclusions and Discussions

In this chapter, we have summarised the facts relating to China's grain demand and supply and its implications for the world market. China's population is still growing, and the rise in incomes, and the resulting diet transition, will continue to drive up grain demand over the next decade or so. Its domestic production is also growing, primarily as a result of its investment in research and development. However, the natural constraints from water availability and other environmental conditions prevent its growth in supply from being sufficient to meet the growth in demand. China's grain imports are expected to continue to grow at a modest speed. Although no significant threat to world food security can be observed, it is reasonable to anticipate more opportunities to export to China and greater competition for grain resource with other importing countries.

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The Wheat Sector in India: Production, Policies and Food Security

Amarnath Tripathi and Ashok K. Mishra

1 Introduction

India—located to the south-east of the Eurasian countries—is a fast-growing country. Its population is growing by 2 % a year (the current population is 1.24 billion people). However, about 59 % of the population still lives in rural communities, and the majority of rural households are directly dependent on agriculture for their livelihood. The agricultural sector's contribution to gross domestic product (GDP) fell from 43 % to 14 % during the period 1970–2011. Rapid growth in non-agricultural sectors (such as the service and manufacturing sectors) has led to the migration of labour out of agriculture. Nonetheless, agriculture is an important sector of the economy, which accounts for around 14 % of GDP and 11 % of the country's exports. About 56 % of India's land mass is agricultural land and only 43 % is net cultivated area; moreover, only about 45 % of the cropped area is reported to be irrigated. The net cultivated area has increased significantly by about 18 %—from 119 million ha in crop year 1950/1951 to about 140 million ha in 1970/1971. Since then it has remained more or less stable, at about 140 million ha; however, only 3.5 % of the area is permanently under crops. The average holding size is about 1.3 ha, and about 85 % of farms fall into this category.

After more than 70 years of independence, progress in India's agricultural sector has led to the country becoming self-reliant in its major food staples, namely rice

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and wheat. Much of the progress in the 1960s and 1970s was achieved through the successful adoption of yield-enhancing Green Revolution technology, which was supported by market interventions that sought to balance producer and consumer interests. India progressed substantially in food production both in terms of quantity and productivity. During the 1990s both yield and consumption growth slowed as a result of dietary diversification from staples to high-value food items and, consequently, the Government of India started increasing minimum support price at higher rate than previous years and better targeting of consumer subsidies. Since then, the wheat sector has become more volatile. A recent estimate of growth rate for food grains is about 4.6 %, and the main source of growth is an improvement in productivity. Average growth rates in yields of major crops have improved significantly in the 11th planning period (2007/2008 to 2011/2012) compared with the 10th planning period (2002/2003 to 2006/2007).

Wheat is an important crops in terms of both production and consumption. India almost exclusively raises winter wheat. Wheat is mainly grown in the Rabi season (October–December to March–May) along with barley, lentils, peas, mustard and potatoes. The planting of winter wheat begins about 1st of October and runs through to the end of December. Wheat will usually begin to head in January, with the harvest following in March, April and May. Wheat acreage increased from 13 % of the total cropped area in 1990–1991 to about 15 % in 2009–2010. Wheat production is mainly confined to the Indo-Gangetic Plains Region (Fig. 1), and three northern states, namely Uttar Pradesh (35.53 %), Punjab (18.96 %) and Haryana (13.39 %), supply 72 % of India's total wheat output. In addition, Rajasthan (8.31 %) and Madhya Pradesh (8.78 %) contribute a total output of 86 %. Wheat is one of the staple foods in India and it is a popular food item among both vegetarians and non-vegetarians. It provides nearly 50 % of the calories and protein requirements for the vast majority of population. India is the second largest producer of wheat in the world, averaging an annual production of 66 million tonnes. On average, India consumes 65 million tonnes of wheat, ranking it as the second-largest consumer of wheat in the world. Although India has been self-sufficient in wheat, it also imports wheat. In recent years, India, on average, imports 1 million tonnes of wheat and, for various reasons, exports an average of 0.7 million tonnes.

As mentioned above, 60 % of India's total cropped area is still rain-fed and therefore dependent on the monsoon. India's food grain production, and especially wheat production, slumped in the early 2000s as a result of widespread drought in 2002–2003. Findings in recent literature point to the continued dependency of Indian agriculture on climate in spite of recent technological developments (Kumar et al. 2014). The impact of climate change on agricultural production can adversely affect global food security in four ways: food availability, food accessibility, food utilisation and food-system stability. High variation in environmental factors such as temperature and rainfall, for example, can negatively affect crop growth, although certain crops may be positively affected by changes in these environmental factors. Therefore, changes in climatic variables can have a positive or negative impact on agricultural productivity and the food security situation in a given country (Greg et al. 2011).

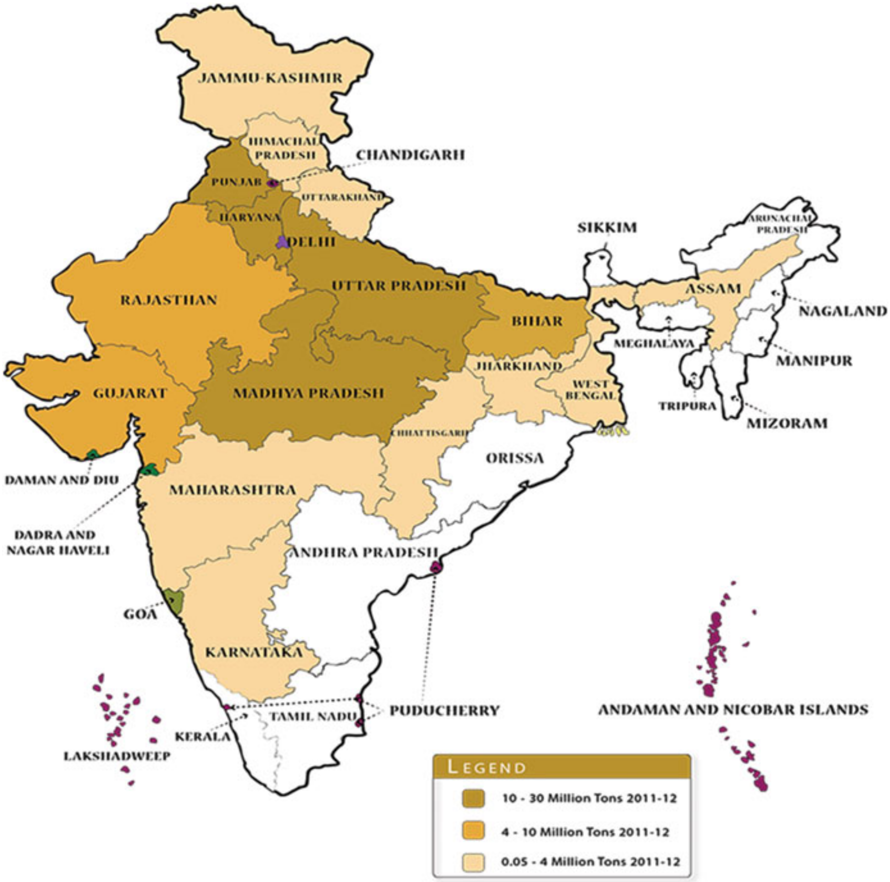


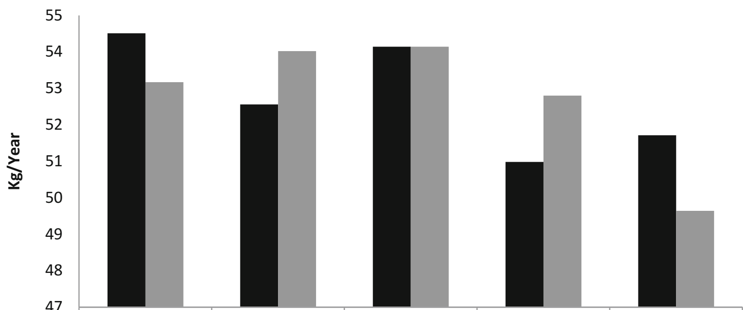
Fig. 1 Wheat-producing regions of India

Indian wheat production has been inconsistent and variable over the past five years (since 2010), which has posed a challenge to the food-security system. This is mainly due to decreased productivity, soil degradation and falls in water tables following overexploitation, a decline in fertiliser consumption, diversification to more remunerative cash and horticulture crops, small marginal landholdings, a fall in the availability of arable land, climate change, etc. Consequently, the sustainability of wheat production is a major challenge facing the Indian Government.

2 Domestic Consumption and Export of Wheat

In India, wheat is an important crop in terms of both production and consumption. It accounts for around 35 % of total food production and 21 % of the total cultivated area in the country. It is cultivated across the country, with the exception of the southern and north-eastern states whose contributions to production are minimal. Both vegetarian and non-vegetarian consumers eat wheat and its products. Nowadays, some of its products (biscuits, bread, noodles, etc.) have become very popular as a result of changes in lifestyle and the westernisation of diets. Wheat provides both macro- (e.g. carbohydrates, fat and protein) and micro-nutrients (e.g. calcium and iron) and hence helps to build a healthy society. Despite this, its per capita consumption has declined marginally over the past two decades, according to estimates provided by different surveys by the National Sample Survey Organisation. Figure 2 provides per capita consumption of wheat per year, although at different time points, for both rural and urban India. However, these numbers are underestimated because the National Sample surveys do not take into account the consumption of certain wheat products (e.g. biscuits, bread, and noodles). Owing to changes in lifestyle, the westernisation of Indian diets and globalisation, demand for the above wheat products has substantially increased. According to the Directorate of Wheat Research (located in Karnal, Haryana), total demand for bread was 9.4 lakh tonnes in 1991, which increased to 14.9 lakh tonnes in 2001; similarly, the demand for biscuits tripled in the same period of time (Directorate of Wheat Research, 2011).

Although per capita consumption of wheat has been declining, total demand for wheat has been increasing as a result of population and income growth (Mishra and Tripathi 2014). Total domestic consumption of wheat for the past 5 years is presented in Fig. 3, which shows a rising trend in the total demand for wheat in India. This upwards trend is likely to continue in the coming years, with a growing



	1987-88	1993-94	1999-00	2004-05	2009-10
Rural	54.51	52.56	54.14	50.98	51.71
Urban	53.17	54.02	54.14	52.8	49.64

Fig. 2 Per capita consumption of wheat across time periods in rural and urban India. Source: Government of India (2012)

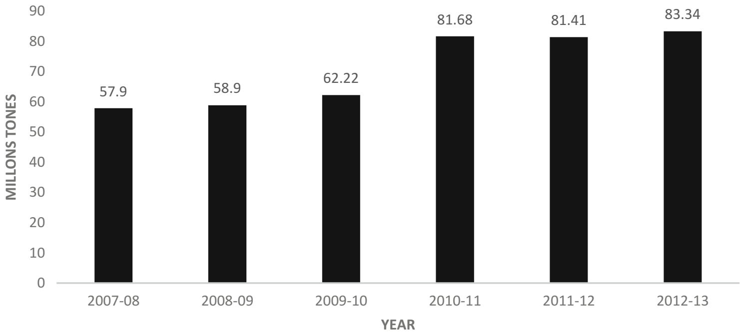


Fig. 3 Total domestic consumption of wheat in India. Source: Commission for Agriculture Cost and Prices, Ministry of Agriculture, Government of India, New Delhi

population and higher incomes projected in the future. In a recent study (Ganesh-Kumar et al. 2012), total demand for wheat was projected to be 91.4–101.7 million tonnes in 2025. Wheat attracts more attention in the booming retail food market because of its high nutritional value compared with rice, which is consumed by a large part of the population. Ready-to-eat wheat products with better shelf lives are now commonly found in retails shops, which attract a large number of consumers, particularly in urban areas. For example, wheat-based products such as bread, noodles, pasta and biscuits feature prominently in the purchases of a large number of consumers in urban areas. With a projected annual increase of nearly 10 % in India's middle-income group, which is currently estimated at around 350 million people, and with the associated higher disposable incomes, consumption of such wheat products is likely to increase significantly.

In addition to domestic consumption, exports are also an indicator of total demand. India has a comparative advantage in agriculture trade, as reflected in Balassa's Revealed Comparative Advantage (RCA) index. It is calculated by the Commission for Agriculture Cost and Prices (CACP) of the Indian Ministry of Agriculture. The RCA index for India's agricultural exports is presented in Fig. 4, which shows that the RCA index has been more than 1 during the period 1980–2011. In addition, an RCA of more than 1 has been noted for the years in which the government imposed export bans on certain commodities (e.g. an export ban on non-basmati rice and wheat during the periods 1996–2000 and 2007–2011). A comparative advantage in agricultural trade has translated into increased agricultural exports from India, from USD 6.0 billion in 2001–2002 to USD 40.8 billion in 2012–2013. India's net agricultural exports have increased eightfold, from USD 2.6 billion in 2001/2002 to USD 20.7 billion in 2012/2013. Despite this favourable situation, wheat is occasionally exported by India. However, it should be noted that during 2006/2007 and 2007/2008, wheat was imported from other countries to maintain buffer stocks. As a result, about 6.1 million tonnes and 1.8 million tonnes of wheat was imported by the government during 2006/2007 and 2007/2008, respectively.

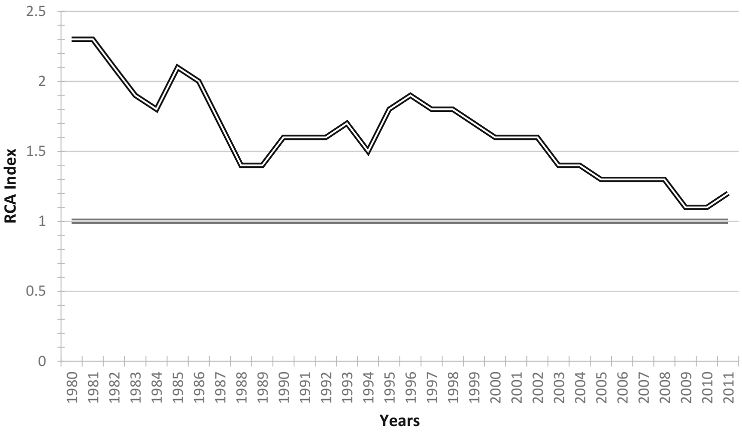


Fig. 4 Trends in the RCA index in India. Source: Commission for Agriculture Cost and Prices, Ministry of Agriculture, Government of India, New Delhi

India exported fewer than 1 million tonnes of wheat throughout the 1980s and 1990s, except for 1996/1997, when export levels were slightly greater than 1 million tonnes (Table 1). India's wheat exports were about 2.7 million tonnes in 2001/2002 and increased to the highest recorded level of 4.1 million tonnes in 2003/2004. However, exports of wheat declined to 2.0 million tonnes in 2004/2005, 0.7 million tonnes in 2005/2006 and 0.05 million tonnes in 2006/2007 because the government stopped wheat exports from the Central Pool stock in August 2003. Exports of wheat by private companies were also prohibited in February 2007. Furthermore, wheat exports were banned during 2007/2008 and 2010/2011. The ban on wheat exports continued until September 2011, when wheat exports of 2 million tonnes were allowed under an Open General Licence by private companies from privately held stocks through Electronic Data Interchange-enabled ports. From February 2012, restrictions on wheat exports were lifted under the Open General License. India's wheat exports for 2011/2012 were a meagre 0.7 million tonnes. However, in 2012/2013, India exported a record 6.5 million tonnes of wheat.

Although there is no consistent trend in Indian wheat exports, one can conclude that in recent years wheat exports from India have improved significantly. India used to import wheat in large quantities from many countries, such as the USA, under Public Law 480 during the 1950s and early 1960s to meets the demands of its large population. The increase in exports is attributable to an increase in production and productivity as a result of growing high-yielding varieties of wheat. The Government of India began a programme of planting high-yielding varieties of wheat in 1966/1967 on 0.54 million ha (4.2 %) of the total cropped area of 12.8 million ha. The area given over to these high-yielding varieties of wheat increased slowly and steadily over the next 10 years to cover about 13 million ha (62 %). Thereafter, large volumes of high-yielding, input-responsive and disease-resistant varieties of wheat were grown for various ecological and economic reasons.

Table 1 Wheat import and exports, 1980/1981 to 2012/2013

Year	Import (000 tonnes)		Export (000 tonnes)	
	Rice	Wheat	Rice	Wheat
1980–1981	18.0	292.1	727.4	75.4
1981–1982	64.9	1389.6	872.5	1.4
1982–1983	19.3	1756.8	453.6	0.0
1983–1984	408.7	3038.6	175.7	23.4
1984–1985	348.6	564.4	247.7	32.4
1985–1986	43.8	183.1	245.0	337.0
1986–1987	6.9	119.2	248.2	439.1
1987–1988	5.4	21.5	388.8	489.8
1988–1989	705.9	1792.4	349.6	14.0
1989–1990	468.6	32.6	421.8	12.0
1990–1991	66.1	66.0	527.5	134.4
1991–1992	12.1	0.0	678.2	586.5
1992–1993	102.4	1363.7	580.4	36.8
1993–1994	75.5	241.7	767.7	0.4
1994–1995	7.0	0.5	890.6	86.6
1995–1996	0.1	8.2	4914.0	632.5
1996–1997	0.0	612.7	2512.0	1145.9
1997–1998	0.1	1485.8	2389.9	1.5
1998–1999	6.6	1803.7	4963.6	1.8
1999–2000	35.0	1366.0	1896.1	0.0
2000–2001	13.2	4.2	1534.5	813.5
2001–2002	0.1	1.4	2208.6	2649.4
2002–2003	0.9	0.0	4967.9	3671.3
2003–2004	0.5	0.5	3412.1	4093.1
2004–2005	0.0	0.0	4778.1	2009.4
2005–2006	0.3	0.0	4088.2	746.2
2006–2007	0.2	6079.6	4748.0	46.6
2007–2008	0.2	1793.2	6469.4	0.2
2008–2009	0.1	0.0	2488.3	1.1
2009–2010	0.1	164.4	2156.4	0.0
2010–2011	0.2	185.3	2471.4	0.4
2011–2012	1.1	0.0	7175.9	740.8
2012–2013	0.7	2.9	10,120.2	6472.0

Source: Commission for Agriculture Cost and Prices, Ministry of Agriculture, Government of India, New Delhi

However, economists and policymakers have suggested that India will not be able to meet the growing demand for wheat in upcoming years (Ganesh-Kumar et al. 2012). In addition, a number of studies (see, for example, Harris et al. 2013; Jha and Tripathi 2011) have found that wheat yields were significantly lower under various climate-change scenarios.

3 Wheat-Production Scenarios

Given future anticipated scenarios for wheat production in India, it is important to assess production and productivity trends and to ascertain the factors and policies affecting wheat output growth. As mentioned above, the wheat crop is cultivated in the winter (*Rabi*[1]) season in India. It is sown between October and November and harvested during April and May. There have been rising trends in wheat coverage, production and productivity since India became independent in 1947. The cultivated area under wheat has tripled from approximately 10 million ha in 1950/1951 to 30 million ha in 2010/2011, and output has increased more than 12-fold, from approximately 6 million tonnes in 1950/1951 to 80 million tonnes in 2010/2011 (Government of India 2013a). However, the above data do not reveal period-specific trends which enable us to compare recent and past growth trends. Therefore, we have calculated annual compound growth rates for the area, production and yield of wheat for each decade, using a log-linear regression model. The results of this analysis are presented in Table 2.

The estimates presented in Table 2 show a decline in wheat area, production and yield in recent decades. During the first decade of the twenty-first century, wheat production increased at a rate of 1.88 % annually, which is almost half the rate seen in the 1990s. Similar trends can be observed for the cultivated area given over to wheat and wheat productivity. Although the total area under wheat has been growing, production and yield have been slowing since the 1980s. Table 2 also indicates that before the 1980s, expansion in the cultivated area was the major source of output growth, followed by the growth in productivity. Productivity was a major source of output growth until the 1990s. However, during the 2000s, expansion in the wheat area has once again become a major source of output growth. In India, during 2000/2001 and 2009/2010, states such as Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra and Rajasthan underwent a major expansion in their wheat areas, whereas there was a marginal improvement in wheat areas in the major wheat-producing states (i.e., Haryana, Punjab and Uttar Pradesh) (Table 3). This points to a slight spatial shift in wheat cultivation from Haryana, Punjab and Uttar Pradesh to Madhya Pradesh, Rajasthan, Maharashtra and Gujarat.

The significant rise in the area under wheat cultivation during recent years has been driven by two important government interventions. These include a significant increase in MSP and government procurement (Figs. 5 and 6). These are market-based interventions and safety nets for agricultural producers and consumer. The CACP conducts comprehensive surveys to calculate the cost of production (cultivation) of principal crops through state agricultural universities and recommends a MSP for principal crops to the government. Thereafter, the government announces a MSP for 25 crops each year and procures food grains, mainly rice and wheat, at the MSP through the Food Corporation of India. Procured food grains are

[1]In India, there are three agriculture seasons: the monsoon or rainy season (*Kharif*); the winter season (*Rabi*); and the summer season (*Jayad*).

Table 2 Growth trends in wheat area, production and yield

Decade	Area (in %)	Production (in %)	Yield (in %)
1950s	3.96* (0.82)	5.04* (0.78)	1.07 (0.19)
1960s	2.22** (0.50)	6.59* (0.60)	0.43* (0.60)
1970s	2.37* (0.75)	4.22* (0.67)	1.85** (0.47)
1980s	0.45 (0.17)	3.51* (0.79)	3.05* (0.87)
1990s	1.70* (0.88)	3.51* (0.91)	1.81* (0.75)
2000s	1.19* (0.78)	1.88* (0.63)	0.69*** (0.31)

The values given in parentheses are the coefficients of determination of the respective equation
The asterisks *, ** and *** show level of significance at 1 %, 5 % and 10 %, respectively
Source: authors' calculations based on data collected from Government of India (2013a)

distributed to consumers, particularly poor households, at a very low prices through public distribution system (PDSs).

Figure 7 indicates the 5-year average increase in government procurement. For example, in 1991 the government procured 8 million tonnes of wheat to support PDSs; this figure had tripled by 2014, when the government procured 28 million tonnes of wheat. Consequently, this has led to a significant increase in the buffer stock of wheat. Currently, the government has buffer stock of 308 lakh tonnes of wheat, compared with 102 lakh tonnes in 2005. These figures are significantly higher than the minimum recommended buffer stocks by the government. Similarly, the MSP (nominal) for wheat increased, at a rate of 7.8 % per year, from 1980 to 2014. However, over the past ten years (2005–2014), the MSP has been rising at a faster rate (Fig. 8).

One can conclude that these government interventions have encouraged farmers to allocate more land and production resources to the wheat crop. However, these interventions have also led to an increase in food prices. An increase in the MSP also increases the open market price of wheat. Similarly, as government procurement increases, supply in the open market decreases which, in turn, increases the price of wheat in the open market. Indian data presented below support these arguments. Figure 8 shows a positive and statistically significant impact of both MSP and government procurement on the wholesale price of wheat. Rising food prices hurt consumers, particularly low-income consumers, because their marginal propensity to consume is higher than that of high-income consumers. In addition, food inflation and government procurement creates a budgetary pressure on the economy. As noted above, a significant amount of government revenue is spent on procuring and maintaining the wheat buffer stock. The 70th round of the National Sample Survey conducted during the 2012–2013 period, on the Situation of Agriculture Households in India, noted that there were approximately 13 million households reporting sales of wheat; however, only 16.2 % of these farm households sold to procurement agencies. Unfortunately, the same report finds that only 34.5 % of the households reporting sale of wheat were aware of the government policy of MSP.

Table 3 Changing area under wheat in India, across states and selected periods

Area under wheat (000 hectares)[a]				
	Period			
State	1980–1982	1990–1992	2000–2002	2010–2012
Andhra Pradesh	16.2	9.2	14.0	9.0
Arunachal Pradesh	2.9	3.6	4.1	3.7
Assam	102.3	80.2	71.3	48.7
Bihar	1697.5	1974.9	2097.1	2122.7
Chhatisgarh	NA	NA	87.9	109.7
Gujarat	679.9	563.0	378.1	1312.5
Haryana	1521.0	1829.0	2327.5	2518.5
Himachal Pradesh	351.7	377.2	364.6	356.9
Jammu and Kashmir	199.0	246.5	270.0	293.4
Jharkhand	NA	NA	64.6	127.5
Karnataka	323.2	198.4	263.3	240.0
Madhya Pradesh	3335.6	3690.7	3507.5	4615.1
Maharashtra	1103.6	750.5	765.0	1075.0
Manipur	NA	NA	NA	2.1
Meghalaya	3.3	4.4	3.5	0.4
Nagaland	NA	0.5	5.5	3.1
Orissa	66.6	32.9	7.9	2.2
Punjab	2864.5	3252.5	3414.0	3519.0
Rajasthan	1701.6	1796.7	2298.6	2707.3
Sikkim	9.5	11.2	7.5	2.6
Tamil Nadu	1.1	0.4		0.0
Tripura	4.5	3.1	1.2	0.3
Uttar Pradesh	7942.0	8599.4	9247.7	9684.0
Uttarakhand	NA	NA	379.6	374.1
West Bengal	248.5	258.6	430.0	316.2
Dadra and Nagar Haveli	0.1	0.3	0.6	0.1
Delhi	42.2	31.7	27.0	22.5

NA, not applicable

[a]The estimated values are the average values of two consecutive years. For example, the value for 1980–1982 is calculated by taking an average of the values for two consecutive years, that is, 1980–1981 and 1981–1982

Source: authors' calculations based on data collected from Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi

Expansion in wheat acreage cannot be a solution for output growth, owing to the limited supply of land, and government policies to increase wheat acreage, such as MSP, may have several unintended consequences, as noted above. Therefore, wheat productivity must be increased by other means. An analysis of yield data for the six decades since independence suggests considerable improvement in wheat yields by more than 300 % since 1950/1951 (Government of India 2013a). Despite sizeable increases, yields in India are still much lower than in other major

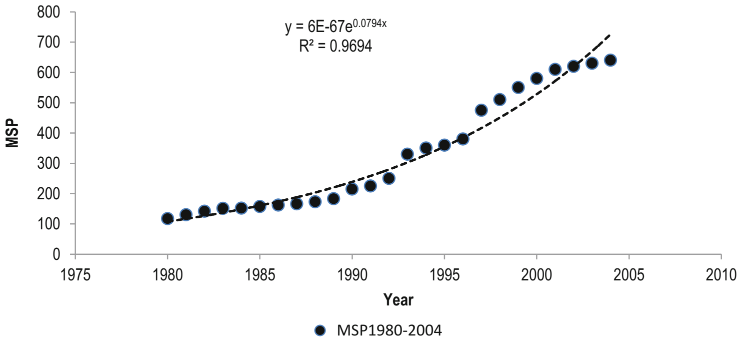


Fig. 5 Trends in MSP in India, 1980/1981 to 2004/2005. Source: Commission for Agriculture Cost and Prices, Ministry of Agriculture, Government of India, New Delhi

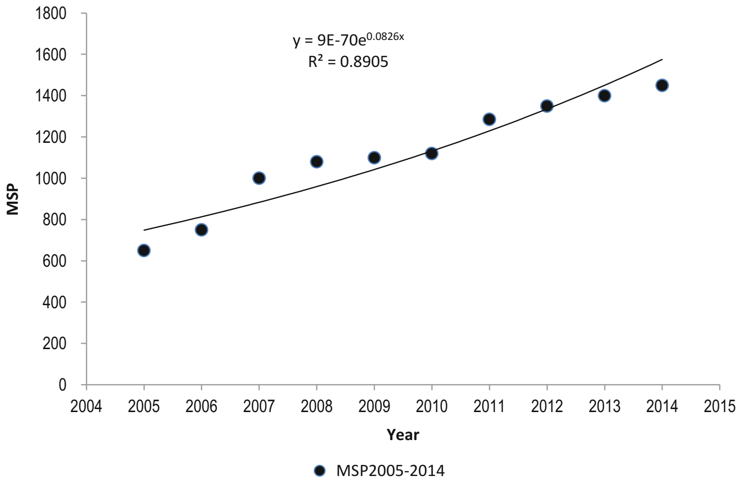


Fig. 6 Trend in MSP in India, 2005/2006 to 2013/2014. Source: Commission for Agriculture Cost and Prices, Ministry of Agriculture, Government of India, New Delhi

wheat-producing countries (e.g. China, France, Germany, the UK and Ukraine). Economists point out that the use of fertiliser and the quality of seeds may explain why India is lagging in terms of its wheat yield. For example, seed replacement rates for wheat in India are about 18 % at the national level (Kumar 2008; Government of India 2010). However, they are about 30 % in Punjab, which has the highest levels of wheat productivity in the country.

India, however, owing to its geographical setup has a large spatial variation in wheat yield. These variations may be due to the availability of irrigation facilities, climatic conditions and the use of high-yield varieties. In some states (e.g. Haryana and Punjab), the wheat yield is higher than the national average, whereas in many other states (e.g. Bihar, Madhya Pradesh and Maharashtra), it is much lower than

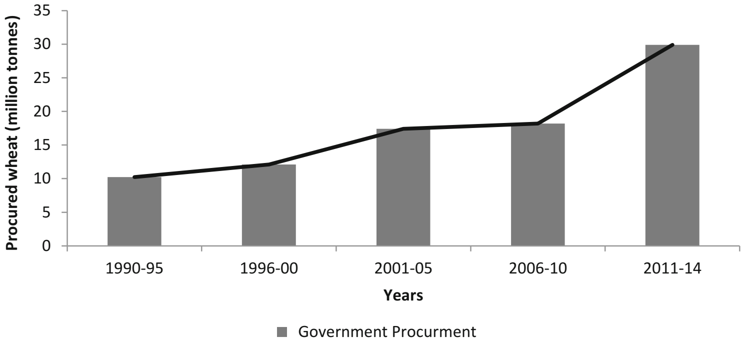


Fig. 7 Government procurement of wheat in India. Source: Commission for Agriculture Cost and Prices, Ministry of Agriculture, Government of India, New Delhi

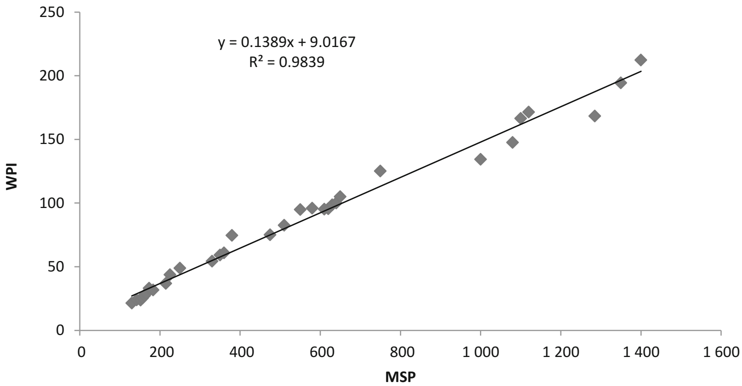


Fig. 8 Relationship between MSP and wholesale price index (WPI). Source: data on MSP and WPI were collected from Commission for Agriculture Cost and Prices and the Office of the Economic Advisor, respectively

the national average. Of these states, Punjab has the highest yield (4531 kg/ha) followed by Haryana (4066 kg/ha), Uttar Pradesh (2691 kg/ha), Rajasthan (2481 kg/ha), West Bengal (2321 kg/ha), Gujarat (2294 kg/ha), Bihar (2143 kg/ha), Uttarakhand (1873 kg/ha), Madhya Pradesh (1753 kg/ha), Himachal Pradesh (1609 kg/ha), Maharashtra (1310 kg/ha), Jammu and Kashmir (1239 kg/ha) and Karnataka (855 kg/ha). The yield gap mentioned above highlights scope for further increases in wheat production in India. It could be even achieved without an increase in the cultivated area.

Finally, the total factor productivity (TFP) for Indian wheat has also been decreasing. We compare TFP of wheat, using the Törnqvist index, for two wheat-growing states, namely, Bihar and Haryana for 1990/1991 to 2005/2006 and 1995/1996 to 2005/2006, respectively (see Fig. 9). We chose these two states because they are at different stages of agricultural development. For example, Bihar is less

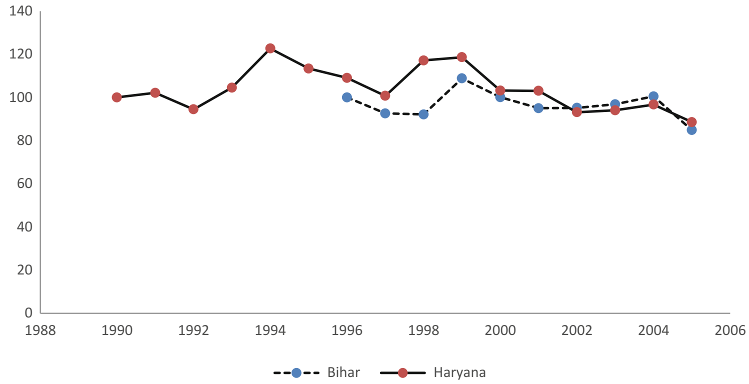


Fig. 9 Total factor productivity for wheat in Haryana and Bihar. Source: Authors' own calculation based on data collected from Commission for Agriculture Cost and Prices using Turnquist Index

developed in terms of agriculture, whereas Haryana—where the Green Revolution began in India—is a highly developed state in terms of agriculture. It is fair to say that Haryana and Punjab are the leading agricultural states in India. Despite the differences between Bihar and Haryana, a decline in TFP can be seen for both states. A negative growth rate in TFP is observed in these two states which, in turn, shows that it limits wheat output growth. It should be pointed out that the major source of output growth in the two states is the growth in inputs.

4 Government Policies in the Twenty-first Century

In order to increase wheat production and productivity, the Government of India has launched three major programmes, namely the National Food Security Mission (NFSM), Bringing Green Revolution in Eastern India (BGREI) and Rashtriya Krishi Vikas Yojana (RKVY). The emphasis of NFSM and BGREI is on the crop sector, whereas RKVY focuses on the agricultural sector as a whole. Another difference among these programmes is that NFSM and BGREI are restricted to regions or districts, whereas RKVY is implemented across the country. The NFSM was launched in districts in which crop productivity was less than the national average. However, BGREI was specifically targeted/implemented in eastern states of the country. NFSM and BGREI aim to increase crop productivity, particularly of rice, wheat and pulses. RKVY aims to encourage states to increase public investment in agriculture and associated sectors and also to incentivise states, through better planning and management, to generate additional growth in agriculture and associated sectors. As a result, wheat output and productivity has increased (Government of India 2013b). For example, the estimates for the 10th and 11th planning periods reflect the impacts of these government policies and programmes (see Table 4). As evident there has been no change in the average annual growth in

Table 4 Average annual growth rates in wheat area, production and yield

Parameters	10th planning period (%)	11th planning period (%)
Area	1.30	1.31
Production	1.11	4.64
Yield	0.32	3.29

Source: Government of India (2013b)

the area under wheat production. However, the average annual growth rate in wheat production and productivity have improved significantly (Table 4).

The Government of India also launched a very ambitious programme called ‘Pradhan Mantri Fasal Bima Yojana (PMFBY)’ in January 2016 to provide safety shield to farmers and protect them against vagaries of nature. Under this scheme, farmers will have to pay a uniform premium of 2 % for all kharif crops and 1.5 % for all rabi crops. For annual commercial and horticultural crops, farmers will have to pay a premium of 5 %. The remaining share of the premium will be borne equally by the Centre and the respective state governments. This scheme will encourage farmers to adopt new technology in farming and hence it will help to increase crop yield and production.

5 Impact of Climate Change on Wheat Production

Wheat, unlike many other crops, is sensitive to climatic factors. In particular, wheat requires a long period of low temperatures (November–March) for physiological growth and a moderately higher temperature at the time of grain ripening (April) (Jha and Tripathi 2011). In the life-cycle of wheat, the two most important stages that require water are crown root initiation (20–22 days after sowing, generally in December) and the flowering and grain filling stage (February–March). In spite of wheat’s sensitivity to water, the effect of rain on wheat yields is not significant, because the bulk of wheat is cultivated on assured irrigated areas.[2] To test the impact of climatic factors on wheat output (yield) for three periods (1980–2003, 1990–2003 and 1995–2003), we conducted a small study in two India states, namely Bihar and Haryana. Both states are known as wheat-growing states, but they represent different stages in agricultural development, as discussed earlier.

Farmers in Haryana are resource-endowed and they have adopted modern agricultural technologies. However, farmers in Bihar are poor in resources and still depend on traditional technologies. The differences between the two states are also reflected in the yield gap between them. The wheat yield in Haryana is much higher than that in Bihar. The correlation coefficients between climatic factors (temperature, rainfall) and wheat yield are calculated and the results are presented in Table 5.

[2]According to the Indian Directorate of Economics and Statistics, 92 % of the cultivated area under wheat in India is irrigated.

Table 5 Correlation coefficients for deviations in climatic parameters and wheat yield

Parameter deviations	Haryana			Bihar		
	1980–2003	1990–2003	1995–2003	1980–2003	1990–2003	1995–2003
Maximum temperature (°C)	0.61*	0.74*	0.76*	0.37***	0.17	−0.39
Minimum temperature (°C)	0.54*	0.59**	0.48	0.38***	0.09	−0.56
Rainfall (millimetre)	0.20	0.05	−0.68*	0.05	0.59**	0.50

Asterisks *, ** and *** indicate significance at 1 %, 5 % and 10 %, respectively

Table 6 Estimates of the impact of climatic variables on wheat yield

Explanatory variables (*dependent variable = wheat yield*)	Coefficients	t-statistic
Intercept	180,863.5	3.04
Irrigation ratio (In %)	34.75	22.22
Maximum temperature (In °C)	−14,658	−2.87
Minimum temperature (In °C)	2856.58	0.66
Rainfall (In millimetre)	−0.78	−0.03
(Maximum temperature)^2 (In °C)	259.90	2.86
(Minimum temperature)^2 (In °C)	−80.32	−0.63
(Rainfall)^2 (In millimetre)	−0.01	−0.04
Adjusted R^2	0.95	
F-statistic	160.90	
Observation	61	
Sample period	1950/1951 to 2011/2012	

Table 5 shows that deviations in the maximum and minimum temperatures are significantly associated with wheat yields in both Haryana and Bihar. However, deviation in the maximum and minimum temperatures for the period 1990–2003 was significant only in the case of Haryana. Finally, deviations in rainfall were found to be negative and significantly correlated with wheat yields for Haryana, during the 1995–2003 period. A possible reason is that in Haryana a large share of the assured irrigated area under wheat is through groundwater and a continuous decline in the groundwater table is constraining the availability of water for irrigation in Haryana and the other wheat-growing regions of India.

Furthermore, wheat yield is regressed on climatic variables (e.g. maximum temperature, minimum temperature and rainfall) along with the irrigation ratio at an aggregate country level for the period 1950/1951 to 2011/2012. We tried several function forms of regression equation and finally chose quadratic equations as they were found to be the best fit. The results are presented in Table 6. Estimated results show that climatic factors, particularly maximum and minimum temperature, have a statistically significant impact on yield. In the case of rainfall, the estimates do not indicate any impact, which may be due to the fact that wheat is mostly grown in India under highly irrigated conditions. (As noted above, approximately 92 % of the area under wheat cultivation is irrigated.) These results suggest that climatic factors significantly affect wheat yields in India. The findings here are consistent with those in the literature (Haris et al. 2013; Mishra et al. 2013; Haris et al. 2013; Lobell et al. 2012; Jha and Tripathi 2011).

6 Food and Nutrition Security

In India, there has not been a famine-like situation for several decades. However, some forms of food insecurity still persist in the country, which has been elaborated in subsequent discussion of this section.

Table 7 Level of grain stock above buffer stock norm (%)

Year	January[a]	April	July	Oct
2000	189.82	182.95	173.86	221.35
2001	272.43	284.67	254.97	321.99
2002	345.90	322.93	259.45	284.07
2003	286.93	207.63	144.74	130.82
2004	148.90	130.68	125.74	112.36
2005	129.15	113.74	103.35	85.90
2006	96.30	102.59	76.26	77.82
2007	88.97	109.83	88.87	96.36
2008	95.94	121.94	134.86	184.85
2009	180.95	219.64	197.71	273.09
2010	238.48	267.31	216.68	287.96
2011	236.10	273.54	238.39	320.21
2012	277.45	329.60	299.51	411.02
2013	333.47	368.88	274.88	NA

[a]Values less than 100 indicate grain stocks below that of the buffer stock norm

Source: authors' calculations based on data collected from Department of Food & Public Distribution, Ministry of Consumer Affairs, Food, & Public Distribution, Government of India

India has recorded a significant increase in food grain production, from 50 million tonnes in 1950/1951 to around 250 million tonnes in 2011/2012 (Government of India 2013b). This has strengthened India's food supply, which is also demonstrated by the food stock available in government granaries (see Table 7). As of July 2013, the grain stock is 131 % more than the buffer stock norms (strategic reserve) of 31.9 million tonnes (Government of India 2013b). More interestingly, with a few exceptions, the grain stock has been greater than buffer stock norms for the past decade (see Table 7).

The food self-sufficiency status at the national level has been translated into improvement in food adequacy at the household level, as reflected in the data on self-reported hunger. Trends in the perceived adequacy of food available at the national level are provided in Table 8, which shows a gradual increase in the percentage of households reporting two square meals every day throughout the year, from about 95 % to about 99 % in rural India and from about 98 % to 100 % in urban India, from 1993 to 2010.

The proportion of households reporting fewer than two square meals every day, in any month of the year, dropped from 0.9 % to 0.2 % in rural Indian households and from 0.5 % to 0.0 % in urban households. The proportion of households reporting fewer than two square meals every day in some months of the year also decreased, from 4.2 % to 0.9 % in rural India and from 1.1 % to 0.3 % in urban India, over the period. The improvement in the perceived adequacy of food is corroborated by some recent field experiences (Vijay 2014, Tripathi and Mishra, 2015,

Table 8 Self-reported hunger statistics

Sector	Year	Throughout the year	Only some months of the year	In no month	Status not recorded
Rural	1993–1994	94.5	4.2	0.9	0.4
	1999–2000	96.2	2.6	0.7	0.5
	2004–2005	97.4	2	0.4	0.2
	2009–2010	98.9	0.9	0.2	[a]
Urban	1993–1994	98.1	1.1	0.5	0.3
	1999–2000	98.6	0.6	0.3	0.4
	2004–2005	99.4	0.4	0.1	0.1
	2009–2010	99.6	0.3	0	[a]

[a]For 2009/2010, the unrecorded frequency is not shown separately but distributed proportionately among the three statuses
Source: Government of India (2013c.)

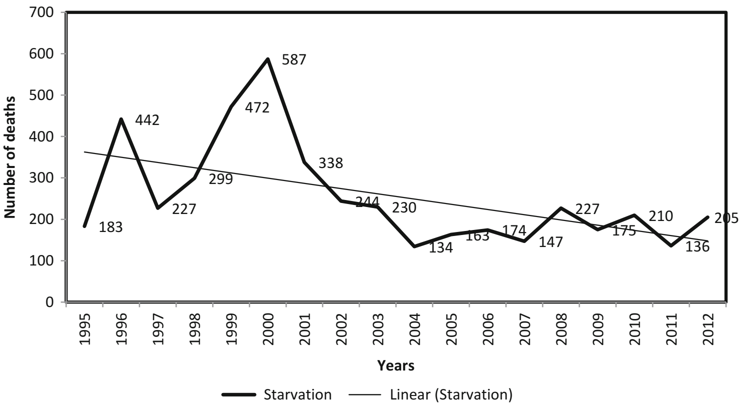


Fig. 10 Number of deaths attributable to starvation, by year. Source: Accidental Deaths and Suicides in India, National Crime Record Bureau, Ministry of Home Affairs, Government of India, New Delhi (see http://ncrb.gov.in/)

Srivastava 2015, and Tripathi and Ghosh 2016, Tripathi 2016) and the decline in the number of deaths attributable to starvation (Fig. 10).

Researchers did not find any case of food deprivation in the surveyed regions. These surveys were conducted mainly in two poor states of India, namely Uttar Pradesh (Vijay 2014, Tripathi and Mishra 2015, Srivastava 2015, Tripathi 2016) and Bihar (Tripathi and Ghosh 2016). Furthermore, evidence for dietary diversification also strengthens the optimistic outlook. The diets of Indian households, including both poor and non-poor households, are becoming increasingly diversified (Imai et al. 2012). As is the case for rich households, food consumption patterns among poor households have also shifted away from cereal to non-cereal items (Srivastava and Tripathi 2011). This change in food consumption pattern is similar

Table 9 Trends in per capita intake of calorie, protein and fat in rural and urban India

Items	Sectors	1993/1994	1999/2000	2004/2005	2009/2010
Calorie (kcal)	Rural	2153	2149	2047	2020
	Urban	2071	2156	2020	1946
Protein (g)	Rural	60.2	59.1	57.0	55.0
	Urban	57.2	58.5	57.0	53.5
Fat (g)	Rural	31.4	36.1	35.5	38.3
	Urban	42.0	49.6	47.5	47.9

Source: Government of India (2012)

Table 10 Distribution of households by level of calorie intake per consumer unit per day

Year	Number of households with calorie intake per consumer unit per day (000 households)[a]							
	Rural				Urban			
	<80	80–100	100–120	>120	<80	80–100	100–120	>120
1993–1994	227	288	230	256	266	306	217	212
1999–2000	258	300	216	225	259	313	221	209
2004–2005	276	337	215	172	282	349	212	156
2009–2010	258	362	219	160	277	357	210	156

[a]Expressed as a percentage of 2700 kcal per consumer unit per day
Source: Government of India (2012)

in both rural and urban India. Despite this optimistic situation, there has been a decline in calorie and protein intake in both rural and urban populations (Table 9).

For example, in 2009/2010, the average per capita calorie intake was about 2020 kcal and 1946 kcal for the rural and urban sectors, respectively. However, it was significantly higher, 2153 kcal and 2071 kcal, in rural and urban India, respectively, in 1972/1973. Similarly, protein intake has also declined during the same period. For example, average protein consumption has declined from 60 g to 55 g per person per day in rural areas and from 57 g to 54 g per person per day in urban areas, during the 1993/1994 and 2009/2010 periods. The above caloric decline is also reflected in the proportion of households with a calorie intake below the 2700 kcal per consumer unit per day, which has increased in both rural and urban India over the past 16 years. It was 52 % in rural India and 57 % in urban India for the year 1993/1994 and increased to 62 % and 63 % in rural and urban India, respectively, for the year 2009/2010 (Table 10). However, a small improvement was observed in per capita fat intake per day in the period from 1993/1994 to 2009/2010 (see Table 9). At the national level, there has been a rise from 31.4 g per person per day in 1993/1994 to 38.3 g for the rural population in 2009/2010 and from 42.0 g to 47.9 g for the urban population over the same period.

The above decline in calorie consumption has been accompanied by a declining calorie requirement, which is attributable to improvements in the epidemiological environment and a reduction in activity levels (Rao 2000; Rao 2005; Deaton and Drèze 2009). Nonetheless, the fact remains that poor households have experienced a significant deficit in calorie intake. The proportion of poor households with a calorie intake below 2700 kcal per consumer unit per day is still significantly higher in poor income groups compared to high income groups.[3] However, poor households' calorie requirements are comparatively higher because they typically engage in more labour-intensive work than rich households.[4] Besides calorie deficiency, outcome-based indicators also emphasise a 'nutritional deprivation' situation in the country. UNICEF (the United Nation Children's Fund) reports that 47 % of all Indian children under 5 years of age are underweight or severely underweight. This points to the presence of chronic malnourishment among children and thereby to poor maternal health and nutrition. Similarly, the latest National Family Health Survey (2005–2006) shows more than one-third of Indians between the ages of 15 and 49 are also undernourished (Arnold et al. 2009, Srivastava 2015).

Therefore, one may conclude that the hunger problem has shifted from one of food deprivation to one of nutritional deprivation in India. However, some cases of food deprivation have been reported in some parts of the country. These cases are mainly the result of poor PDSs and failures in government policies. Therefore, these problems are transitory in nature and can be solved with stronger PDSs and good governance, as can be observed by the performance of Tamil Nadu and Chhattisgarh. These states have taken many initiatives to reform their PDSs which has led to these states having the lowest levels of self-reported hunger.

7 Conclusions

Agriculture is an important sector of the Indian economy. It accounts for approximately 14 % of GDP and 11 % of the country's exports. Indian wheat production has, however, been inconsistent and variable over the past 5 years, which has challenged the soundness of its food security system. India's demand for wheat will not decrease. Economists and policymakers worry that India will not be able to meet the growing demand for wheat in the upcoming years. Indeed, under climate-change scenarios, this seems plausible. There is significant evidence that wheat demand is increasing in both rural and urban areas; the highest demand is coming from middle-class households in both rural and urban areas. As incomes rise, middle-income households tend to consume less rice in favour of more western food items processed from wheat, for example bread, pasta, noodles and pastries.

Although the total area given over to wheat has been growing, production and yield have been decreasing since the 1980s. This is mainly due to decreased

[3]In 2009/2010, around 62 % of households in the lowest income group consumed less than 80 % of the 2700 kcal per consumer unit per day, whereas only 0.24 % of the richest households were in this category (Government of India 2012).

[4]This is based on a well-known economic theory that states that as income levels increase, people shift towards a more sedentary lifestyle.

productivity, soil degradation and falls in water tables following overexploitation, low fertiliser use, diversification to other more remunerative cash crops (i.e. sugarcane, cotton, etc), fruits, and vegetables, small and marginal landholdings, a fall in the availability of arable land and climate change. Consequently, the sustainability of wheat production is now a major challenge facing the Indian Government. Despite being self-sufficient in food staples, Indian wheat productivity falls behind that of Brazil, the USA and France. TFP is still low (about 2 %) because the agricultural sector is dominated by smallholdings. However, China which is also dominated by smallholdings, has an agricultural productivity of approximately 6 %. There is scope for productivity gains and total output gains in Indian agriculture, especially in wheat. The yields of all cereal crops, but especially wheat, rice and maize, have been virtually stagnant over the past 16 years. Many grain farmers are moving towards growing higher-yield crops such as fruit and vegetables.

In addition, a loss of arable land to non-agricultural uses and increased land fragmentation as a result of a growth in the population has put a significant emphasis on raising productivity through increasing yield per acre such as high-yielding varieties, and adoption of stress-tolerant varieties of wheat and rice. Finally, climate change, land degradation (which affects about 37 % of geographical land) and the rising cost of agricultural production is of concern to farmers and policymakers. It emphasises the need to further increase food production to meet demand. India's low average wheat yields compared with other major world producers suggest that there is significant scope to boost yield and output. Finally, the perceived adequacy of food and dietary diversification are reported as rising in Indian households. However, the hunger problem has shifted from one of food deprivation to one of nutritional deprivation in India. Increase in supply of wheat and its based products and their efficient distribution could tackle the above problem significantly.

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Conclusions and Policy Recommendations

Pavel Ciaian, Sergio Gomez y Paloma, Sébastien Mary, and Stephen Langrell

1 Introduction

This chapter summarises the main findings of this book on developments in, and the potential future growth of, the wheat sector in Eurasia. More precisely, the chapter reflects on main developments in reform patterns and agricultural policies and summarises their impacts for the agricultural sector in general and the wheat sector in particular. The chapter also attempts to provide a set of policy recommendations conducive for promoting rural productivity growth and regional and global food security. This chapter references and draws heavily on material presented in earlier chapters of the book.

The Eurasian region covers Commonwealth of Independent States (CIS) countries that were formerly part of the USSR. The special emphasis of this book is the Russia, Ukraine and Kazakhstan (RUK) countries and Central Asia. However, Belarus and Caucasian countries (Armenia, Azerbaijan, Georgia) are also considered when relevant for comparison purposes. The Eurasian region is a key player in world wheat markets. RUK are important countries in the region and account for the majority of its wheat production and trade.

Although the agricultural sectors of CIS countries had a common structure and organisation during the Soviet period, after the dissolution of the USSR in 1991, development patterns and subsequent transition processes diverged considerably across CIS countries. During the Soviet period, the agricultural production was

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organised into large collective and state farms, the allocation of resources was centrally planned and resources (including land) were state owned. The transition processes, initiated in the early 1990s, aimed to reorganise the whole sector, and ranged from farm restructuring to the privatisation of resources. However, these process diverged considerably across CIS countries, which resulted in differences in terms of farm organisation, land privatisation, land use and agricultural policy choices. These structural differences have largely determined how the wheat sector has developed over the past decades; they also define its current status and determine its potential future growth.

2 Agricultural Reform Patterns in the Commonwealth of Independent States Countries

CIS countries implemented large-scale agrarian reforms during their transition processes, with the aim of creating market institutions and transferring agricultural assets (including land) from state to private ownership. Two principal reform elements that reshaped the whole agricultural sector in the region involved land privatisation and farm restructuring. In most CIS countries, privatisation involved the distribution of land shares to agricultural workers. The beneficiaries received paper shares which certified their entitlement to a certain amount of land without specifying a physical plot. The exceptions are Armenia, Georgia, Moldova and Tajikistan. Armenia and Georgia distributed physical plots to agricultural workers, whereas Moldova and Tajikistan initially adopted the same strategy as Russia and Ukraine but later converted land shares to physical plots. This farm restructuring aimed to reorganise production from large-scale collective and state-owned farms to small and medium-sized individual farms (Mathijs and Swinnen 1998; Lerman 2001; Rozelle and Swinnen 2004).

The land reform and farm restructuring initiated in CIS countries in the 1990s have created pre-conditions to reduce rural poverty and to improve food security in rural areas in two respects. First, they have increased household assets via one-off transfers of resources (land, livestock and farm machinery) from collective and state farms to households, thereby empowering rural populations to improve their welfare. Second, this asset transfer to individual farms has created conditions for increased agricultural productivity and food security in rural areas (Lerman, chapter "Privatization and changing farm structure in the Commonwealth of Independent States").

However, the outcomes of these agricultural reforms vary greatly across CIS countries. The Caucasian CIS countries (Armenia, Azerbaijan, Georgia) have made the most progress in terms of land reforms and farm restructuring. At the other end of the spectrum are the Central Asian countries (CACs) (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan), which have lagged in their implementation of reform and which have allowed the state to be heavily involved in their agricultural sectors. After more than 20 years of land reform, CIS countries still have not achieved the original goal of creating an institutional framework that determines the allocation of land resources based on market signals (Lerman, chapter "Privatization and changing farm structure in the Commonwealth of Independent States"; Shagaida and Lerman, chapter "Land Policy in Russia: New Challenges"; Rozelle and Swinnen 2004; Lerman 2012).

The causes of incomplete transition process vary across CIS countries largely being reflected in creating substantial transaction costs in agricultural markets associated with the costly reconfirmation of landownership rights, the costly conversion of land shares to physical plots, the incomplete cadastral registration of plots, the restrictions maintained on sale and rental markets and adoption of inconsistent and unpredictable agricultural policy framework (Shagaida and Lerman, chapter "Land Policy in Russia: New Challenges").

3 Agricultural Policies

The transition process initially led to a significant reduction of state involvement in the agricultural sector in most CIS countries, but this was followed by a re-emergence of government subsidisation and state intervention in the sector over the past decade. Although CIS agricultural sector subsidies tend to remain below the levels observed in developed countries, market intervention is frequently used to regulate commodity prices. According to the Organisation for Economic Co-operation and Development (OECD), the producer support estimate (PSE) in total agricultural receipts in RUK dropped from more than 60 % before 1991 to below 15 % in 2011–2012. By comparison, the PSE in the USA, the European Union and Japan was 8 %, 19 % and 53 %, respectively, in 2011–2012 (Fig. 1).

There is a strong and growing involvement of the state in grain markets (including wheat) in CIS countries. An important role of state intervention is market stabilisation and price regulation and includes, to varying degrees among countries, price intervention, trade policies, support for storage, processing and transportation and investment in grain infrastructure and grain export facilities. However, in reality, the stabilising effects of state interventions are often ineffective and introduce a degree of uncertainty to the whole sector (Sedik, chapter "The New Wheat Exporters of Eurasia and Volatility").

Subsidisation of wheat has increased over time but at varying degrees among the CIS countries. Agricultural policies give clear preferences to producer support across the CIS. For example, in Russia, price intervention dominates in the total support (Uzun and Lerman, chapter "Outcomes of Agrarian Reform in Russia"). In Uzbekistan, farmers operating under the state-procurement system have access to subsidised inputs for wheat, such as fertiliser, diesel and machinery services, as well as access to cheaper loans (Goletti and Chabot 2000; Robinson 2008; Pomfret 2008). In other CIS countries, price interventions and/or production subsidies are applied (Bobojonov et al., chapter "Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan").

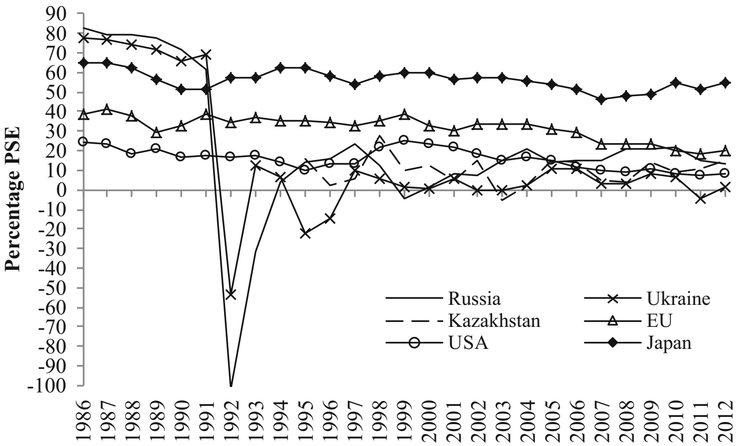

Fig. 1 Development of total PSE in CIS and developed countries (% PSE). Source: OECD

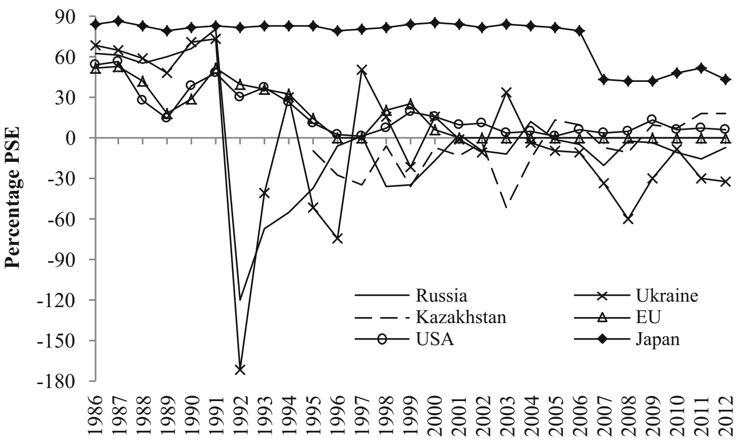

Fig. 2 Development of PSE of wheat in CIS and developed countries (% PSE). Source: OECD

In RUK, market price intervention and input subsidies dominate wheat policies. According to the OECD's PSE, the wheat sector tends to be taxed in Russia and Ukraine, whereas it is subsidised in Kazakhstan (Fig. 2). Temporary export-restricting policies are also often applied in RUK, in particular when production is adversely affected by bad weather conditions, and these are justified on the grounds of national food security. Examples of temporary grain export restrictions include the introduction of an export quota in Ukraine between July and October 2007, an export tax of 40 % on wheat in Russia, an export ban in Kazakhstan from April to September 2008, an export ban in Russia from August 2010 to June 2011 and a grain export quota in Ukraine from October 2010 to July 2011 (OECD 2011; FAPRI 2013; OECD 2013a; Fellmann et al. 2014).

State intervention in the wheat sector (or agriculture in general) is often motivated by food security concerns. This is particularly valid for Caucasian countries and CACs (e.g. Armenia, Georgia, Azerbaijan and Kyrgyzstan). The high dependence of most CACs on imports from RUK has created several challenges during the food crisis linked to regional production volatility and trade restrictions imposed by RUK countries. As a response, CACs have reinitialised their policies towards increasing self-sufficiency, mainly by providing several form of subsidies to boost domestic production (Robinson 2008; Götz et al. 2013; Bobojonov et al., chapter "Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan").

Uzbekistan and Turkmenistan have some of the most highly state-regulated wheat sectors in the region. Uzbekistan maintains a state-procurement system under which farmers are assigned production targets at state-determined prices (which are lower than market prices) and have access to subsidised inputs such as fertiliser, diesel, machinery and credit. Only the excess production beyond the state set target can be sold at market prices. The state procurement policy also regulates the minimum cultivated area of wheat per farm, as well as the amount of fertiliser to be applied per hectare (Bobojonov et al. 2010; Kienzler et al. 2011; Goletti and Chabot 2000; Robinson 2008; Pomfret 2008; Bobojonov et al., chapter "Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan")

Wheat production in Turkmenistan is also under a state-procurement system. All aspects of wheat production are controlled by the government. This includes the choice of land allocation, the biological varieties of wheat to be grown, the supply of seeds, land, water, fertilisers and herbicides, technical services, bank credits, the cost of inputs and services and, ultimately, procurement prices. The wheat sector is perceived as a strategic sector and is subject to the *Zerno (Grain)* programme adopted in 1991, the aim of which was to achieve full self-sufficiency in wheat production (Stanchin and Lerman, chapter "Wheat production in Turkmenistan: Reality and expectations").

Even CACs that initially had relatively few interventions in agricultural production and trade also became more active in supply chains as a result of the export restrictions and uncertainties in wheat exports from RUK. For instance, Armenia—widely known for its liberal agricultural policy—introduced a grain self-sufficiency policy in 2008, similar to the approaches put in place in Uzbekistan and Turkmenistan (ICARE 2012). However, in contrast to Uzbekistan and Turkmenistan, Armenia opted to subsidise its grain producers instead of introducing a state regulated procurement system (Bobojonov et al., chapter "Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan").

The state also supports several (semi-public) services in different CIS countries. Crop insurance is one such example (existing only in Uzbekistan and Kazakhstan). Uzbekistan subsidised insurance premiums during the years 1997–2001 but abolished this practice in 2002. The insurance penetration in Uzbekistan is nevertheless the highest among the CIS after Kazakhstan (where the insurance sector is still publicly subsidised) (Bobojonov et al., chapter "Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan").

4 Agricultural Sector Impacts and Developments

4.1 Farm Structure

Land reforms in the 1990s led to the emergence of a dual farm structure in CIS. Two types of farms operate across the CIS: corporate farms ('agricultural enterprises') and individual farms. Corporate farms are transformed state and collective farms and are usually large in terms of land use. Individual farms are newly created agricultural operations and tend to be small in size and include family/peasant farms and household plots. The CIS countries with the highest individualisation of agriculture include Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan and Azerbaijan. In Russia and Ukraine, there has been a growth in individualisation, but corporate farms continue to dominate the sector. In Kazakhstan corporate farms continue to maintain a dominant position in the sector (Lerman, chapter "Privatization and changing farm structure in the Commonwealth of Independent States"; Shagaida and Lerman, chapter "Land Policy in Russia: New Challenges"; Pugachov and Pugachov, chapter "Agrarian reforms in Ukraine").

The heterogeneity in farm structure is observable not only across the CIS but also within some CIS countries. For example, in Russia in 2000, corporate farms dominated in 23 % of Russia's regions, individual farms dominated in 22 % of the regions, whereas 55 % of the regions had a mixed farming structure. Individual farming is observed mainly in eastern and northern regions of Russia, in ethnic republics (e.g. Tatarstan), and also in non-*chernozem* regions suffering from depopulation. Corporate farms, however, are observed in regions with the best natural and economic conditions (the Belgorod, Lipetsk, Moscow and Leningrad oblasts, Krasnodar and Stavropol' territories) (Uzun and Lerman, chapter "Outcomes of Agrarian Reform in Russia").

The extreme concentration of land into large agro-holdings is growing in some CIS countries. This development has been observed in Russia and Ukraine, in particular over the past 10 years. The growth of large agro-holdings largely happened as a result of informal and dysfunctional land markets, which led to the consolidation of large stretches of farmland by vertically integrated legal entities. Such corporations often control many other agricultural enterprises and cultivate hundred of thousands of hectares. Their access to a wide array of financing options has enabled them to initiate diversified activities along the full product chain, from input supply and basic crop production to agricultural processing and exports. For example, in Ukraine in 2013, the estimated number of agro-holdings was about 140. They control more than 6000 (40 %) other agricultural enterprises and 7.8 million hectares, with hundred of thousands of hectares each. In total, these agro-holdings produce and sell about half of all wheat, more than half of maize and rapeseed, one-third of sunflower products, three-quarters of sugar beet and over 80 % of poultry produced in the country. They also benefit from special tax privileges (Uzun and Lerman, chapter "Outcomes of Agrarian Reform in Russia"; Keyzer et al., chapter "Unlocking Ukraine's production potential").

4.2 Agricultural Credit

The agricultural sector in CIS countries suffers from a lack of reliable and accessible financing, which slows the growth and development of the sector. The main causes are the lack of overall macro-economic stability, which undermines existing financial institutions, the weak institutional frameworks that hinders the development of financial markets, weak management and accounting practices at farm level, a lack of credit demand, dysfunctional land markets, unstable policy framework, as well as the inherent risks that are traditionally associated with agricultural production (e.g. weather variability) (Schroeder and Meyers, chapter "Credit and Finance Issues in the Eurasian Wheat Belt"; Pugachov and Pugachov, chapter "Agrarian reforms in Ukraine").

Constraints on demand are often limiting factors for agricultural credit in CIS countries. For example, for many Ukrainian and Kazakh small farms, a major barrier to obtaining additional financing is their inability to generate the sufficient documented cash flow to repay credit. Furthermore, many small farms operate in the cash market and do not have any financial records that lenders could use to assess their financial status (Homans et al. 2011; OECD 2013b). Ukrainian agricultural producers are often reluctant to use bank credit owing to their distrust of the banking system or to a lack of knowledge about the benefits of credit for their business (Homans et al. 2011). As a result, informal borrowing through family, friends and self-help groups is widespread in the country (Schroeder and Meyers, chapter "Credit and Finance Issues in the Eurasian Wheat Belt"). Micro-evidence from Kazakhstan shows that the greatest constraint to credit market growth is the lack of effective demand as a result of the low and uncertain returns from farm production (Petrick et al., chapter "More than pouring money into an ailing sector? Farm-level financial constraints and Kazakhstan's "Agribusiness 2020" strategy").

Common credit instruments used in CIS countries include bank lending, state-supported credit, systems of warehouse receipts, non-bank lending (e.g. credit unions, leasing and value chain financing) and informal borrowing. Kazakhstan is one of the CIS countries that has successfully introduced warehouse receipts. The country was able to build initial consensus among key stakeholders on the development of a warehouse receipt system, to adopt legal framework, to institutionalise the important elements of the system and to involve the financial system in its use from the early stages of development (EBRD 2004; Hollinger et al. 2009). As a result, a well-functioning system of warehouse receipts has proven to be rather successful in securing agricultural financing in the country (e.g. in 2010 over 30 % of the loans issued to agriculture were guaranteed by grain receipts) (OECD 2013b; Schroeder and Meyers, chapter “Credit and Finance Issues in the Eurasian Wheat Belt”).

State-subsidised credit is a common support policy in CIS countries in the form of interest subsidies for short-, medium- and long-term loans. In Ukraine, the amount of support was around 5 % of all input subsidies in 2010–2012. In Russia, the government’s credit subsidies have been on the rise since 2006 and are expected to represent a 23 % share of the total agriculture support for the period 2013–2020. In Kazakhstan, state credit support constitutes 7 % of the OECD PSE (Schroeder and Meyers, chapter “Credit and Finance Issues in the Eurasian Wheat Belt”).

Often, credit support is biased towards large farms in CIS countries. For example, in Russia, beneficiaries of credit subsidies are predominantly large farms and downstream borrowers. Small farms, households and cooperatives have typically received only a small fraction of the subsidised credit (Schroeder and Meyers, chapter “Credit and Finance Issues in the Eurasian Wheat Belt”; Pugachov and Pugachov, chapter “Agrarian reforms in Ukraine”).

Large farms have easier access to finance and more financing options than small farms. For example, in Ukraine, there is a ‘funding gap’ for farms of between 100 and 1000 ha in size. Smaller farms (less than 100 ha) can often obtain credit from credit unions. Farmers with over 1000 ha of land enjoy various sources of lending such as value chain financing, leasing opportunities and credit from national and regional banks. The medium-sized farms (100–1000 ha) are, however, too large to access financing from credit unions but too small to take advantage of other sources of financing available for larger farms (Homans et al. 2011; Schroeder and Meyers, chapter “Credit and Finance Issues in the Eurasian Wheat Belt”).

4.3 Productivity Impact

The main drivers of productivity during the transition period were (1) initial conditions of the levels of development, resource endowments and technology, (2) agricultural policy development (e.g. price liberalisation, subsidy reduction) and (3) land-reform choices. In general, the first driver had a mixed impact on productivity, depending on the type of initial conditions prevalent in a given country. Price liberalisation and subsidy reduction resulted in a fall in productivity because of a decrease in the terms of trade in agriculture. Land reform that returned land to its former owners and/or distributed physical plots to agricultural workers was more conducive to promoting productivity growth than the reform that distributed land shares to agricultural workers. This is because the first two types of land reforms resulted in relatively well-defined property rights which stimulated owners to invest in agricultural activities (Rozelle and Swinnen 2004; Swinnen and Vranken 2010).

The empirical evidence suggests that the individualisation of agricultural land led to productivity growth across the CIS. Countries dominated by small individual farms tend to have higher levels of productivity and welfare growth than countries dominated by large corporate farms. This is indirectly linked to land-reform choices. Countries that implemented land reforms where landownership rights were better defined led to higher levels of agricultural individualisation and thus also stimulated productivity growth (Lerman, chapter "Agrarian reforms in Ukraine").

Land productivity development, however, followed different trends for corporate farms and family farms in Russia. The productivity of agricultural land fell between 1990 and 1998. Corporate farms' productivity began to increase from 1998, and by 2012 it had more than doubled relative to 1998 to exceed pre-reform levels. In the case of family farms, however, land productivity dropped until the first half of 2000s. Only in recent years has the productivity of family farms stabilised. Despite these different trends, family farms use land more efficiently than corporate farms and their land productivity is consistently higher. In recent years, the production per hectare of family farms was double that of corporate farms (Uzun and Lerman, chapter "Outcomes of Agrarian Reform in Russia").

Farm structure indirectly determines the agricultural products in which a country specialises and in which it has a competitive advantage on international markets. Corporate farms are large in size and thus are competitive in capital-intensive products and products with low labour-monitoring requirements (e.g. cereal production). Individual farms usually have more abundant labour and reduced access to capital and, hence, tend to be competitive and specialise in higher labour-intensive products (e.g. fruits and vegetables). CIS countries in which corporate farms dominate the agricultural sector (e.g. RUK) have a pre-condition to be competitive in cereal production (including wheat) and thus their agricultural sector tends to specialise in this production activity. However, an indirect effect of this specialisation in capital-intensive cereal production is lower labour use in agriculture and lower employment opportunities in regions where corporate farms dominate (Ciaian, et al. 2009; Kancs and Ciaian 2010, 2012).

An important effect of the transition reforms was the reduction of the agricultural area (land abandonment) in several CIS countries. According to Food and Agriculture Organization of the United Nations (FAO) data, in 2012 the total agricultural area had decreased by 23.6 million ha (–4 %) in CIS countries relative to the area in 1992, whereas the arable area had reduced by 25.6 million ha (–12 %). In Kazakhstan, Russia, and Ukraine, the reduction in the total agricultural (arable) area was –6 % (–35 %), –3 % (–9 %) and –1.5 % (–2.5 %), respectively.

5 Development of the Wheat Sector

5.1 Production

After an initial fall in production in the early 1990s, wheat production showed a positive upwards trend in CIS countries in the subsequent period. Wheat production

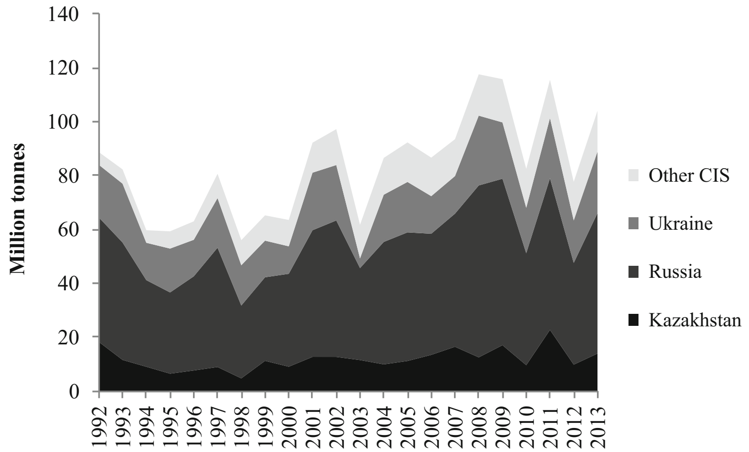

Fig. 3 Development of wheat production in CIS countries (million tonnes). Source: FAO

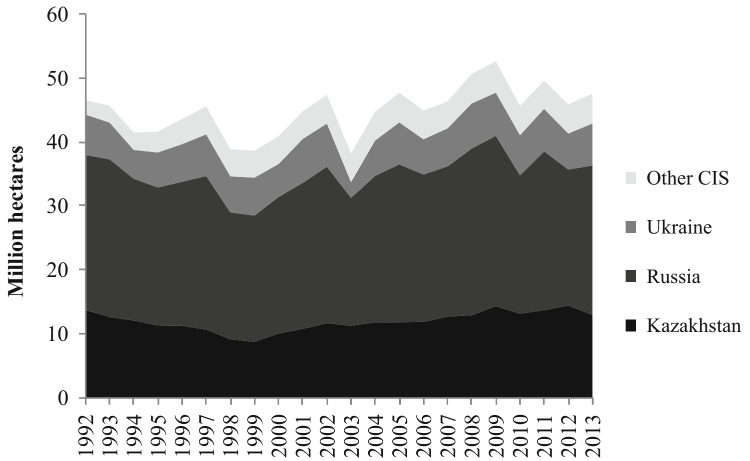

Fig. 4 Development of wheat area in CIS countries (million hectares). Source: FAO

had increased by around 50 % in 2012–2013 relative to 1995–1996 (Fig. 3). Production growth was driven by an expansion of the cultivated area and by yield increases. The wheat area expanded by 10 %, and yield increased by 35 % in 2012–2013 relative to 1995–1996 (Figs. 4 and 5). Despite this growth, wheat yields in the CIS are far below the yields of other world wheat-producing regions. The average wheat yield in CIS countries is around 40 % lower than the world average, more than two times lower than in China and more than three times lower than in France and Germany (Fig. 6).

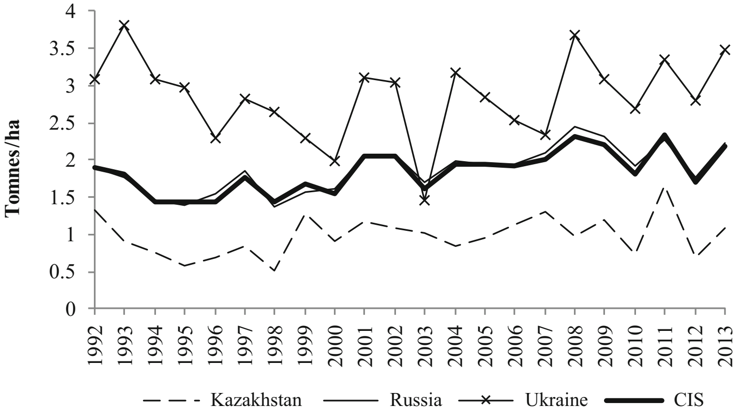

Fig. 5 Development of wheat yield in CIS countries (tonnes/hectare). Source: FAO

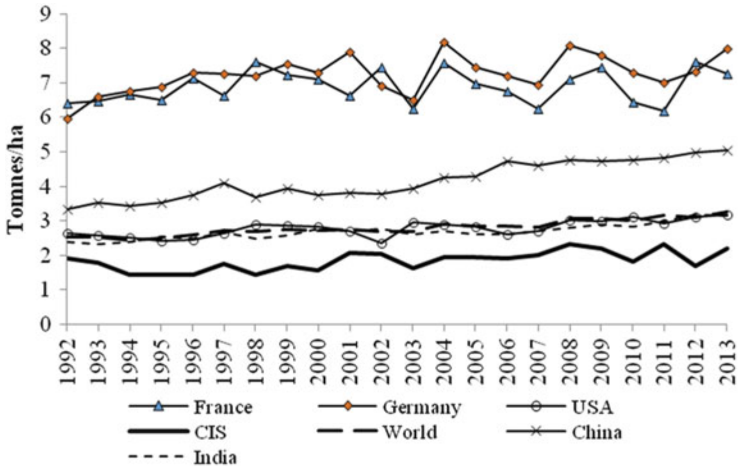

Fig. 6 Wheat yields in CIS countries versus developed countries and at a global level (tonnes/hectare). Source: FAO

The main producers of wheat in the CIS are RUK. These three countries together account for 90 % of the wheat area and 85 % of wheat production in the CIS (Figs. 3 and 4).

Self-sufficiency policies have stimulated wheat production in several CIS countries. The transformation of the wheat sector as a result of state intervention has been so intensive that several CIS countries have become self-sufficient or even net exporters of wheat. For example, according to FAO data, wheat production in Turkmenistan, Tajikistan and Uzbekistan expanded by a factor of 3.6, 4.6 and 7, respectively, in 2013 relative to 1992 (Bobojonov et al., chapter "Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan"; Stanchin and Lerman, chapter "Wheat production in Turkmenistan: Reality and expectations").

Wheat production is highly volatile in the CIS. Wheat production in most CIS countries relies on rain-fed cultivation, which causes year-to-year fluctuations in yields as a result of variations in levels of rainfall (Fig. 5). These changes adversely affect the food security in all CIS countries, induce price fluctuations at regional and global levels and often trigger policy responses that often lead to significant market distortions (Sedik, chapter “The New Wheat Exporters of Eurasia and Volatility”; Araujo-Enciso et al., chapter “Eurasian grain markets in an uncertain world: A focus on harvest failures in Russia, Ukraine and Kazakhstan and their impact on global food security”).

Food security in the region is largely dependent on cereal production, most notably wheat. Some of the CIS countries (e.g. RUK) are able to meet their own cereal (including wheat) needs, whereas others (e.g. Tajikistan and Turkmenistan) rely on imports. However, the food security risk associated with wheat availability has diminished significantly owing to production growth in most CIS countries since the beginning of the transition process. The potential risks to food security faced by all CIS countries are now mostly confined to food price volatility arising from market volatility and instability and fluctuations in production that are attributable to weather conditions (Sedik et al. 2011; Fehér et al., chapter “Kazakhstan’s production potential”).

5.2 Trade

The CIS countries are gaining a growing share of the world wheat markets. The CIS has changed from being a net importer of wheat in the 1990s to being a net exporter in 2000s. CIS countries annually export around 25 million tonnes of wheat, which represented around 15 % of the total world wheat exports in 2011, up from 3 % in 1992. Net trade represented 19 million tonnes in the CIS in 2011, increasing from –28 million tonnes in 1992 (Figs. 7, 8, 9, and 10).

The expansion of wheat (and grain in general) exports from CIS countries can be attributed to a drop in livestock production during the transition period. During the Soviet period, the regime expanded the livestock sector and imported large volumes of feed (including grains). Agricultural restructuring during transition reversed these policies, causing a severe contraction in the livestock sector, which led to a significant increase in imports of meat and other livestock products, while grain (including wheat) exports expanded. The CIS livestock sectors revived during the 2000s but this did not reverse the trend in grain export growth. The growth in grain productivity has offset the growth in domestic grain demand (including feed), such that exports have continued to increase (Uzun and Lerman, chapter “Outcomes of Agrarian Reform in Russia”; Liefert and Liefert, chapter “The Development of the Eurasian Livestock and Grain Economies”).

The key CIS wheat exporters are RUK. According to FAO data, they account for more than 95 % of total CIS exports. In 2000 these three countries accounted for only 5 % of total world wheat exports. After five years, this proportion had more than doubled, varying between 14 % and 22 %. The OECD/FAO projections show that this region will continue to increase its market share to around 26–28 % of

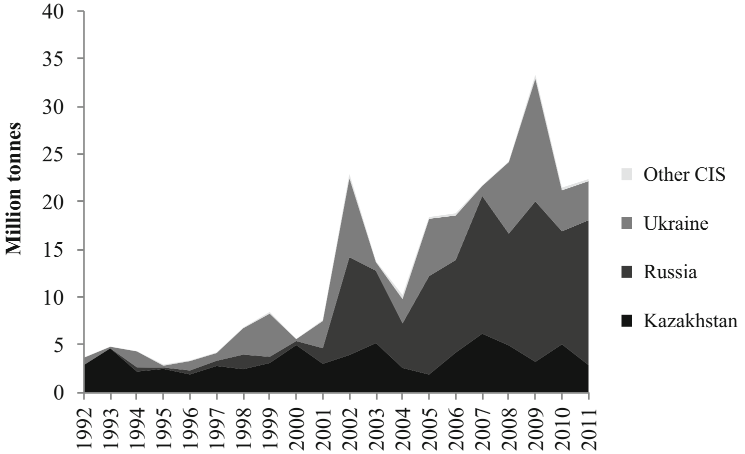

Fig. 7 Development of wheat exports in CIS countries (million tonnes). Source: FAO

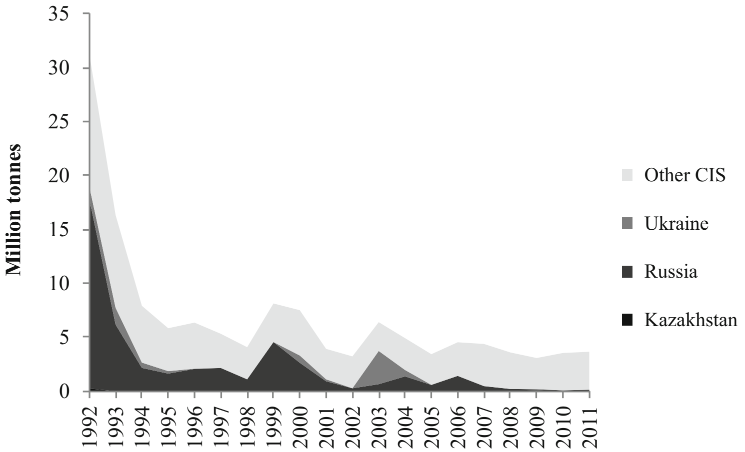

Fig. 8 Development of wheat import in CIS countries (million tonnes). Source: FAO

world wheat exports by 2022–2023 (Sedik, chapter "The New Wheat Exporters of Eurasia and Volatility"; Araujo-Enciso et al., chapter "Eurasian grain markets in an uncertain world: A focus on harvest failures in Russia, Ukraine and Kazakhstan and their impact on global food security").

Other CIS (non-RUK) countries have reduced their import dependency. Self-sufficiency agricultural policies implemented in a number of non-RUK CIS countries have stimulated domestic production, thereby reducing their dependency on imports. Some of these countries have become net exporters of wheat and thus also contribute to regional food security. For example, around 40 % of Uzbek wheat is exported to Afghanistan, Azerbaijan and Iran. Wheat production in Uzbekistan is less volatile than in RUK. A comparative advantage of Uzbekistan's rain-fed wheat

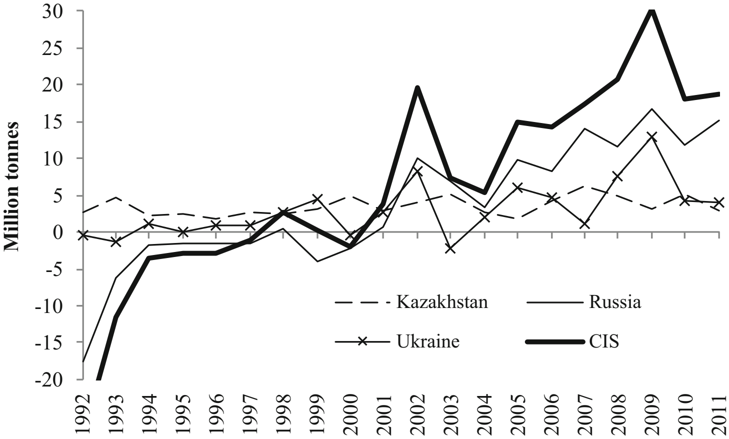

Fig. 9 Development of wheat net trade in CIS countries (tonnes/ha). Note: The net trade is calculated as the difference between exports and imports. Source: FAO

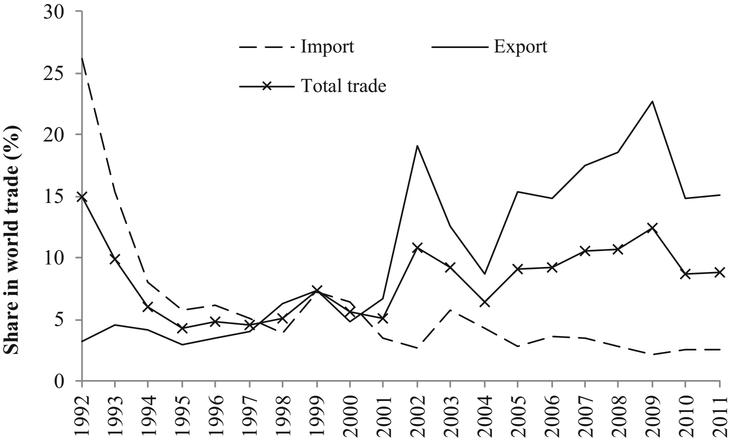

Fig. 10 Share of CIS countries in world imports, exports and total trade (%). Source: FAO

production compared with that of RUK is the fact that production risks are not correlated. Although Uzbekistan is a net exporter, it simultaneously imports high-quality wheat because of the low quality of domestic wheat and its correspondingly limited applicability for baking (Bobojonov et al., chapter "Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan").

CIS countries contribute to global cereal price volatility, mainly as a result of the nature of their wheat production and trade policy choices:

- High production volatility in CIS countries (particularly RUK) is a reason for export volatility, which is further transmitted to global price volatility.

Production volatility is induced by the reliance on rain-fed production systems, which leads to high year-to-year yield fluctuations as a result of weather-related phenomena. Other factors contributing to production volatility are low input use (e.g. fertilisers, plant protection), low levels of investments and the increase of winter-wheat cultivation to the detriment of spring wheat (especially in Russia) (Sedik, chapter "The New Wheat Exporters of Eurasia and Volatility"; Araujo-Enciso et al., chapter "Eurasian grain markets in an uncertain world: A focus on harvest failures in Russia, Ukraine and Kazakhstan and their impact on global food security"). In Ukraine, given that almost all wheat is winter wheat, there is a high vulnerability to frost and snow mould in the northern regions, whereas the southern regions suffer from droughts. Consequently, climatic variation results in large output swings, often around a 20–30 % difference from one year to the next, and under extreme weather conditions as in 2003, a decrease of up to 80 % (Keyzer et al., chapter "Unlocking Ukraine's production potential"). Simulation analysis conducted using the AGLINK-COSIMO global model shows that lower wheat yields in RUK are a major source of uncertainty for international grain markets. Historically, harvest failures led to substantially lower RUK wheat exports (on average –15 % in Russia, –30 % in Kazakhstan, –38 % in Ukraine) and an increase in the wheat world market price (on average by 7 %) (Araujo-Enciso et al., chapter "Eurasian grain markets in an uncertain world: A focus on harvest failures in Russia, Ukraine and Kazakhstan and their impact on global food security").

- Export constraints in Ukraine and Russia have contributed to price volatility on world cereal markets. First, various export bans were introduced in Ukraine and Russia in years of low production. These induced a cascade effect in the entire global market by encouraging further export restrictions by other countries and higher global prices. Second, the export restrictions introduced by Russia and Ukraine temporarily reduced the degree of integration of domestic wheat in world wheat markets, thereby increasing market instability and reducing the supply response of producers. Third, the increased political uncertainty caused by government intervention decreased investment incentives, thus lowering long-term growth prospects in the region (Sedik, chapter "The New Wheat Exporters of Eurasia and Volatility").

Important constraining factors for the future growth of wheat exports in the CIS are storage, logistics and the transport infrastructure. Logistics services and infrastructure are important prerequisites for market development and determine the competitiveness of the agricultural sector on global markets. There are constant problems associated with the development and the status of storage, logistics and the transport infrastructures in CIS countries. These are exacerbated by the fact that the infrastructure inherited from the previous communist system is import-oriented. The key challenge for CIS countries (in particular Russia and Ukraine) is to convert the existing infrastructure from one that is import-oriented to one that is export-oriented.

6 Wheat Production and the Export Potential of Commonwealth of Independent States Countries

Wheat production and exports have a strong potential to expand in the future in the CIS. CIS countries with a high potential to further expand production and export of wheat are RUK, as a result of their abundant land resources and yield growth prospects. Other CIS countries face greater challenges to achieving substantial growth in their wheat sector ranging from policy choices to environmental constraints. These challenges need to be addressed before non-RUK countries can become important players in ensuring food security in the region and beyond.

There are two ways in which wheat production can expand in CIS countries: the expansion of production into abandoned areas and productivity growth. For example, Russia has a relatively large amount of abandoned arable land, which represents a potential source of production and export growth. According to the 2006 Agricultural Census, 94 million ha (43 % of all agricultural land in Russia) is abandoned (Uzun and Lerman, chapter "Outcomes of Agrarian Reform in Russia"). With improved market conditions, the recultivation of abandoned land may boost grain exports in the medium term. Projections developed by Saraykin et al. (chapter "Assessing the potential for Russian grain export: A special focus on the prospective cultivation of abandoned land") show that in the event of favourable developments in world grain prices, the abandoned land could be reclaimed for grains and could expand production by up to 6 million ha, which represents a 14 % increase relative to 2010 levels. However, in the case of exceptionally high world prices, expansion of the grain area may represent as much as 19 million ha (or a 44 % increase). The corresponding projected grain export growth is 9.4 million tonnes (or a 50 % rise relative to 2010 levels) and 21 million tonnes (more than a 100 % increase), respectively (Saraykin et al., chapter "Assessing the potential for Russian grain export: A special focus on the prospective cultivation of abandoned land").

However, abandoned land is often of lower quality than cultivated land and may not be always suitable for wheat cultivation. Therefore, its contribution to potential wheat-production expansion is uncertain. For example, the abandoned area in Russia is located primarily in regions with a low bio-climatic potential and depopulated villages. This unused area is basically registered to defunct agricultural enterprises and inactive family farms. It is no longer used in production because of low soil fertility, as well as the administrative difficulties with demarcation and titling (Uzun and Lerman, Chapter "Outcomes of Agrarian Reform in Russia").

In Kazakhstan, the potential for expansion of the wheat-cultivated area is limited. Local farmers face several challenges from sowing to harvest and access to markets. The most crucial challenges, which together impose the greatest constraints on wheat production, are threefold: competition with weeds for nutrients and moisture, pre-harvest losses owing to pests (e.g. plant diseases and herbivorous insects) and water scarcity (Fehér et al., chapter "Kazakhstan's production potential").

Further, the potential for growth in wheat production in Kazakhstan is highly dependent on global climate changes, which causes uncertainty as regards the prospect of sustainable growth in the wheat yield in this region. According to climate-change scenarios based on global climate modelling, further temperature increases with no significant increase in precipitation may lead to a drier climate. In addition, the climate zone boundaries may shift northwards, and wheat yields may be reduced by more than 25 % (Fehér et al., chapter "Kazakhstan's production potential").

The primary source of wheat-production growth in the CIS countries is yield improvement through the adoption of modern technologies and the improvement of management and farming practices. For example, in Ukraine, the potential to raise and stabilise cereal output through yield improvements is significant. The International Institute for Applied Systems Analysis (IIASA)-FAO global Agro-Ecological Zones study estimates that this potential is currently realised for only 40 % of the cultivated area given the soil and agro-climatic conditions. Ukraine's full potential can be reached only with significant investments in modern irrigation technologies. The OECD projections indicate that Ukraine's share in world wheat markets could rise to 20 % in the next decade, based on a small expansion of area and a continued yield increase (OECD-FAO 2014; Keyzer et al., chapter "Unlocking Ukraine's production potential").

An important factor that may affect the export potential of CIS countries is the future development of the livestock sector. In the event that growth in the livestock sector will be strong, larger domestic feed consumption will reduce the availability of wheat for exports. For example, although wheat production is expected to increase in Kazakhstan over the medium- to long-term time horizon (by around 30 % in the next four decades), exports are expected to decline (by around 30 % over the same period). This is because yield growth and the reduction in wheat losses are expected to be more than offset by the reduction of arable land and the increase in the domestic use of wheat for human consumption and animal feed (Fehér et al., chapter "Kazakhstan's production potential").

There are significant environmental challenges in the CIS countries that may put the future growth of the wheat sector in doubt, but these vary in importance across the region.

Water scarcity is often discussed as the main source of risk for agricultural production, particularly in Central Asian CIS countries. The agricultural production of a number of CIS countries (e.g. Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan) is heavily dependent on irrigation. Low levels of maintenance and investment have led to the deterioration of the irrigation and drainage infrastructure, which in turn has led to inefficiencies in water use and unreliable distribution. These infrastructural constraints, combined with institutional and governance problems and increasing water scarcity, are expected to limit the future agricultural growth of the region (Bucknall et al. 2003).

However, the impact of water scarcity on the wheat sector is not straightforward. For example, in Uzbekistan, wheat is mainly produced as a winter crop (and is thus rain-fed) and is usually less affected in water-scarce years, because water shortages in the region are mainly observed in the summer months and the water supply in winter seasons is more stable. As a result, allocation of farmland to wheat production may increase in Uzbekistan if the availability of water for irrigation declines in the future as farmers will tend to shift away from the cultivation of water-intensive crops (Bobojonov and Aw-Hassan 2014; Bobojonov et al., chapter "Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan").

An important factor that may affect the future production of wheat is climate change, which may reduce wheat productivity in a number of CIS countries. For example, in Kazakhstan, the agro-ecological status for wheat production is expected to deteriorate in the long term. Projections indicate that the climate will become warmer and dryer, and the number of drought periods and weather extremes will increase, which may increase the agro-climatic risk to the cereal sector in Kazakhstan. Without adaptation of management practices, current wheat yields cannot be maintained in Kazakhstan. The main management practices that can attain higher yields include increases in input use, the adoption of new wheat varieties and investments in modern technologies (Fehér et al. chapter "Kazakhstan's production potential").

In Ukraine, nutrient imbalances have caused soil degradation in large parts of the country, which has had a detrimental effect on crop yields (including wheat). According to the National Report on Environment, soil erosion affected 57 % of arable land, of which some 32 % was affected by wind erosion, 22 % by water erosion and 3 % by a combination of both. Furthermore, the loss of organic matter in soils is substantial (around 0.6–1.0 tonnes annually) as a result of the excessive removal of crop residues from the fields. The problem is particularly relevant for Ukraine because of its nutrient imbalances across the territory, which means that nutrients in animal feed are not returned to the land of origin, and because of the large volumes of grain exports. If grain exports rise as predicted, nutrient outflows would increase, thus putting strain on future productivity growth. The loss of nutrients would need to be compensated by imports of chemical fertiliser, which will make grain (and wheat) production more expensive. All major grains exporters (including Russia) face similar challenges (Keyzer et al., chapter "Unlocking Ukraine's production potential").

Two potential large markets for CIS wheat exports are China and India. China and India face challenges in terms of limited resources, such as arable land, and agricultural productivity. The rising number of middle-income households and urbanisation in both countries will potentially increase the demand for grains. In addition, grain demand in China and India is expected to grow as a result of the increased demand for feedstock, which is associated with a dietary transition to a more meat-rich diet as a result of rising incomes (Wang and Ha, chapter "China's Role in World Food Security"; Tripathi and Mishra, chapter "Wheat Sector in India: Production, Policies and Food Security").

7 Policy Options to Improve Rural Productivity and Food Security

This book has shown that, given the availability of large land resources and the low levels of current yields, CIS countries have a great potential to further increase their wheat production and exports and thus strengthen their contribution to global food security. Production growth can be achieved primarily by bringing more land into cultivation, by enhancing current yields and by incorporating modern technologies into farming practices. However, the production potential can be realised fully only if the agricultural sector is supported by policy changes. Below we list key policy recommendations that may stimulate agricultural growth in rural areas in general and in the wheat sector in particular.

7.1 Complete Land-Reform Processes

To varying degrees among CIS countries, this will involve the completion of the conversion of land shares to land plots, the introduction of rules to enable the transparent enforcement of the physical delimitation of plots and the creation of physical access to plots, the completion of the cadastral registration of land plots, the removal of land market restrictions and the adoption and enforcement of regulations to protect land tenure rights (Lerman, chapter "Privatization and changing farm structure in the Commonwealth of Independent States"; Shagaida and Lerman, chapter "Land Policy in Russia: New Challenges"; Keyzer et al., chapter "Unlocking Ukraine's production potential").

7.2 Facilitate Institutional Changes to Promote the Distribution and Relocation of Land to Small Farms

Such policies may lead to the enlargement of household plots and to the creation and expansion of family farms. This could be achieved primarily by the finalisation of the process of land reform. Additional land can be distributed from the state reserve. There are large reserves of unused state-owned land in many CIS countries. In addition, large areas of agricultural land (more than 50 % of the total agricultural area in some countries) are managed inefficiently by large corporate farms, which achieve productivity levels that are substantially lower than the productivity of individual farms. Governments should create institutional framework supporting output and factor market development that would facilitate the relocation of unused land from the state reserve and under-used inefficient farms to more productive users (Lerman, chapter "Privatization and changing farm structure in the Commonwealth of Independent States").

7.3 Encourage Development of the Land Market

Land markets provide a mechanism to relocate land from passive or inefficient users to active and more productive users. Land markets are conducive to productivity growth and, therefore, to increased food security. The basic prerequisites for land-market development are the enforcement of secure property rights and the transferability of landownership and land-use rights. In several CIS countries, legal restrictions and the incomplete enforcement of land tenure regulations still exist. This is most problematic in parts of Central Asia. Another prerequisite for the development of land transactions is the registration and titling of land. Modern registration and titling systems exist in all CIS countries, but the 'titling coverage' is generally limited, mainly as a result of complex administrative procedures and high costs. Simple and transparent registration procedures should be instituted with minimum transaction costs (Lerman, chapter "Privatization and changing farm structure in the Commonwealth of Independent States").

7.4 Implement Land-Consolidation Programmes

Land consolidation can stimulate the growth of small farms. Effective consolidation programmes are driven by market mechanisms through free transactions between owners of fragmented plots (FAO 2010). Examples of such market-driven consolidation efforts are provided by the World Bank/FAO project in Moldova (2007–2009) or the US Agency for International Development project in Kyrgyzstan. In Moldova, a consolidation project reduced the number of land parcels by 23 %, thus significantly increasing the average parcel size. This consolidation activity furthermore encouraged elderly and inactive landowners to leave agriculture, which led to an increase of 32 % in the average size of farms (AGREX 2011; Lerman, chapter "Privatization and changing farm structure in the Commonwealth of Independent States").

7.5 Reduce State Involvement in the Agricultural Supply Chain

Governments still play an important role in all stages of the supply chain in a number of CIS countries. These government supply chains coexist with privately operated supply chains. In Uzbekistan, for example, one of the main consequences of this is the lack of incentives to agricultural producers to improve the quality of their products, which is particularly relevant for flour production. In fact, management practices are geared towards maximising quantities. Hence, improving the supply chains and allowing price differentials to drive markets could ultimately motivate farmers in Uzbekistan to invest in quality-enhancing practices and technologies and make locally produced wheat competitive with high-quality imported wheat (Bobojonov et al., chapter "Future perspectives on regional and international food security, Emerging players in the region: Uzbekistan").

7.6 Implement Fair Agricultural Support System that Is Equitable to All Producers, Including Small Individual Farms

This book has shown that the individualisation of agriculture has led to productivity growth in CIS countries (see also Lerman 2009; Swinnen and Vranken 2010; Macours and Swinnen 2002). However, small individual farms are often discriminated against in the allocation of agricultural subsidies. The fair treatment of these farms thus has the potential to function as a catalyst for their further development. Small individual farms could function as tools in poverty-reduction initiatives while also providing rural populations with access to food and employment.

7.7 Reduce Barriers to Trade and Refrain from Using Export Restrictions

Reductions in export quotas and/or export taxes in CIS countries could increase the welfare of both producers and consumers in the medium term. Avoiding measure that aim at the partial or complete ban of exports would contribute to a reduction in price volatility and instability on regional and international agricultural markets.

7.8 Adopt Policies that Address Environmental and Climate-Change Effects

Adverse environmental developments, climate change and increasing incidences of climate variability are likely to affect production levels, cropping patterns and land suitability in CIS countries. Strategies that may be adopted to cope with these effects could include: adopting drought-resistant wheat and/or other crop varieties, adapting wheat-cropping systems in response to climate change, investing in irrigation systems and supporting weather risk-management instruments.

7.9 *Support the Development of Agricultural Financial Markets*

Two crucial variables influencing potential wheat production and export growth in Eurasia are the establishment of financial institutions which may improve credit access to the farming sector and the modernisation of the transport and logistics infrastructure. The existing credit system limits the flow of financial capital for investments in agriculture. The absence of credit for replacing obsolete machinery and technology restricts the ability of the farming sector to enhance its efficiency and productivity. Investment in infrastructure is particularly required to enhance export channels, which involves the improvement of the handling and storage capacity of grain terminals along with investment in the transport infrastructure.

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