Studies on the Agricultural and Food Sector
in Central and Eastern Europe

Continuity and change
Land and water use reforms in rural Uzbekistan

Socio-economic and legal analyses for the region Khorezm

Edited by
Peter Wehrheim, Anja Schoeller-Schletter and Christopher Martius

IAMO
LEIBNIZ-INSTITUT FÜR AGRARENTWICKLUNG
IN MITTEL- UND OSTEUROPA

Continuity and change: Land and water use reforms in rural Uzbekistan

Socio-economic and legal analyses for the region Khorezm

Studies on the Agricultural and Food Sector
in Central and Eastern Europe

Edited by
Leibniz Institute of Agricultural Development
in Central and Eastern Europe
IAMO

Volume 43

Continuity and change
Land and water use reforms in rural Uzbekistan

Socio-economic and legal analyses for the region Khorezm

Edited by
Peter Wehrheim, Anja Schoeller-Schletter and Christopher Martius

IAMO
2008

Bibliografische Information Der Deutschen Bibliothek
Die Deutsche Bibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.ddb.de abrufbar.

Bibliographic information published by Die Deutsche Bibliothek
Die Deutsche Bibliothek lists the publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the internet at: http://dnb.ddb.de.

Leibniz-Institut für Agrarentwicklung in Mittel- und Osteuropa (IAMO)
Theodor-Lieser-Straße 2
06120 Halle (Saale)
Tel. 49 (345) 2928-0
Fax 49 (345) 2928-199
e-mail: iamo@iamo.de
http://www.iamo.de
ISSN 1436-221X
ISBN 978-3-938584-27-9

In der Schriftenreihe *Studies on the Agricultural and Food Sector in Central and Eastern Europe* werden durch das IAMO Monographien und Tagungsberichte herausgegeben, die sich mit agrarökonomischen Fragestellungen zu Mittel- und Osteuropa beschäftigen. Wissenschaftlern, die in diesem Bereich forschen, steht die Schriftenreihe als Diskussionsforum offen.

In its series *Studies on the Agricultural and Food Sector in Central and Eastern Europe* IAMO publishes monographs and proceedings focusing on agricultural economic issues specific to Central and Eastern Europe. This series offers a forum to researchers studying this area.

ISSN 1436-221X
ISBN 978-3-938584-27-9

PREFACE AND ACKNOWLEDGEMENTS

Decades of Soviet rule have left a heritage of environmental and social problems in Central Asia. The demise of an entire ecosystem at unprecedented pace, the "Aral Sea Syndrome", is the most prominent of the undesired outcomes of the focus on agricultural production that has dominated land and resource use and continues till today. The international outcry over this ecological crisis has delegated other – and maybe more urgent – problems to a second pane. Rural livelihoods are rapidly deteriorating, unemployment is high, and rural poverty widespread. Ecological aspects, although strongly affecting everyday life in rural areas – such as water and soil salinity and environmental pollution – are not the fore most concern to the local population, as the economic survival is the more pressing need. Nevertheless, it is exactly in this situation where the larger part of the population exploits the natural resources further rather than preserving the ecological basis as a natural means of the local land's productivity.

Since their independence in 1991, the five countries of Central Asia have dealt with these challenges in different ways. Uzbekistan has opted for slow, gradual reforms, keeping a strong government control over agricultural production. Its agricultural sector is still characterized by a dominance of state ordered crops, mainly cotton and winter wheat which are sold to state agencies. State control and the lack of land ownership, true privatization (land is leased, not owned) and skills are widely seen as the major causes for the rural poverty and rampant environmental degradation. According to common opinion, the slow pace of reforms and the strong government control have aggravated environmental degradation and social problems. Careful analysis shows that the real picture is more complex and less straightforward than a quick look at the system would suggest, however.

It is here that the Center's for Development Research (ZEF) project on "Economic and Ecological Restructuring of Land- and Water Use in the Region Khorezm (Uzbekistan)" sees its role. In this rural economy the use of natural resources, economic performance and the related social dimensions are closely linked. The innovative approach of the project is to tackle the issues at stake with a strongly interdisciplinary approach. Economists, social scientists and natural scientists are working together to analyse the on-going changes in land and water use, allowing a deeper insight into the causal change between land use, poverty and environmental degradation. The results of some of the individual research projects – some of them surprising – are the subject of this book and will provide the basis

for recommendations and solutions for decision-makers that address the ecological deterioration as well as its economic and social consequences. The project aims at providing a comprehensive, science-based plan for restructuring, at three nested intervention levels: Markets, policies and institutions, and technologies. Modelling will assist in developing scenarios of different levels of resource use and provide decision makers with information as to the future consequences of the decisions taken today.

These concepts are being developed in a long-term scientific research program with the ultimate goal of improving rural livelihoods through judicious and sustainable land and water resource management. There is a specific regional focus on the Khorezm district of Uzbekistan, and the main partner is the State University of Urgench (capital of the Uzbek region Khorezm). The co-operation is based on strong links built with local partners and international agencies for technical co-operation. Most prominent in this context are the collaborative agreements with UNESCO and with the Ministry of Agriculture and Water Resources Management of the Republic of Uzbekistan. The cooperation with both partners is essential, not least because they will further ensure a strong embedding in national policy making and capacity building efforts.

Khorezm is a district of the Republic of Uzbekistan, located in the irrigated lowlands of the Amu Darya River, which is the major tributary to the Aral Sea. It is in many ways an example of all of the irrigated lands along the rivers that cut through the Middle Asian deserts – mostly flatland, former desert areas that are irrigated for hundreds – if not sometimes even thousands of years – which have been subjected to huge changes in the last 40-50 years by means of immense irrigation projects that represent a very strong path dependency for today's efforts to manage the resources in the region.

From the outset the main donor of the project, the Federal Ministry of Education and Research (BMBF) of Germany, understood that such a project can be developed only with a long-term perspective. The project was laid out for 10 to 12 years, structured into four phases of which the first two have been completed so far. Phase I saw the establishment of central databases and infrastructure, and Phase II field surveys and trials for understanding institutions and processes, that allowed the development of simulation and optimization models. Phase III will be dedicated to testing an integrated concept for restructuring land use in a typical area of the region, on-farm, which will lead in Phase IV to the development of policy recommendations and a contribution to informed decision making by Uzbek policy makers, by the water administration, and by farmers.

The present volume represents preliminary results of the research undertaken mainly in the social and economic realm during project phase I and part of phase II. It combines the contributions from a workshop held at Bonn University in April 2005. Its intention is manifold: First it provides basic information related

to ongoing changes in land and water use and thereby enhances the knowledge base for judging the effects of further change. Second, it describes those research tools which have been adapted by colleagues to become suitable for this region in transition and for the given historical background. One other goal was to enhance the analytical capacity on the basis of which solutions and/or recommendations are to be developed. As the articles are the result of phase I and, to some extent, of phase II of the project, they are "work in progress".

This book should be seen in the context of two forthcoming volumes: One on the diverse aspects of tree intercropping systems in the Central Asian regions, and another that will provide an integrative view of the research undertaken in the first years of this project.

We would like to thank all partners, and particularly our colleagues from Uzbekistan, for having made this book possible. Without the close cooperation in this international, multicultural research team, the achievement would not have been possible. Most prominently we would like to thank Prof. Dr. Alimboy Sadullaev, Dr. Ruzumboy Eshchanov and Prof. Dr. Bahtiyor Ruzmetov from the State University of Urgench who have always supported this project unfalteringly and with great enthusiasm and continue to do so.

Furthermore, we would like to thank those who have helped in editing the text. In that respect the special attention given to this volume by our colleague Jennifer Franz is greatly appreciated. Thanks also go to Guzal Matniyazova, Elena Kan, and Vefa Moustafaev for their support and the provision and correction of Russian abstracts. We finally would like to acknowledge the never failing efforts by Sandra Staudenrausch, Eva Niepagenkemper and Kirsten Kienzler with editing, formatting and endless bug-chasing. Without them, the edition of this book would have been delayed much more! And of course our most sincere thanks go to Paul. L.G. Vlek, Director at ZEF, who initiated this project. Without his guidance and support, his unwavering efforts for raising the necessary funds and his readiness to always openly discuss the topics and problems of agriculture in Central Asia, this book would never have been possible. Last but not least, we also are greatly indebted to the BMBF for its continuous efforts to provide the project funds, and we would like to thank especially Dr. Jürgen Heidborn and Dr. Susanne Kieffer at BMBF, as well as Dr. Ingo Fitting from Project Management Jülich for their never failing support.

Peter Wehrheim (Brussels)

Anja Schoeller-Schletter (Madrid)

Christopher Martius (Bonn)

Table of contents

Section 4: Policies, technology adoption, and agricultural markets

SECTION 1

INTRODUCTION

Continuity and change: Land and water use reforms in rural Uzbekistan
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 1, pp. 1-15.

CHAPTER 1

FARMERS, COTTON, WATER AND MODELS – INTRODUCTION AND OVERVIEW

PETER WEHRHEIM [*] *AND CHRISTOPHER MARTIUS* [**]

1 RATIONALE FOR THE BOOK

Uzbekistan became independent in 1991 and since then has been characterised by *continuity* and a process of *change*. The country inherited a multi-facetted legacy from the Soviet era which continues to determine decisions in politics, economics and in every day's life of the local population. At the same time, the cultural identity of the Uzbek nation stems from the long history and cultural richness of Central Asia. The cities along the former Silk Road such as Khiva, Bukhara and Samarkand which flourished in ancient times continue to be witnesses of the cultural achievements of the past. Part of the advancement was the ability of the people to make use of the water from the Amu and Syr Darya by building and using a rather sophisticated irrigation and agricultural production system. Much earlier than in other regions of the world, the intelligent use of land and water enabled the local population to harvest decent yields and to nourish themselves. The resources extracted from irrigated agriculture seem to have been one factor explaining the cultural richness of this region.

An important change of the system came with the advent of the Soviet era. The irrigation and agricultural production system which had been utilised to serve the needs of the local population for many centuries all of a sudden had to face a completely new demand. A popular quote often heard in the region and attributed to Stalin is the following: "Any drop of water flowing down the Syr and Amu Darya, that reaches the Aral Sea, is a drop of wasted water"; it is indicative for

[*] Between 1998 and 2004 Senior Research Fellow and Assistant Professor at the Center for Development Research (ZEF), University of Bonn, Germany, Department of Economic and Technological Change. Currently Brussels, Belgium, Email: PWehrheim@skynet.be.

[**] Senior Research Fellow and Associate Professor at the Center for Development Research (ZEF), University of Bonn, Germany. Co-ordinator of the Uzbekistan-BMBF project. Email: c.martius@uni-bonn.de.

the magnitude of the change associated with the Soviet regime. Due to economic and military expansion, the Former Soviet Union had an ever increasing demand for natural resources and Central Asia in general and Uzbekistan in particular became the cotton chamber of this growing empire. The increasing demand for cotton between 1930 and 1990 by far exceeded what the region could sustainably produce. A second change came with the advancement of medical science in the second half of the 20th century: A significant growth of the local population increased the pressure on the natural resources land and water.

While the Soviet regime is today history, the vast irrigation system which it put in place continues to exist and to determine much of today's land and water use patterns in the land. This includes the physical part of the system, i.e. the irrigation channels, as well as the institutional arrangements decisive for agricultural production: Cotton continues to be the most important agricultural crop and is subject to a restrictive policy regime.

It is this combination of *continuity* and *change* which the new nation-state Uzbekistan was faced with after independence. Since then, many changes in land and water use in Uzbekistan have been put in place. However, it is often questioned whether these changes have been far-reaching enough to provide for a better living of the population that continues to grow at high rates. Instead many of the reforms related to land and water use seem to have been path-dependent: The policy-mix continues to favour high intensive agricultural production and the use of high amounts of water per land unit is standard practice. In fact, the dominance of *continuity* over *change* in the use of land and water use seems to be indicative for Uzbekistan's transition process as a whole: Political and legal reforms were kept at a minimum and the profound changes to a market based system and a more democratic political system which constituted the major elements of the transition process in other former socialist countries in eastern and central Europe as well as many of the republics of the Former Soviet Union were rather the exception than the rule.

Against this background the Aral Sea basin has been declared an "ecological disaster area" by international development agencies. This disaster can be summarised as follows (VLEK et al., 2001: 4): "The extreme specialisation of Uzbekistan's agricultural sector in cotton production associated with large scale flood irrigation of the arable land used for agricultural production and the arid climate of the country resulted in ever fewer water reaching the Aral Sea. The major source for irrigating the respective agricultural land has been water from the two major central Asian rivers, Amu and Syr Darya, which fe(e)d into the Aral Sea. Due to the inefficient use of water, high evaporation on the irrigated land, and the mono-cultural production pattern at least three major ecological disasters have been observable: First, salination of the agricultural land, substantial contamination of the agricultural land with pesticides, and a significant reduction of the water quantity arriving at the Aral Sea and henceforth a decline in the lake's water level."

In 2001 the Center for Development Research (ZEF) took the initiative to launch an interdisciplinary research project on this topic (VLEK et al., 2001: 4 ff.). Focusing on causes of the ecological disaster of the Aral Sea rather than on its symptoms, the three departments of this research institute jointly developed an integrative research approach together with partners in Uzbekistan and other research institutions in Germany. Different disciplines started to combine their research efforts and their respective findings on possible alternatives of land and water use in the region. The research focused since the beginning of the project in 2001 on one case study region, namely the region Khorezm which is one major agricultural production region in Uzbekistan located along the Amu Darya.

The papers presented in this book are all based on research carried out in the first phase of this project which aims to be operational over a period of twelve years. The intention is to first analyse the underlying causes of the unsustainable use of natural resources, then look into the alternatives of resource use which may help to improve the standard of living of the local population and to reduce the ecological unsustainability. A third and essential element of the research strategy is to start early on with testing essential research findings by putting them into practice; e.g. by on-farm implemention of some of the new approaches to land and water use. Research on the intricate process of doing so is part of the concept.

This collection of articles entirely builds on research conducted in the context of this research project. It is a "young book" because it presents the first results of the socio-economic research initiated under the umbrella of this multi-dimensional project. Furthermore, most researchers who contributed to this book are young in the sense that they obtained part of their formal University education in the course of this research project. In fact, most contributions are part of the formal academic work of Master or Ph.D. students who were involved in the project and or co-operations with their supervisors. It is important to note not only that many of the researchers involved in the project and in the studies presented here are from Uzbekistan, but also that each chapter of the book is truly grounded in field research. All authors have greatly benefited from having been welcomed by the officials and by the local population of the region Khorezm in North-western Uzbekistan in a very friendly and open-minded way. Another characteristic of the book is a rather wide variety of economic and social science approaches to look at certain aspects of land and water use in this region. Some of these methodological approaches are rather sophisticated and advanced; others are based on standard economic tools that are applied to the context of the Uzbek or Khorezmian agricultural sector. Others again are rather descriptive and provide qualitative insight on specific aspects related to land and water use.

Furthermore, another similarity of the chapters in the book is that they ask two different sets of questions: The first set of questions asked is rather *positive* in kind: *What is* the socio-economic situation that emerges from current land and

water use patterns in Uzbekistan? This question related to the fact that in the first part of this research project the main aim was to get a better understanding of the actual patterns of land and water use and their socio-economic implications. The basic mission of that stage of the research project was "fact-finding". This objective was accomplished only due to the co-operation with many colleagues from the Uzbek academic system in general and with those from the local University of Urgench in the case study region of Khorezm in particular. The cooperation with these local partners and the possibility for many of the junior and senior researchers from abroad to stay longer in the region allowed extensive field surveys. These in fact played a crucial role because data often is not readily available. This is why data issues are frequently dealt with and why data mining in the form of field surveys and analyses of various sources of official data was an important task in the context of all chapters of the book. In fact, in many articles the issue of consistency of the data is dealt with explicitly.

A second group of questions addressed in most of the articles is more *normative*. For instance, it is asked "What type of policies *should be* implemented to reach more optimal land and/or water use patterns?" This type of questions comes up whenever simulation models are being used which is the case in three chapters of the book (i.e. Chapters 3, 4 and 6). At the same time some of the articles are asking what objectives the local people and policy-makers had throughout the reform period.

In the next section of the book we will provide an overview of the agricultural sector in Uzbekistan before presenting a brief synthesis of each paper in the third section.

2 BACKGROUND: AGRICULTURE IN UZBEKISTAN AND THE KHOREZM REGION[1]

Uzbekistan covers an area of 447.4 thousand km^3, of which 4.2 million ha are irrigated arable land. With a population of 23.7 million in 1997 only 0.17 ha of arable land are available per capita (the same ratio as in China). The ever growing population rate in the Aral Sea Basin during the last century was strongly correlated with the enormous increase of the irrigated area in this region.

During the period of the Former Soviet Union, Uzbekistan's primary agricultural role was to produce cotton, fruits and vegetables largely for export to other Soviet republics. Agriculture continues to be the key sector of the Uzbek economy with a share in GDP of over 30 percent (IMF, 1994, 1998; WORLD BANK, 1993). As part of the Government's policy to achieve national food sufficiency, the

[1] The following section is based on VLEK et al., 2001, p. 17 ff.

wheat production was drastically increased during the past 6 years. Now, cotton and wheat account for about 70 percent of the area under cultivation. According to official data, approximately 3.5 million persons are employed in agriculture, equivalent to about 40 percent of the total work force.

Cotton is the world's most important natural fibre (MUNRO, 1994). In Uzbekistan, cotton, as an exported arable crop, has a high significance for the national budget. In 1970, 70 % of the irrigated land was used for cotton, but this declined to 56 % in 1990 (before independence), and has declined since then in favour of the increase in wheat production mentioned above. The annual cotton production today amounts to roughly 3.6 million t unprocessed cotton, which after ginning yields 1.15 million t raw fiber, of which 960.000 t are exported and 190.000 t are processed within Uzbekistan (estimates for 2007; Baumwollbörse 2007). With this, Uzbekistan remains the second largest cotton exporter globally, after the USA (which exports 3.69 million t).

World market prices for cotton have continuously decreased over the past years and amounted to around US$ 1000 per t ex farm in 2003. Cotton trading in Uzbekistan is strictly state-controlled. Law allows other buyers to establish themselves, but in practice farms are selling their cotton to the state ginneries and are paid at fixed rates according to quality, which average at about one third the price for processed cotton. The price difference between the world market price and the price at farm-gate which is often perceived as "unjust" in the literature can thus be attributed to the mass ratio of unprocessed to processed cotton which is approximately 1:3. MÜLLER (2006) and ongoing work by RUDENKO (2008, forthcoming) are demonstrating that Uzbekistan – maybe surprisingly so, given the often reported "exploration of the cotton farmer" – pays for the cotton production at least in some years and gets little surpluses.

An important part of the agricultural production system in Central Asia consists of the irrigated lowlands in the Aral Sea Basin. The Aral Sea's largest tributaries are the rivers Amu Darya and Syr Darya. The irrigated lowlands of the Amu Darya comprise the whole of the intensely irrigated agricultural lands between the Tuyamuyun reservoir and the Aral Sea, approximately 400 km of river including the adjacent, irrigated croplands. This region belongs to two countries and consists of three administrative areas. The province of Khorezm and the Autonomous Republic of Karakalpakstan are part of Uzbekistan and make up 265,000 and 500,000 ha of irrigated area, respectively, while the district of Dashoguz (310,000 ha irrigated) belongs to Turkmenistan. In total this area corresponds to about 13 % of the total irrigated land (8 million ha) in the Aral Sea Basin. In total, 3.5 million people live in these lowlands, corresponding to roughly 10 % of the Aral Sea Basin population. These lowlands contrast to the upland irrigated regions such as the Ferghana Valley which have different biophysical as well as social-economic settings, and also are much more intensively studied.

This book is therefore focusing on the Khorezm region, which serves as a case study for the irrigated lowlands. Of the 1.3 million people that live in Khorezm, about 70 % are rural and about 27.5 % live below the poverty line of 1 US$ per day; unemployment rates especially in rural areas are high (MÜLLER, 2006). Hidden unemployment in agriculture, i.e. a vast number of people employed in rather unproductive jobs, is a substantial problem. Hence, breaking the vicious link between increasing rural poverty and the misuse of the region's natural resources must be one of the main regional development objectives.

With an average annual precipitation of only 92 mm (varying between 40 and 160 mm/year), all agriculture in Khorezm needs irrigation. The summer is extremely arid with an average precipitation of less than 5 mm. This translates into a highly unfavourable ratio of rainfall to potential evapo-transpiration (PET) which in the cropping season amounts to 750-775 mm (CONRAD, 2006) which again explains the high irrigation water consumption for the cultivation of cotton. Cotton has an annual water demand of 700-800 mm. Together with losses due to inefficient irrigation procedures (most commonly flood irrigation is applied because of which not every drop of water actually reaches the plant) and conveyance losses (high infiltration losses in the deteriorated and dysfunctional canals; SARYBAEV, 1991; TISCHBEIN, 2007) this amounts to the average irrigation water needs of 2000-2300 mm for cotton determined by MÜLLER (2006). Actual water needs for the region are still higher due to excessive leaching of soil salinity in the winter and prior to the cropping season. These figures which are more or less similar in other districts of the country and show the urgent need for an integrated water management program (MARTIUS et al., 2007).

At present, cotton, wheat, rice, and fodder maize dominate the crop portfolio of the farmers in the region. This project has seen successful work on alternative crops, such as potatoes, sorghum (BEGDULLAEVA, 2005), indigo (a cash crop), and several native tree species (KHAMZINA, 2006; KHAMZINA et al., 2005; 2006; LAMERS et al., 2005) that are suited to the region and that could provide new sources of income while at the same time being more favorable for the environment. Rice plays an increasing role in the local system as cash crop (RUDENKO and LAMERS, 2006), but, due to its high demand for irrigation water does not have any ecological benefits. Nevertheless, the potential of aerobic (dry) rice is actually being explored in cooperation with the Uzbek Rice Research Institute.

As opportunities for alternative crops are limited in the short run, the cropping systems of the present dominant crops must be improved for more rational resource use. Production methods such as Conservation Agriculture (CA) work very well for the Uzbek standard crops, cotton and wheat. They reduce water use, save costs by reducing the number of necessary plowings, and help control the soil salinity. If combined with mulching, CA conserves soil moisture and builds up soil organic matter, thereby reducing the need of fertilizer input (EGAMBERDIEV, 2007).

Furthermore, CA proves to be of great interest to farmers. Even without resorting to CA, the efficiency of the standard cropping systems (cotton-wheat rotation) can be improved (KIENZLER, 2008 forthcoming). Proper fertilization improves crop yields, and more importantly, also crop quality, which is important, given the low quality of Uzbek wheat at present.

Macroeconomic analyses have furthermore shown that animal husbandry is rapidly gaining in importance and presently provides the second largest income source in the agricultural production of Khorezm (MÜLLER, 2006). However, to a large extent animal husbandry is carried out by the small-scale *dehqon* farms and the products are used either for consumption in the household or sold at local markets. In short, options for improvements are manifold.

This book will show that careful analysis is the first step to finding solutions that work and are efficient. Two examples: The Soviet heritage and the extensive irrigation and drainage systems built up over decades of central planning created a strong "path dependency" of the agricultural production on central administrative systems. Due to the importance of agriculture, the Uzbek government maintains its strong control on agricultural production, and it is often said that this creates strong disincentives for development and more rational resource use; however, the picture is much more complex. The state order system, in which farmers have to meet production targets while receiving the inputs for free or at low costs, more likely represents a subsidization than a taxation of the farmer, and adhering to it is often a risk-minimizing strategy (MÜLLER, 2006; RUDENKO and LAMERS, 2005). As the farmers often are poorly capitalized and non-state markets are still under-developed, the system functions as an effective credit system for important production resources (seeds, fertilizer, diesel, machines, water), guarantees stable input prices (although fuel prices have soared in late 2005), and ultimately works as a risk avoidance strategy. For instance, state organizations were instructed to cancel debts incurred by farmers during the droughts of 2000 and 2001.

Likewise, it is often stated that Uzbekistan's state budget depends largely on cotton revenues generated from the difference between state-order prices and world market prices. However, this role of cotton seems greatly overestimated if the state budget earnings from selling cotton on the world market are balanced against the maintenance and subsidy costs the government covers from the state budget, too (MÜLLER, 2006). Our data point to the fact that the state order policies seem to have different goals; I.e. they may be aiming in part at providing jobs for the rural population. These different and conflicting interests need to be taken into account when policy recommendations are designed.

In the complex issue of land use in Uzbekistan, sound scientific analysis is needed at different levels of decision-making regarding land and water use. Recommendations and interventions must be based on the sound analysis of policies, institutions, and technologies that have an impact on the use of land and water.

Introducing efficient land use or water-saving technologies depends on an "enabling policy environment" for which institutions are needed which help to "translate" and implement these policies. In turn, institutional change by itself would have little effect if no real options would be made available to the farmers which would help him to increase the efficiency, sustainability, and profitability of his business. Developing and testing innovations and successfully out-scaling these to a number of farmers or farmer groups will make policy-makers more open to set policies and develop institutions that facilitate change. The interplay of the interventions at the various levels can be modelled with modern computer tools which incorporate information about the long-term effects that different possible development scenarios might have on developmental and environmental indicators.

In this context, this book represents a first step, the beginning of sound economic analysis of the regional land use system and its economic underpinnings, as a basis for discussion and decision, for a world which makes better use of endable resources to the benefit of both nature and people.

3 THE STRUCTURE OF THE BOOK

Against this background the intention of this book is to describe *change* related to land and water use in Uzbekistan and more specifically in the region Khorezm. For this purpose, the studies presented describe the most important changes which already have been implemented in the agricultural production system in the first decade of the Uzbek transition process. Second, and based on their individual analyses, they analyze some "windows of opportunities" for enhancing economic and ecological sustainability of land and water use patterns.

The book is structured as follows: This introductory section first provides this general introduction and an overview of the structure of the book and synthesis of all chapters (Chapter 1, WEHRHEIM and MARTIUS). Secondly, a synopsis of the most important features of legal reform related to the agricultural production is given in Chapter 2. SCHOELLER-SCHLETTER introduces the institutional aspects of the book from a lawyer's and social scientist's point of view by providing an overview of the organizational forms of agricultural production and the institutional environment in which it functions. Pointing to the structuring effect of the legal settings, SCHOELLER-SCHLETTER presents a summary of legislative activity in Uzbekistan since independence. She continues with a synthetic overview of the legal basis for agricultural production in general, of the administrative environment and of the legal basis for the three major farm types that have emerged in the transition process: First, the agricultural cooperatives (*shirkat*), that were created as a transitory successor of former *kolhozes* and s*ovkhozes*; second, the *dehqon* farms, which are the Uzbek version of the small, subsistence-oriented household plots that were and are the basis for many million of families in rural areas of the

countries that used to be part of the Former Soviet Union[2]; third, the *fermer* enterprises, a new type of farm that has emerged during the past five years and that is established on the basis of long-term leases and that has a commercial orientation. Subsequently the author discusses some of the problems inherent in the present regulatory framework and highlights some of the challenges for future reform, among them resolving the ambiguity of the farmer enterprise between private farming and out-sourcing of state-run production and further developing the system of administrative justice to control administrative acts. In a final section SCHOELLER-SCHLETTER addresses the environment in which development cooperation has to operate. She points out that the recent shift in attention towards the structure and the functioning of the governmental system and the distribution between competences is a step in the right direction. Continuing this process in close cooperation with the Uzbek government and the Uzbek research community will also be a pre-requisite for a transition towards long-term sustainable land and water use patterns that can count on the support of the international community.

Section 2 provides an overview of continuity and change in "Land Use Patterns". It discusses the effects of the land use reforms set into force since independence started and explains the associated steps of farm-level reforms. Thereby, this section focuses on the essential causes for the high water use: Land allocation determines water use and not vice versa. The two papers in this section are partially descriptive but both also provide some quantitative analysis.

In Chapter 3 DJANIBEKOV presents a quantitative and economic model which will become a tool for analyzing the allocative effects of change related to land use. The model is firmly based in neo-classical theory but accounts for some of the rigidities inherent in the present agricultural policy regime, particularly in the cotton sector. The non-linear model is employing an optimization procedure based on which regional production decisions are determined. However, the optimisation mechanism is not driven by an omni-potent external power but within the model via a price-endogenous solution mechanism. Hence, prices determine where the highest rate of return for specific forms of land use may be obtained. The model rests on the assumption that the implicit actors of the model, i.e. farmers, are rational agents who are free to allocate land within the limits determined by the system. Hence, farmers are assumed to maximise profits. The most important rigidity which the model takes into account is the "state order system" for cotton.

---

[2] For instance, in Russia the so-called LPH household, small-scale and subsistence-oriented agricultural producers had and still have a major role to play in securing the living of many rural families. In the beginning of Russia's transition process they were a buffer against the risk to fall into poverty but also constituted an important "labor sink" in rural areas. A vast literature on their role in the transition process of the former Soviet republics exits (e.g. LERMAN and SCHREINEMACHERS, 2005; WEHRHEIM, 2003; QAIM and VON BRAUN, 2000).

The state order implies that a pre-determined share of agricultural land has to be used for cotton production which is sold at pre-determined prices to parastatal agencies. The paper is also providing an outline of the most important features of the three major types of agricultural producers, i.e. *dehqon*[3]*, shirkats and private fermer*, which have emerged over the past decade. The model incorporates these producers, the major production activities and has a regional breakdown to the district level (10 different sub-regions are represented in the model). The model focuses on the production side and remains stylized on the demand side. Nevertheless, the base-run solution, with which the model was calibrated, and some first simulations provide interesting insights into some causal relationships of the agricultural production system. For instance, the model comes up with estimates of shadow prices for land and water which is very relevant for one of the most controversial internal policy debates in Uzbekistan: How and with which prices should the privatisation of land and water be implemented? Regarding water this raises further questions about the institutional design of such user fees: Should there be flat rats, or should they be crop-based and/or differ between districts etc. Finally, the results of some first and cautious simulations runs are presented. One simulation looks into the effects of introducing water user fees, a second one addresses the abolishment of the state procurement system for cotton and a third one looks into the effects of completing the farm restructuring process. The results of theses model simulations always have to be seen against the sometime restrictive features of the underlying model economy. Hence, they should be considered as complements but not substitutes of one's own mental arithmetics in assessing a vast range of policy instruments.

This argument also holds for the analysis presented in chapter 4 by BOBOJONOV, RUDENKO and LAMERS, which is based on a simulation model as well. While the model developed by DJANIBEKOV focused on the entire region of Khorezm, the linear programming model presented in this chapter, optimizes farm level production decisions. The model was initially developed for the so-called *shirkats*, joint-stock farms originating from former *kolkhozes* and *sovkhozes*. Although reforms in the very recent past favoured the establishment of private farms at the expense of these *shirkats*, the developed model can be used for similar analyses for instance for the *private fermers* once the necessary numerical data on this recently developed private farm type becomes available. In a first step the authors explain how they developed a stylized and representative data base for the model. In a second step alternative policy alternatives are simulated to assess their impact on farm-level production decisions. The results indicate that the rigidities of the current policy-system, mirrored particularly in the state orders and fixed procurement prices, are hindering more efficient forms of land and water use as well as income generation. The findings furthermore suggest that no reforms

[3] We are using here and throughout the book the Uzbek transcription of this term.

will bring about the urgently needed increase in resource use efficiency when introduced as isolated, "sectoral" measures.

Section 3 deals with the analysis of water use which is associated with the observed land use patterns. While the topic of all three papers is "water use", the chosen methodological approaches range from being purely economic analyses, to employing a inter-disciplinary economic-hydrological optimization model, to using New Institutional Economics for the analysis of an important organisational change for water use; i.e., the introduction of Water User Associations.

The first article in Section 3 poses the lyrical question "Where has all the water gone?" The author of chapter 5, MÜLLER, starts out with providing an overview water balance for the region Khorezm covering the time period 1990 to 2001. The discharged water amount at the major up-stream water reservoir on the Amu Darya is compared with the extent of the harvested area for irrigated crops. This simple analysis already reveals the effects of policies that continue to be in place ever since established under the Soviet regime: The harvested rice area declined most strongly following the water shortages in 2000 and 2001 not only because of the high water demand of this crop but also because cotton and wheat production continued to be determined over this entire period by state orders. The novelty of this chapter is to quantitatively assess the specific water input levels for the various crops produced of this region for the most recent time period for which sufficient data has been available (1998 to 2001). Such information has been missing to date due to the difficulties in measuring the specific water amounts allocated to individual fields. In view of the limited data points available for an econometric assessment of this issue the author employs a mixed estimation method. He combines readily available data on water use with prior information about the input parameters to be estimated. The results indicate that the actual crop-specific water use is systematically higher than the hydrological norm values determined by the local authorities. Indeed the results suggest that the up-ward deviation was highest for cotton while the largest consumer of irrigation water in the region during the observed period was rice. Furthermore, the results revealed substantial water losses due to sub-optimal management of water distribution and to losses of irrigation on the field. The paper concludes by identifying the irrigation issues with the highest potential to decrease the region's overall demand for irrigation water. While the paper confirms the view that changes related to cotton production would be most promising it is stated that enhancing the efficiency of water use in cotton production may be already a very important first step in the right direction.

In the second chapter in this section SCHIEDER and XIMING are presenting another method for the quantitative analysis of water use in the Khorezm region which is quite different from the one in the first chapter: In the previous chapter a combination of spatial (regional) and time series (annual) data was used and the

method was based on econometrics. In contrast, in this chapter, an optimization model composed of a set of non-linear equations which establishes a theoretically and empirically comprehensive and consistent description of a baseline situation of water use in the region of Khorezm for one year has been developed. Similarly to the previous chapter the model makes a distinction between the sub-regions (districts) and the crop-specific water use. Being an integrated or, one could even say, inter-disciplinary model it not only builds on economic theory but also incorporates various ecological relationships in a functional form. After having described the major "ingredients" of the model in terms of theory and data, some model runs are used to validate the model. A "ground water" simulation reveals the monthly groundwater values for all sub-regions of Khorezm over a complete year. The levels obtained on the basis of the model were compared with actually observed ones and turned out to be in a plausible range. Furthermore, results for economic indicators obtained from the model are reported, most importantly for shadow prices for water at the district level. While in the past irrigation water was basically a public good its supply is currently being changed such that it will be a private good: Water user fees are being introduced. In this context the estimates of shadow prices for water presented in this paper will be most valuable. Furthermore, a comparison of gross margins for individual crops in the various districts of Khorezm with and without water user fees is being made. And, the economic value of water is assessed for the various crops without water user fees being introduced. The results indicate that the economic returns for water use are comparatively high for rice and vegetables, reflecting the high prices producers may get for these products given current market conditions. Being work in progress, this is where the paper stops. Further simulations will be presented in the forthcoming thesis of SCHIEDER. Notwithstanding the chapter indicates how valuable the presented model will be for such consecutive analyses of various scenarios of change.

The third chapter in this section by HIRSCH (al. ZAVGORODNYAYA) is dealing with an important institutional change in relation to water use: The most recent introduction of Water User Associations (WUA) as the organisational entity responsible for future water allocation. The paper differs from the previous two in as far as it is more descriptive and not employing a quantitative model analysis. But it presents the results of intensive field-studies conducted by the author in different regions of Uzbekistan in an effort to collect first hand information about this important organisational innovation. The chapter explains the process of change which resulted in the introduction of WUA in Uzbekistan and then assesses their functioning on the basis of a standardized survey and semi-structured interviews conducted with eight such organisations in different regions of the country. The theoretical background for the drafting of the questionnaire is the theory of New Institutional Economics. The results indicate various interesting facts relevant for the further development of this organisational form and essential for the future efficiency of water allocation in the region. On the one hand it was revealed that

the efficiency of the WUA is severely hampered by lack of payments for water and often, an unclear mandate and weak rule of law both as regards the design and its enforcement. Another important finding was that international development assistance has an important role to play in the setting-up of such organisations. Particularly investments into capacity building seem to have been most beneficial for the WUA.

Section 4 deals with a wider set of issues: "Changes in agricultural technologies, markets, and policies". The section starts out with chapter 8 by WALL that deals with "Barriers to technological change and agrarian reform in Uzbekistan". The paper confirms the view stated in other papers of the book already: Farm decision making autonomy in Uzbekistan more than 15 years after the country gained independence is still severely restricted. However, it is argued further that these restrictions are not only binding on the output side but also pose a real constraint on the input side. Particularly, the transfer of new agricultural technologies – which could improve the economic efficiency as well as the ecological sustainability of land and water use – are severely affected. The author argues that the current trend towards strengthening the *private fermers* holds real potential for change but needs to be complemented with lifting the existing barriers to technology change in order to be exploited fully.

Chapter 9 by BOBOJONOV and LAMERS complements the previous papers by looking at another essential element in the agricultural production system: It provides a descriptive overview of the *market* outlets accessible to the producers in the case study region. The chapter adds further indications of the magnitude of *change* that already has taken place since independence started. The authors explain that the rigid system of fixed market prices, which prevailed during the Soviet era for agricultural products, has been abandoned. Except for cotton and wheat, prices of other agricultural products are determined by production and demand, price movements in other regions, seasonality, and other factors which typically determine (free) market prices. Furthermore, a considerable number of market actors, outlets and marketing channels for agricultural commodities have emerged since independence. The findings of the commodity flow chain analyses showed that many agricultural commodities were primarily produced for own-consumption and for local and regional sales. However, not only the cash crop cotton, but also rice, meat and fruits were exported to some extent to other regions of Uzbekistan and other countries underlining at least a certain comparative advantage of the Khorezm region for these produces.

Hence, on the one hand the paper argues that indications for more liberal and free markets are gradually emerging: Prices are more responsive to market signals and the growing diversity in market outlets is likely to stimulate competition at the benefit of consumers. However, on the other hand, the paper also clearly states that there is still a significant element of *continuity* as evidenced by the manifold

market distortions. Particularly the national price setting for cotton and winter wheat prevent that buyers, sellers and consumers alike can realize the benefits from liberalised markets. Furthermore, the analysis confirms the view that market failures in Uzbekistan's agricultural marketing system are also the result of under-developed formal and informal market institutions (e.g. missing price information systems).

In the final chapter of the book MÜLLER asks one of the most classical questions of the agricultural economist's profession: Is the agricultural sector taxed or discriminated against? Most western observers have been of the opinion that the Government of Uzbekistan has effectively and substantially taxed domestic cotton production over the past decades and thereby withdrawn substantial revenues from the agricultural sector. This seems to be perfectly plausible against the background that the cotton policy in place more or less dates back to the Soviet era and to the associated system of exploiting the agricultural sector of the country. MÜLLER, however, argues that taxation of the cotton sector may in the past decade not have been as straightforward. Instead he shows that much depends on the exchange rate at which foreign exchange earnings from exports of cotton are being converted into domestic currency. His view is based on a theoretical partial welfare analysis and a quantitative sector analysis. The novelty of the analysis is to not only do this analysis for the production of raw cotton but to include also the processing of cotton in the analysis. The results are surprising in as far as it is shown that rent extraction from cotton production takes place only in some years. This raises the question whether the policy regime continues to be "rational"? Or, are other objectives than rent extraction being pursued such as shedding labour in rural areas in the agricultural sector. If the latter were the case, liberalising production decisions of farmers could be beneficial for all major actors involved: The government, producers and consumers.

Summing up, the papers provide evidence that ever since independence Uzbekistan has initiated many important steps of change related to land and water use reforms. Farm-level reforms such as the restructuring towards private farmers while at the same time keeping the small-scale dehqon farmers alive seem to be rational reform elements. While the former may be able to increase the sector's competitiveness and substantially enhance the efficiency of land and water use, the latter will continue to play a crucial role in buffering the negative effects of structural change on the rural labour force. The introduction of water fees and Water User Associations are examples of institutional and organisational change that point into the right direction because both instruments potentially may help reducing the wastage of water. Furthermore, the partial liberalisation of agricultural output markets in terms of outlets and price formation is an important and fundamental change: Instead of believing that an omnipotent hierachy of decision-makers is capable of developing a socially and environmentally optimal system of prices this task is continuously entrusted to the "invisible hand of the market".

However, the articles also point to the fact that many elements of continuity remain in place and continue to determine land and water use patterns in rural Uzbekistan. Legal reforms seem not to have been sufficiently consistent nor consequent. The restrictive system of state orders for cotton production but also the far-reaching interventions in wheat production are examples of rigid policies. In fact, the present cotton policy seems not to fully serve the objective of extracting rents from the agricultural sector. Market failures due to imperfect formal and informal institutions are also frequent and seem to be the source of manifold distortions on the input and the output side.

Hence, much remains to be done! The "windows of change" which the country has opened itself need to be pursued further. Support in capacity building, institution-building and strengthening governance structures from international donors will be an essential ingredient in supporting the Uzbek government's efforts to implement change. Finally, research on the topic needs to be continued and deepened in order to provide the needed knowledge about the right mix between elements of *continuity* and *change*.

ACKNOWLEDGEMENTS

This study was funded by the German Ministry for Education and Research (BMBF; project number 0339970A).

The research of Peter Wehrheim on this project greatly benefited from the support he received as a Heisenberg-scholar from the German Research Foundation (Deutsche Forschungsgemeinschaft).

REFERENCES

BAUMWOLLBÖRSE (2007): *Bremen cotton report Nr. 13/14,* 13. April 2007.

BRAUN VON, J., QAIM, M., THO SEETH, H. (2000): Poverty, subsistence production, and consumption of food in Russia: Policy implications, in: WEHRHEIM, P., FROHBERG, K., SEROVA, E., VON BRAUN, J. (eds.): Russia's agro-food sector – Towards truly functioning markets, Kluwer Academic Publishers, Dordrecht.

KIENZLER, K. (in print): Potential for increasing nitrogen use efficiency in cotton and wheat for irrigated agriculture in Khorezm, Uzbekistan, University of Bonn [Dissertation].

LERMAN, Z. SCHREINEMACHERS. P. (2005) Individual farming as a labor sink: Evidence from Poland and Russia, *Journal for Comparative Economic Studies, (47).*

VLEK, P., MARTIUS, C., WEHRHEIM, P., SCHOELLER-SCHLETTER, A., LAMERS, J. P. A. (2001): Economic restructuring of land and water use in the region Khorezm (Uzbekistan), ZEF *Working Papers for Sustainable Development in Central Asia. No. 1,* Centre for Development Research, University of Bonn, <http://www.khorezm.uni-bonn.de>.

WEHRHEIM, P. (2003): Modelling Russia's economy in transition, Ashgate Publishers, Aldershot.

Continuity and change: Land and water use reforms in rural Uzbekistan
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 2, pp. 17-40.

CHAPTER 2

ORGANIZING AGRICULTURAL PRODUCTION – LAW AND LEGAL FORMS IN TRANSITION

ANJA SCHOELLER-SCHLETTER[*]

ABSTRACT

Introducing the legal-institutional aspects of the book, this chapter provides an overview of the organizational forms of agricultural production and the institutional environment in Uzbekistan. After a brief summary of recent legislative activities in Uzbekistan and the local administrative system, the chapter focuses on the three basic forms of agricultural enterprises: *Shirkat*, *dehqon* and *fermer*. In the second part, the chapter describes some of the problems inherent to the present regulatory framework and thus highlights some of the challenges for future legal reforms. The results suggest that regulations should become less ambiguous, i.e. are farming enterprises intended as private farms or as an out-sourcing of state-run production? Does the *hokim* have executive or representational powers? In addition, an independent system of administrative justice needs to be developed in order to control the functioning of the regulatory framework.

Keywords: Uzbekistan, law and development, corporate law, local administraion.

[*] Max-Planck-Institute for Comparative Public Law and International Law, Heidelberg. From 2000 to 2004 Senior Research Fellow and Project Coordinator at the Center for Development Research (ZEF), University of Bonn, Germany. Email: anja2sch@gmx.de.

ОРГАНИЗАЦИЯ СЕЛЬСКОХОЗЯЙСТВЕННОГО ПРОИЗВОДСТВА – ЗАКОНОДАТЕЛНЫЕ И ПРАВОВЫЕ ФОРМЫ В ПЕРЕХОДНЫЙ ПЕРИОД

АНЯ ШОЛЛЕР-ШЛЕТТЕР[*]

АННОТАЦИЯ

В данной главе книги отражаются правовые-институциональные аспекты, а также представлен обзор организационных форм сельскохозяйственного производства и институциональной среды в Узбекистане. После краткого обзора правовой деятельности и местной административной системы в Узбекистане в течение последних лет, изучены три основные формы сельскохозяйственных предприятий (*ширкат*, *дехкан* и *фермер*). Во второй части данной главы описываются проблемы, свойственные регулирующей структуре в настоящее время и рассматриваются некоторые вопросы, препятствующие дальнейшим правовым реформам. Результаты исследоваия показывают, что регулирование должно стать более определенным: Цель создания фермерских хозяйств – это организация частного хозяйства или привлечение внешних ресурсов для государственного производства? Имеет ли *хоким* исполнительную или представительную власть? Для эффективного регулирования необходимо, необходимо развитие независимой системы административной юстиции для обеспечения контроля над функционированием регулирующей структуры.

Ключевые слова: Узбекистан, закон и развитие, корпоративный закон, местная администрация.

---

* Институт Сравнительного Общественного и Международного Права им. Макс-Планка, Хайдельберг, Германия. С 2000 по 2004 гг. автор являлся старшим научным сотрудником и Координатором Проекта в Центре по Исследованию Развития (ZEF), Боннский Университет, Бонн, Германия. Эл. почта: anja2sch@gmx.de.

1 INTRODUCTION

Since the collapse of the Soviet Union, Uzbekistan has been facing challenges of transformation. For more than a decade, international donors (WORLD BANK, USAID, EU) have injected large amounts of hard currency into various development projects. Nonetheless, the unfavorable outcome of attempts at reform has lead to increasing frustration among the international development community. While economists call for more market oriented resource management and privatization, other social scientists blame vested interests (JONES LUONG, 2002: 10-27), non-transparent network structures and informal ties that dominate over formal structures in crisis or conflict situations (WEGERICH, 2004), or consolidated rent-seeking patterns for failing reforms (RENGER and WOLFF, 2000).

In development research, only recently has the impact of the regulatory framework and administrative proceedings for achieving development goals received increasing attention, while in the debate on "good governance", institutional structures and arrangements, as well as interest groups and their conduct, have been recognized as decisive factors in transformation processes. However, only in the past few years has law "as an instrument in development" risen from the pitfalls of the "law and development" debate of the seventies and eighties to become fully acknowledged by a more comprehensive understanding (SCHOELLER-SCHLETTER, 2003: 277f.). In many countries in transition, a new constitution adopted after the fall of the former authoritarian system is now in place. However, frequently civil rights, the principles of democracy, the rule of law, and the separation of powers – at least nominally called for by most constitutions (cf. Constitution of Uzbekistan Art. 7, 11, 13, 15, 32-35) – are not concretized accordingly. Parliament might pass laws in accordance with the constitution, but acts of administrative bodies "specify", contradict and de facto overrule them in violation of constitutional norms. If in addition there is no independent, competent and accessible judiciary in which people can trust, governmental branches are not limited in the exertion of power and individual rights are not protected effectively. Finally, if the individual cannot be sure that his rights are being protected, he will be reluctant to take individual responsibility, or make personal investment. It is not astonishing therefore, that an Uzbek farmer, to whom "privatization" has entailed above all the "privatization of risk" (TREVISANI, 2007: 176), who does not have the certainty that he will work the same fields again in the future; who does not have the freedom to choose the crops and the buyer of his products; and who does not have a realistic chance to seek and find justice in court against administrative acts, will not invest in the soil quality of his fields, even if they are allotted to him for his own use.

A discrepancy between law and reality is frequently stated as a general problem in Uzbekistan. The reasons identified and explanations offered are – and with

good reason – to a great extent of political, economical or cultural nature, be it informal networks, kinship ties and longstanding patterns of behavior that are blamed for impeding the system from working (GEISS, 2002; PASHKUN, 2003: 31). Meanwhile, the corresponding regulatory structure on all levels, including norms and acts of administrative bodies from presidential decrees down to administrative acts on the level of the implementing authorities, is hardly looked at as crucial in its nature of structuring reality and its function of "translating" overarching principles into everyday administrative decisions. Looking at the regulatory system in its structuring and "translating" nature may help to shed light on fundamental difficulties inherent in the institutional environment of agricultural production and the different forms of agricultural production itself (cf. SCHOELLER-SCHLETTER, 2005).

The following introduction pursues two aims. First, it intends to give an overview of the legal system regulating agricultural production in Uzbekistan today. A better understanding of the present regulatory framework is deemed necessary for understanding the structure of the agricultural sector of Uzbekistan and thus as a reference for the other chapters in this book. Secondly, this chapter summarizes some of the problems inherent in the present regulatory framework and thus highlights some of the challenges future reforms will have to face.

In doing so, the chapter intends to contribute to a theme central to many of the other contributions published in this volume – the effect of the central government on the social structure and economy of Uzbekistan. In contrast to the chapters by WALL (Chapter 8) and HIRSCH (Chapter 7), who describe the effect of political and social structures on the use of natural resources and the economy in sociological terms, and the contributions by DJANIBEKOV (Chapter 3), BOBOJONOV, LAMERS, and RUDENKO (Chapter 4), and MÜLLER (Chapter 10), who describe the effect of the state on the agricultural sector in economic terms, the following chapter focuses on laws and regulations as the primary means by which the influence of the government on social structures and the economy is effected. Directly or indirectly, this influence by the central government is responsible for how agriculture makes use of natural resources and is thus at the root of the ecological problems Uzbekistan faces today, as described by the chapters of MÜLLER (Chapter 5) and SCHIEDER and XIMING (Chapter 6).

2 THE REGULATORY FRAMEWORK OF AGRICULTURAL PRODUCTION

2.1 Legislative activity in Uzbekistan since independence

Since Uzbekistan became independent in 1991, its legal system has been subject to frequent changes.[1] An enormous amount of legislation and presidential decrees have been passed, with phases of stagnation in the face of daunting economic and social problems. With the general aim of liberalizing former state owned sectors, the new legislation has redefined the legal status of agricultural producers, governmental bodies, supplying and purchasing entities, as well as the relationship between them. Market-oriented laws passed by Parliament coincided with resolutions of the ministerial cabinet and presidential decrees regarding the economy.[2]

In various aspects, however, legal reform in Uzbekistan has remained a patchwork process (cf. SCHOELLER-SCHLETTER, 2005). Although a great amount of legislation has been passed since independence, in numerous areas the existing Soviet law has remained in force more or less unchanged. Frequently, the legislature has opted for minor amendments or laws changing only specific aspects of the existing legal system. For example, Uzbekistan did not adopt the 1991 Fundamental Principles of Civil Legislation of the USSR and Republics – like Kazakhstan or the Russian Federation did – but instead, the Civil Code of 1963 was partially replaced and augmented by additional laws on ownership, entrepreneurship, enterprises, foreign economic activity, lease, pledge, insurance, trade marks and service marks, foreign investment, bankruptcy, the protection of electronic computer and database programs, inventions, useful models and industrial design, joint-stock societies etc. (cf. BUTLER, 1999: XII). Only step-by-step have new codes been passed covering complete fields of law, including a Criminal Code and a Code of Criminal Procedure (1994), a Civil Code and a Code of Civil Procedure (1995-97), a Labour Code (1995), a Tax Code and a Customs Code (1997).

During the transformation process, the focus of legal reform has been on privatization and deregulation of the economy, the establishing of national symbols and attributes of an independent state, and the reform of the judicial system. Among the other fields in which new legislation has been introduced, the amount of

---

[1] A set of compilations of Uzbek laws exists in English, among them most notable those with regard to the foundations of market economy by William E. Butler (BUTLER, 1996a, 1996b, 1998, 1999). Uzbek laws in German are hardly available (except: SCHOELLER-SCHLETTER, 2005). Although some studies (SAIDOV, 1998; BANTEKAS, 2005) on the legal system of Uzbekistan exist, very few of them are related to questions of transformation (exceptions: ABA/CEELI, 2002; CAMPELL, AFIA, and AZIZOV et al., 2003).

[2] An overview of the legislative development is offered by CAMPBELL, AFIA, and AZIZOV et al. (2003). A list of the laws passed up to 1999 is contained in (BUTLER, 1999: 933-68).

laws devoted to the protection of the environment is noteworthy and reflects the grave problems Uzbekistan faces in this regard.[3]

Changes to the regulation of the economy were enacted well before Uzbekistan became an independent state, already as a part of *perestroika*. In contrast to reforms of other sectors of the economy, changes in the agricultural sector were delayed for a considerable amount of time, partly because of the importance of cotton for export revenue of the state budget. (CAMPBELL et al., 2003: 49) While laws regulating the use of land and water were passed early on[4], serious changes to the organizational structure of farms began only in 1998, with the Land Code, the Law on the Agricultural Cooperative (*Shirkat*), the Law on the Fermer Enterprises, and the Law on *Dehqon* Enterprises.

Subsequent to Uzbekistan having become an independent state, a considerable amount of legislation has been devoted to national symbols and, still fairly frequently, to changes in denominations of governmental bodies or positions. Since the official declaration of independence on August 31, 1991, a new constitution was promulgated on December 8, 1992 and laws were subsequently passed regulating each of the new organs (for the most part between 1993 and 1995). Some changes to the state system have been introduced consecutively – among them the transformation of the legislative branch from a Supreme Soviet (1991) to an Oliy Majlis (1993), which later was turned into a body with two chambers (2004). A direct result of the independence process has also been laws nationalizing the anthem, flag, alphabet, state holidays, medals and honors granted by the state, the military oath, among other areas.

Another major field of legal reform has been the judiciary system of Uzbekistan. Following the enactment of the constitution, laws have been passed regulating the Procuracy (1992), the Courts (1993), the Qualification of Judges (1993), the Notary (1996), the Advocacy (1996) and the Ombudsman (1997), as well as laws on appeals by citizens (1994 and 1995). Regardless of these new norms and regulations, even president Islam Karimov had "to admit frankly that despite undoubted achievements, the judiciary system itself is still feeling the legacy of the Soviet past" (Address on 29 August 2001, cited by CAMPBELL et al., 2003: 1).

---

[3] Chief among them are the laws on the Protection of Nature (1992), on Specially Protected Nature Territories (1993), on the Protection of the Atmosphere (1996), on the Protection and Use of the Flora (1997) and on the Protection and Use of the Fauna (1997).

[4] Law on Land (1990), Law on Land Tax (1993), Law on Water and Water Use (1993), Law on Veterinary Science (1993), Law on Subsoil (1994), Law on Breeding Livestock (1995), and Law on Seed Growing (1996).

2.2 Institutional setting on the local level

2.2.1 Levels of government

The Republic of Uzbekistan is divided into fifteen regions – three of which constitute the autonomous republic of Karalpakstan – and the city of Tashkent, which has the status of a region. Each region (Uzbek *viloyat*, Russian *oblast*) is divided into several districts (*rayon*). Aside from Karalpakstan, which has its own government, governmental bodies generally exist at three levels, the level of the central government in Tashkent, the regional level and the district level. While all major policy decisions are taken at the level of the central government, the main purpose of the lower levels is to implement the policy decisions of the next higher level. Only in certain areas are competences delegated to lower levels of government, such as the establishment of local taxes and the execution of a local budget (Constitution, Art. 100).

2.2.2 Institutions and competences

Local government both on the regional and the district level combines representative and executive functions (Law on State Power on Local Level). The main body representing the people of a region or district is the *kengash* of People's Deputies, formerly called the Soviet of People's Deputies. The deputies of the *kengash* are elected every 5 years (Law on the Election of the Kengash). The executive body of government at the regional or district level is the *hokimiyat*, comprising a number of different agencies and departments. The highest official of a region or district is a *hokim*, who is the head of both bodies of government at the same time – the *kengash* and the *hokimiyat*. The *hokim* therefore combines representative and executive powers, making a clear distinction difficult. The *hokim* of a region is appointed by the president and confirmed by the *kengash* of the region for 5 years. The *hokim* of a district is appointed by the *hokim* of the region and confirmed by the *kengash* of the district.

Most decision making power on the regional and district level rests with the *hokim*. He ensures public law and order, fosters the economic, social and cultural development of the region or district, proposes the local budget and development plan, implements the budget, administers the assets and services of the region or district and is responsible for the protection of the environment. On the other hand the *hokim* is responsible for the execution of all decisions taken by higher levels of government; he is held personally responsible for all decisions and actions of the agencies directed by him (Constitution, Art. 103). The *hokim* of a region may be removed from office by the President, the *hokim* of a district, or by the *hokim* of the region. In contrast to the *hokim*, the *kengash,* or Assembly of People's Deputies, has few competences. The *kengash* confirms the appointment

of the *hokim* and the local budget and development plan proposed by the *hokim*. The only exclusive competence of the *kengash* is to determine the local taxes.

In essence, the *hokim*, the *hokimiyat* and the *kengash* of a region or district are organs responsible for the implementation of decisions by the central government (Law on Agencies of Self-Government). In order to introduce an element of self-government, additional bodies of local government have been created. These new bodies of self-government exist on a level below the district level. In each settlement, village (*kishlak* or *aul*) and city neighborhood (*mahalla*), meetings of all citizens are held. The main function of these meetings is the organization of the social life of the settlement, village or neighborhood, including, for example, the celebration of weddings, the improvement of sanitary conditions and the collection of money for the improvement of public spaces. The assemblies of citizens elect a chairperson every 2.5 years, called an oqsoqol, who represents the interests of the settlements, village or neighborhood against government agencies (Law on Election of Oqsoqol). Bodies of self government do not influence the decision making process of higher levels of government. At times, bodies of self government have been used as an instrument to implement decisions of higher levels of government. Not by chance, the election of an *oqsoqol* must be approved by the *hokim* of the district.

2.2.3 Governmental control of land use

The role of the different levels of government in land allocation and land use corresponds to their role in other areas (Art. 4-6, Law on Land). All major policy decisions are taken by the central government. The function of local government – the *hokims* of regions and districts – is primarily the implementation of these policies. The basis for all acts of government in land allocation and agricultural production is the "State Policy on the Rational Use and Protection of Land", passed by the central government. The Cabinet of Ministers is responsible for implementing this policy by passing regulatory acts on land, developing state programs for increasing the fertility, use and protection of land and reorganizing land allocation. The *hokims* of regions and districts implement the guidelines of the Cabinet of Ministers through the development of local programs, supervising the correct and effective use of the land, monitoring the reorganization of land, allocating land to citizens and legal persons and confiscating land where necessary. The "representative organs" of local government – the *kengash* and the Assembly of Citizens – have no direct influence over the administration of land and agricultural production.

2.3 Organizational forms of agricultural production

In the agricultural sector in Uzbekistan, three organizational forms of production are common: The agricultural cooperatives (*shirkats*), the agricultural production business entities in form of *fermer* enterprises and the farmer households or so-called *dehqon* enterprises. They are the basic, but no longer the exclusive business entities in the sector.

2.3.1 The agricultural cooperative (shirkat)

The agricultural cooperative (*shirkat*) is a business entity in the organizational form of a cooperative in the agricultural sector. It is a special form of business cooperative. The form of business cooperative is distinguished by the fact, that the personal labor participation of each member is required. In contrast to other business units, each member of a cooperative possesses one vote regardless of the amount of their corporate share or the amount of labor contribution. Business cooperatives, based on membership, had been popular during the first years of transition, but are now increasingly rare types of legal persons.

The *shirkat* is a production cooperative. It is a voluntary association of citizens under the principle of membership for the purposes of joint agricultural production, based on the labor participation of the members, defined by an annual contract with the head of a family, i.e., the "family contract". Its regulatory basis is Law No 600-I of 30 April 1998 "On Agricultural Cooperatives (*Shirkat*)", with amendments of 30 August 2003 (No 535-II) and 12 December 2003 (No 568-II), in the following abbreviated as "Law on *Shirkats*". Apart from producing agricultural goods, the agricultural cooperative may also process agricultural raw material, produce foodstuffs and consumer goods, pursue trading activities, maintenance and construction works and offer services. This can be done inside or outside the territory of the agricultural cooperative within the limits stipulated by the law (Art. 4, Law on *Shirkats*).

The agricultural cooperative also has its role within infrastructural development of rural settlements. It is supposed to undertake measures to develop the social infrastructure, health, living comfort and social environment. These also include building measures, measures to expand the provision of electricity, gas and drinking water on the territory of the *shirkat*, support of health care measures, and local enterprise and market support (Art. 27, Law on *Shirkats*).

Constitutional documents

The constitutional document of an agricultural production cooperative is its charter that serves as the basic document regulating the cooperative activities. The founders who want to establish a *shirkat* have to agree on a charter and approve it in a general meeting. Changes in the charter may be made by the general

meeting of members (Art 6, Law on *Shirkats*). After official registration at the *hokimiyat* of the district, the *shirkat* is presumed to be established and holds the rights of a legal person, controls its accounts and balances independently, and holds its own bank accounts (Art. 5, Law on *Shirkats*).

In the charter, the following has to be stipulated:

- The name of the *shirkat* and its location;
- The activity of the *shirkat* and its purpose;
- The procedure for joining the cooperative as well as the procedure for terminating membership;
- The composition of the founders and the number of members of the *shirkat;*
- The rights and duties of its members;
- The internal administrative organs including their organization, competences and procedures, size and procedure for establishing the funds, the forms of labor contribution and the remuneration of the members for it, the procedure for distributing the income (profits) of the shirkat, among them the procedure for distributing the dividends according to the share held, and the procedure for reorganization or liquidation of the *shirkat* (Art. 6, Law on *Shirkats*).

Members

The law does not mention a minimum of members required to establish a *shirkat*. Any natural person over the age of sixteen may become a member of the agricultural cooperative. Legal persons may become "collective members" on a contractual basis. The candidate who wants to join has to hand in a request for membership. The decision of the board on accepting a member has to be confirmed by the vote at a general assembly by existing members and in the presence of the candidate (Art. 7, Law on *Shirkats*).

Management

The highest management body of the *shirkat* is the general meeting of members. The general assembly of members elects the chairman, the board, and the audit commission and transfers to each of them their competences with regard to the ongoing administration of the agricultural cooperative (Art. 10, Law on *Shirkats*).

The general meeting has exclusive powers over certain substantial issues, including: Approval of the *shirkat's* charter and amendments of the charter according to the applicable rules; appointment and dismissal of the chairman; election of the board and the audit commission and consideration of their reports; acceptance, expulsion and retirement of members; adoption of by-laws, such as the internal business regulations of the *shirkat* and the remuneration of labor; approval of business plans and progress reports; evaluation of the contribution of each member and

distribution of the respective amount of shares to each member of the *shirkat*; the resolution for the distribution of profits and the utilization of the cooperative's funds; proposals for the distribution of land to citizens for agricultural use in the form of *fermer* and *dehqon* enterprises, which will then serve as reference for the decision to be taken by the district *hokim*; reorganization and liquidation of the *shirkat* and its acquiring or terminating membership of other associations, companies, agricultural enterprises and other associations. Other exclusive competences of the general meeting of the members may be set forth in the charter (Art. 11, Law on *Shirkats*). The general meeting will be convened once a year after the closing of accounts for the fiscal year/annual statement of the financial accounts. It may convene an extraordinary meeting by decision of the board or on the initiative of at least one third of the overall number of members of the *shirkat*.

All members of the *shirkat* have equal rights with regard to deliberations in the meetings. Each member has one vote, which applies also for the "collective members" (see above: b. Members), regardless of the amount of their corporate share (Art. 3 and 11, Law on *Shirkats*). Every person that is being employed by the *shirkat* by terms of a labor contract participates in the general meeting and has the right of an advisory voice, but no vote.

The board of the agricultural cooperative has preparatory and executive functions and the number of board members is determined by the charter. The board may elect from within a chairperson and a secretary of the board, according to the procedures set out in the charter. The board develops business plans for the cooperative's activity and presents them to the general meeting for confirmation. It also proposes to the general meeting resolutions regarding the attribution of land for the agricultural use as *fermer* and *dehqon* enterprises. The board also makes the contracts with the head of the families (family contracts) and land leasing contracts with the heads of the *dehqon* enterprises.

The audit commission is responsible for the inspection of the financial and business activity of the cooperative. Apart from the in-house audit commission, the general meeting of members can retain an independent auditor (Art. 13, Law on *Shirkats*).

Attribution of land and conditions for use

With regard to the agricultural cooperative, two main types of attribution of land may be distinguished: The attribution of land by the state to the agricultural cooperative and the distribution of this land inside the cooperative among its members.

To the agricultural cooperative, land from public property classified for agricultural purposes is attributed for lease to a maximum of 50 years time, but no less than 30 years. The attributed land has to be used in accordance with the indicated purpose. It may not be privatized, bought, sold, mortgaged, donated or exchanged.

Agricultural cooperatives that use their land appropriately and efficiently may lease or be attributed additional territory. On the other hand, territory given to the cooperative may be seized "in accordance with the provisions in force, taking into consideration the existing guarantees" (Art 14, Law on *Shirkats*).

The cooperative may proceed with the land it has been attributed as follows: Territory of the cooperative that is not being used may be sub-leased to or given for preliminary use to other natural or legal persons for up to three years. Territory may also be given to workers in the agricultural cooperative for the use of *dehqon* or farmer household enterprises (Art. 14, Law on *Shirkats*).

The agricultural cooperative, after resolution by the general meeting, attributes territories to families for a limited time, but no less than five years, for the purpose of agricultural production according to the terms of a contract with the family; this territory may not be sub-let (Art. 15, Law on *Shirkats*). Once the period has elapsed the family has a right of prolongation of the contract for a newly set period of time.

Production (Family contract)

The production of an agricultural cooperative may be described as "planned economy by contract". Production is based on a system of annual contractual obligations between the agricultural cooperative and the heads of families with regard to producing agricultural goods. The family takes over the obligation to produce a certain amount and quality of a product and to deliver it on time to the agricultural cooperative, who is, on the other hand, obliged to purchase at a price fixed in advance (Art. 21, Law on *Shirkats*). Apart from fixing size, situation and present condition of the territory, the contract stipulates what measures each side is obliged to undertake in order to raise the quality of the soil and the productivity of the plants. It also specifies the provision of water for irrigation and the supply of technical and material resources by the cooperative. The contract also includes clauses specifying the responsibility of each side in the case of breach of contractual obligations.

After the work is accomplished – usually to be carried out independently by the family community – the payment is made according to the product, as stipulated by the contract. The payment may be reduced by the value of remaining material or technical resources that are not handed back to the cooperative after the work has been completed, and remains with the family community. Those family members with corporate shares also receive remuneration for work in the form of a dividend that is fixed annually according to the profit made by the agricultural cooperative (Art. 21, Law on *Shirkats*) and dependent on the share held (Art. 3, Law on *Shirkats*). This payment is separate from remuneration for the work carried out.

Liability

The agricultural cooperative is liable for its aggregate property and overall assets. It is not liable for obligations of its members. The members of an agricultural cooperative do not bear liability with their assets for obligations of the cooperative. Their liability is limited to the extent of their contribution.

Termination of membership

Stated as a basic principle of the *shirkat* (Art. 3, Law on *Shirkats*) is the guaranteed possibility to end the membership in the *shirkat* at any time. What procedure to follow is to be stated by the charter (Art. 6, Law on *Shirkats*). Membership may be terminated voluntarily, when participation in work ends, or under circumstances as stipulated in the charter (Art. 9, Law on *Shirkats*).

2.3.2 The *DEHQON* farm

The *dehqon* farm is the smallest business entity for agricultural production and is based on the principle of self-sufficiency of a family household on a plot of land owned for life. Its regulatory basis is Law No 604-I of 30 April 1998 "On *Dehqon* Enterprises", amended on 15 December 2000 (No 175-II), 12 May 2001 (No 220-II), 12 December 2003 (No 568-II), 3 December 2004 and 23 May 2005 (SRU-2), in the following abbreviated as "Law on *Dehqons*".

Foundation

The *dehqon* farm is a family enterprise that may be founded as a legal entity (Art. 1, Law on *Dehqons*). The plot of land for the enterprise is granted to the head of the family for life and may be bequeathed by him to his descendants, including the assets of the farm. The land is exclusively cultivated by the members of the family household and external workers may not be employed.

In order to establish a *dehqon* farm, the enterprise must be registered and land must be granted. Any member of a *shirkat*, of another agricultural enterprise, institution or organization, as well as any teacher, medical doctor or specialist employed in a rural area for at least 3 years is entitled to apply for a *dehqon* farm. The application is examined by the administration of the *shirkat* or the employer. The final decision regarding land allocation rests with the *hokim* (Art. 5, Law on *Dehqons*). The farm is finally registered with the *hokimiyat* and the farmer receives a document giving him ownership rights over the land (Art. 6, Law on *Dehqons*).

The land granted to a *dehqon* farm may be used for cultivation and construction of a home for the family of the farmer. The agricultural products may be used both for private consumption and for sale (Art. 7, Law on *Dehqons*). *Dehqon* farms may not be larger than 0,35 ha on irrigated land, 0,5 ha on non-irrigated land or 1 ha in the steppe (Art. 8, Law on *Dehqons*).

Activity

Regarding agricultural production, the farmer has complete freedom, including in the choice of crops and in fixing prices. Like in other *fermer* enterprises, he is not allowed to leave land fallow and must respect laws on the protection of the environment (Art. 12, Law on *Dehqons*). He may lease extra land from a *shirkat* (Art. 8, Law on *Dehqons*) and mortgage his property. The size of the land cannot be changed without the consent of the farmer (Art. 9, Law on *Dehqons*). The *dehqon* farm may join cooperatives, unions and associations (Art. 22, Law on *Dehqons*). The economic results of the farm must be registered (Art. 26, Law on *Dehqons*). The *dehqon* farmer is liable with his total private assets (Art. 30, Law on *Dehqons*).

Liquidation

The *dehqon* is liquidated upon the death of the owner if there is no heir; upon application by the owner; if the owner systematically does not pay his taxes, or if he does not begin cultivating his plot within a year of allocation (Art. 27, Law on *Dehqons*). Confiscation is permissible, but only if a land of the same quality is offered in exchange (Art. 9, Law on *Dehqons*). The *dehqon* is liquidated by decision of the members of the *dehqon* farm or by a court decision (Art. 28, Law on *Dehqons*).

2.3.3 *FERMER* enterprise

A *fermer* enterprise is a business entity for agricultural production on leased land and is headed by the founder. Its regulatory basis is Law No 602-I of 30 April 1998 "On *Fermer* Enterprises", with amendments resulting in the revised version of 26 August 2004, in the following abbreviated as "Law on Farms".

Foundation (Participants, constitutive documents)

In order to found a *fermer* enterprise the founding farmer must be at least 18 years old and have a corresponding agricultural qualification or experience (Art. 4, Law on Farms). The founding entails on the one hand the registration with local authorities and on the other hand the signing of a leasing contract. Responsible for both procedures is the *hokim*.

In order to register a *fermer* enterprise, the farm must have a charter, indicating the name of the founder, the location of the land, the purpose of the farm and the amount of the charter fund. A standard charter has been adopted by the Cabinet of Ministers (Art. 9, Law on Farms). With respect to the purpose of farms, the law mentions three types of farms: Animal stock farming/production; cultivation of cotton or grain; cultivation of fruits, wine or vegetables and others. Farms for animal production must have at least 30 livestock and at least 0.3 ha of land per

livestock (0.45 ha in Karalpakstan and 2 ha in areas without irrigation). Farms for cultivating cotton or grain must be at least 10 ha large, for other crops 1 ha (Art. 5, Law on Farms). With regard to the charter fund the law does not mention a financial minimum. The farmer should endow the farm with "corresponding funds" (Art. 6 and 18, Law on Farms). In practice, however, the amount a farmer is able to invest is decisive in whether he receives land for founding a farm or not (TREVISIANI, 2007:185 f.)

Land allocated for the establishment of *fermer* enterprises is leased to farmers for up to 50 years but no less than 30 (Art. 11, Law on Farms). The plots are put up for tender by the commission for granting land or, in the case of land previously held by a *shirkat* or other enterprise to be liquidated, the special commission for the restructuring of *shirkats*. Members of *shirkats* may found *fermer* enterprises on *shirkat* land on the basis of a tender by the general assembly of the *shirkat*, thus the preliminary decision being taken within the *shirkat*. In every case the final decision rests with the *hokim*, who also makes the leasing contract with the farmer. The foundation of a farm becomes legally effective upon approval by the commission for granting land, which is actually chaired by the *hokim* himself.

For the plot allocated to him, the farmer pays a lease that is equivalent to the property tax (Art. 14, Law on Farms). The leasing contract specifies not only the location and quality of the land, but also the type of agricultural production to be pursued on the land and the minimum output to be produced. Land may not be left fallow. The amount fixed as obligatory minimum output is determined by the quality of the land as established in the cadastral plan of the territory. For meeting the requirement it is considered sufficient that the average production of three years surpasses the amount fixed in the contract (Art. 5, Law on Farms).

Production and liability

The land leased to a *fermer* enterprise may not be sold, exchanged, donated, pledged or privatized. The farmer may bequeath the farming to his children and extend the leasing contract. He is not allowed to sublease the land, however. In his decisions regarding land use and production, the farmer is bound by the charter and the leasing contract of the *fermer* enterprise. Both the charter and the leasing contract limit the farmer to a specific type of production. The leasing contract furthermore specifies the minimum output to be produced on the land. The verification of the compliance of the farmer with the terms of the contract may be cause for an examination of the farm (Art. 30, Law on Farms).

In contrast to the agricultural cooperative (*shirkat*), where members only bear liability with what has been contributed to the cooperative, in a farm enterprise, the head of the farm is liable for insuring there are sufficient funds. (Art. 35, Law on Farms).

Liquidation

A *fermer* enterprise is liquidated upon the death of the farmer if there is no heir who wants to continue; upon the voluntary renouncement of the right to lease a plot of land; and in case of insolvency of the owner or if he does not begin cultivating his plot within a year of allocation.

Table 2-1: Comparison of different organizational forms of agricultural production

Type	*Shirkat*	Member of *shirkat*	*Dehqon* enterprise	*Fermer* enterprise
Size	Not specified. 2003: Average 1445 ha	Determined by *shirkat*	Less than 0,35-1,00 ha 2003: Average 0,17 ha	More than 10 ha (Pastures: More than 9-60 ha) 2003: Average 13 ha
Owner	Members	Head of family	Head of family	Farmer
Land allocation	Lease for 30-50 years, or assigned	More than 5 years, by contract with head of *shirkat*	Ownership for life, by application to *shirkat*, approved by *hokim*	By tender, lease for 30-50 years, contract with *hokim*
Sub-leasing	Possible for 3 years	Not allowed	Not allowed	Not allowed
Crop choice	Free	Fixed by contract with *shirkat* every year	Free	Fixed by leasing contract, violation grounds for liquidation of farm
Liability	Total assets of *shirkat*, state for accidents	Private assets	Private assets	Private assets, state for accidents
Influence by *hokim*	Allocation of land	No	Allocation of land	Foundation and leasing contract, control of contract every 3 years

The leasing contract may be terminated and the plot of land confiscated if the land is needed for public use. The misappropriate use of the land, including the cultivation of crops not mentioned in the contract of lease, is considered a major breach of contract, which may entail the confiscation of the land and liquidation of the farm (Art. 32, Law on Farms). The farm is liquidated by decision of the head of the *fermer* enterprise or by a court decision (Art. 33, Law on Farms).

3 CHALLENGES FOR REFORM

Experience in Uzbekistan has shown that the ancient structures and mechanisms in executive power and administration, a legacy of Soviet times, have not been modernized as much as expected under the influence of economic reforms.

Among researchers and donors alike, the reform of state organs and administration has been viewed as secondary to the liberalization of prices, privatization and the development of entrepreneurship. The restructuring of the governmental system has not been perceived as a serious task, partly because state reform simply appeared too overwhelming; furthermore, too many expectations have been attached to the success of economic reforms, which were expected to lead to democratic transformations in legislative, executive and judicial bodies (SIMEK et al., 2003: 9).

Only recently has a slight shift in focus towards the structure and functioning of the governmental system occurred; the distribution of competencies within its institutions and procedures may be noticed. While on the political level in bilateral cooperation activities an understandable and often necessary reluctance and reserve persists in order not to interfere in the other country's internal affairs[5], international donors for development cooperation are slowly trying to consider some sensitive structural problems by starting off with cooperation projects in areas where the problem manifests itself in the least politically controversial manner. As part of these attempts the OSCE, having already set up a legal clinic for journalists, is also trying to launch a program on training and assistance to restructure police forces[6]. The latter is an important element of executive power and is regarded as not effectively law enforcing and remains notoriously unreformed since the Soviet period – not only in Uzbekistan but in Central Asia in general (INTERNATIONAL CRISIS GROUP, 2002). Responding to the rising demand for more encompassing structural change, such as supervision over law enforcement agencies and a more independent judicial system (INTERNATIONAL CRISIS GROUP, 2002: 3), international donors are now trying in some areas to make what seems a first feasible step by trying to establish respect for individuals' rights and consciousness of the limits of power. On similar grounds, the EU is consolidating plans for cooperation in reforming the judicial system and institutions in Uzbekistan, starting with the defenders and the pre-detention, probation

---

[5] This is the position identified in interviews conducted by the author with representatives from several German federal ministries and agencies (Ministry of the Interior, Agency for Criminal Investigation, Border Guard, Ministry of Justice, Ministry for Development and Cooperation) in January and February 2005, on German-Uzbek cooperation.

[6] OSCE, Organization for Security and Cooperation in Europe, information by an OSCE representative.

and penitentiary system, but also aiming at procuracy, advocacy, administrative commissions and courts.[7]

Not surprisingly, and in part as a consequence of the focus of development co-operation's set of priorities, research within the international community that analyzes problems, reform needs and reform potential of governmental structures is rather rare so far.[8] This is – naturally – linked to the fact that such structural reforms have to be backed by a respective political will of the countries' governments.[9]

The following section intends to give a brief summary of some of the major problems persisting in the regulatory framework described in the previous section. The emphasis will be on problems relevant to agricultural production and thus to the aim of the present publication. This overview is not exhaustive and is meant to stimulate further research in this much neglected field.

3.1 Improving legislative quality

In spite of wide-ranging legislative activity, major problems persist or have been created in the legal system of Uzbekistan. In a survey of recent legislation, CAMPBELL et al. (2003: 50) summarize that, "as in other post-Soviet countries, the adoption of statutory legislation was not sufficient in establishing the rule of law, as the ruling authorities had a tradition of statutory (legal) nihilism." It has furthermore become apparent that many problems stem from deficiencies in the drafting of the law itself. Among the chief deficits, those that may be called "technical" in contrast to deficiencies by substance, are the following:

- In certain areas, many laws and regulations have been introduced, creating textual collision and conflict of norms. For example, two separate laws regulate foreign investment; contracts are regulated both by the Civil Code and by the Law on Contractual and Legal Basis of Activity Carried out by Economic Establishments;

---

[7] TACIS, Central Asia Indicative Programme 2005-2006 (adopted by the European Commission on 20 August 2004).

[8] The rare existing political-institutional, and partly sociological analyses are either dealing with regional and local level institutions (e.g., BEKTEMIROV and RAHIMOV, 2000), not seldom resulting as an auxiliary by-product of development research projects dealing with resource use, or economic restructuring (e.g., WEHRHEIM and WIESMANN, 2003), or specifically with the assessment of the national administration (e.g., PASHKUN, 2003; PERLMAN and GLEASON, 2004).

[9] The political situation is also the main reason why in countries of Eastern Europe the literature on law and state reform in transformation processes is much more extensive than in Uzbekistan (e.g., BOULANGER, 2002). It is not by chance that studies on Eastern Europe have been the main source for the theoretical aspects of the current "law and development" debate.

- Within the drafting of laws, uniform terminology is lacking. Identical words and phrases are used with different meaning. For example, "resident" is defined differently for the purpose of exchange and taxation controls;
- Legislation for the implementation of norms is frequently lacking, for example in the case of the Law on Evaluating Activity;
- The government has tried to pass executive regulations as laws, thus transgressing the hierarchy of normative acts and violating the limits to the executive power provided by the constitution. Even though the Constitution expressly subordinates the regulation of customs, exchange and banking issues to Parliament, for example, the Cabinet of Ministers has frequently adopted important regulations on banking issues, such as No. 24 of 15 January 1999 on measures for further reforming the banking system (CAMPBELL et al., 2003: 51);
- Laws regulating public administrative bodies often do not differentiate between functions, tasks and authorities. Formulations like "other functions determined by legislation" leave plenty of room for interpretation. The lack of clarity and the vagueness of functions of the Cabinet of Ministers allow almost all issues to be referred to it (ERGASHEV, 2003: 5-7).

3.2 Elaborating administrative law and justice

Aside from the aforementioned challenges to Uzbek legislative activity, the regulation of agricultural production exhibits some insufficiencies that are to the detriment of Uzbek agriculture. Some of these stem from shortfalls in administrative law and justice and in the way local institutions are regulated.

A weak point is the lack of consistent mixing of old and new forms of organization. The new laws on farming enterprises combine elements of privatization – such as the individual responsibility of enterprise owners – with elements of state control, including decisions about the kind and amount of crops produced. The laws on local institutions dilute executive power delegated by the central government with elements of local self-government.

With regard to executive power bodies, the fact that there do not exist any general criteria differentiating the various types of state administration bodies (such as "ministry", "state committee" and "committee", "agency", "republican commission", etc.), leads to the difficulty that typology, legal status and operational mandate remain unclear. Not always is the status of these bodies legally grounded, and on some occasions their formation violates administrative norms related to competence. The merging of administrative functions, coordination tasks, and provision of administrative services with control functions at a time still is an impediment that needs improvement as the unnatural combination of powers can potentially cause biased administrative and legal decisions and distort the motivation of a

civil servant (KHVAN, 2005: 66-69). While the law has established incompatibilities for civil servants between different activities and functions, administrative legislation provides us with examples where state officials hold two different positions at the same time. In particular, the situation is not legally correct where regional and district *hokims*, as heads of the executive body in their territory, are also in charge of representative branch authorities or head of a Republican NGO (KHVAN, 2005: 77).

Attempts at government reform might also want to turn to the provisions by which specific rights may be pursued to render the court more effective. In several instances, the laws specifically mention the involvement of courts. Actions of the *hokim*, including decisions of *hokims* on land allocation, may be appealed in court (Art. 28, Law on Local Institutions; Art. 11, Law on Farms). The liquidation of farming enterprises without the consent of the owners are allowed only by court decisions (Art. 33, Law on Farms). Decisions of electoral committees for the election of the Kengash (Art. 18, Law on Election of Kengash) and elections of the Oqsoqol (Art. 25, Law on Elections of Oqsoqol) may be contested in court. The possibility to take recourse in court only makes sense, however, if a judiciary exists which is independent of influence from the executive power, so to say influence of those officials whose actions are to be controlled. Where an executive body applies measures of administrative coercion that significantly restrict personal rights and freedoms, there must exist a mechanism that effectively serves as legal defense against such actions. An independent judiciary and specifically an independent system of administrative justice still need to be established in Uzbekistan (KHVAN, 2005: 58; 85).

3.3 Improving consistency in legal forms of agricultural production

In the first years after independence, the *shirkat* – the successor of the Soviet *kolkhoz* and *sovkhoz* – was the basic organizational unit of Uzbek agriculture, but has since then been replaced by the *fermer* enterprise. The presidential decree of March 2003 postulated a policy of restructuring former *shirkat*s as *private fermer* enterprises. By the end of 2006, 98 % of all *shirkat*s were intended to become *fermer* enterprises (cf. chapter 4 by BOBOJONOV, RUDENKO, and LAMERS). The policy was formulated in terms of a privatization of Uzbek agriculture.

A comparison of the laws regulating *shirkats* on the one hand and *fermer* enterprises on the other reveals a very different legal situation (cf. chapter 8 by WALL). The transition towards *fermer* enterprises de jure did not entail greater economic freedoms for the individual farmer, and in some respects less freedom than before. In respect to crop choice, for example, neither form of organization allows the farmer much influence as power of decision continues to reside mostly in the central state. The freedom of the individual was actually reduced compared with the *shirkat*, as contracts binding agricultural producers to the production of a

crop applied only to one year, while the leasing contracts of *fermer* enterprises bind the farmer to a specific kind and amount of product for 30 to 50 years. The reduction of economic freedoms of the *fermer* enterprise in comparison with the *shirkat* is also exemplified in the right to sub-lease land: The *shirkat* was allowed to sub-lease land not needed, *fermer* enterprises are not.

A further consequence of the transformation of *shirkats* into *fermer* enterprises is a shift of powers from the *shirkat* leadership to the local government, specifically the *hokim*[10]. While in the *shirkat* agricultural producers made their contracts with the board of the *shirkat*, in *fermer* enterprises the leasing contracts are made with the *hokim*. Even more importantly, the allocation of land is now administered by the *hokim*, a supervisory committee putting land out to tender with only an advisory function. Furthermore, the stipulation that *fermer* enterprises may "only" be reviewed in regard to their compliance with leasing agreements actually implies that such examinations are an important instrument of the *hokim* in controlling *fermer* enterprises. The non-compliance with the leasing contracts – especially the terms regarding crop choice and production quotas – are grounds for the confiscation of land and the liquidation of farms. Examinations regarding leasing contracts are envisaged for every third year. The shift of power from the *shirkat* to the *hokim* strengthens his role in implementing policies of the central state, and thereby the pressure of the central government on the *hokim*.

While the substitution of the *shirkat* by farming enterprises does increase the economic freedoms of the farmer, the risks taken by farmers are increased. While the *shirkat* was liable only up to the amount of the total assets of the *shirkat*, the owner of a *fermer* enterprise is now liable to pay with his private assets as well, in case the funds of the *fermer* enterprise are not sufficient to meet his obligations. In this context, from a sociological perspective, TREVISANI (2007: 176) has noted this constitutes a significant "privatisation of risks".

4 SUMMARY AND PERSPECTIVES

The restructuring of the agricultural sector of Uzbekistan has been accompanied by fundamental reforms in the legal framework regulating agricultural production. Among other changes, new forms of agricultural enterprises have been created: The *shirkat*, the *dehqon* and the *fermer* enterprises. In order to understand how the agricultural production in Uzbekistan has been developing since 1991, a clear understanding of these reforms, their intentions and their implications is essential. Without doubt, any changes that will be effected in the future will be effected to

[10] In the area of water allocation, the relationship between members of the *shirkat* and its leadership has found continuity in relationship between farmer enterprises and the chairmen of Water User Associations (WUA). See chapter by HIRSCH (below).

a large extent by means of laws: Laws on the rights of farmers, laws on the role of the state on agricultural production, as well as laws on the environment.

The brief analysis of the present regulatory framework presented in this introductory chapter suggests two main objectives for future reform. First, regulations should become less ambiguous. For instance, are *fermer* enterprises intended as private farms which are free to decide what and how to produce or are they intended as subcontractors carrying out state orders? Does the *hokim* have executive or representational powers? Second, an efficient administrative justice should be developed and the judiciary in general must be made more independent and able to control the functioning of the executive branch and the regulatory framework. Addressing these and other related problems in the regulatory framework would represent an essential step in the creation of a more sustainable agricultural production in Uzbekistan.

Reforming the organization of agricultural production will improve only one aspect of the problems currently facing Uzbekistan and one of the factors determining the future of the Aral Sea basin. Just as importantly, changes will be necessary in the way agriculture makes use of natural resources, in the role the Uzbek government takes in the economy, and in the social and political structures of Uzbekistan. Such changes will imply the development of alternatives to agriculture and the reconsideration of the amount of control exerted by the central government on society. How to understand and deal with these further aspects is the subject of the following chapters.

REFERENCES

AMERICAN BAR ASSOCIATION'S CENTRAL EUROPEAN AND EURASIAN LAW INITIATIVE [ABA/CEELI] (2002): Judicial reform index for Uzbekistan, Washington, D. C.

BANTEKAS, I. (ed.) (2005): Law and the legal system of Uzbekistan, Huntington.

BEKTEMIROV, K., RAHIMOV, E. (2000): Local government in Uzbekistan, in: MUNTEANU, I., POPA, V. (eds.): Developing new rules in the old environment. Local governments in Eastern Europe, in the Caucasus and Central Asia, Budapest, pp. 470-520.

BOULANGER, CH. (ed.) (2002): Recht in der Transformation, *Potsdamer Textbuch 7*, Berlin.

BUTLER, W. E. (1999): Uzbekistan legal texts: The foundation of civic accord and a market economy, *CIS Legal Texts Series, Vol. 3*, The Hague/London/Boston.

CAMPBELL, J., AFIA, J., AZIZOV, I. (2003): Legislative evolution in Uzbekistan, *Law in Transition, Spring*, pp. 48-53.

ERGASHEV, B. et al. (2003): Current condition and perspectives of reforming the system of executive power in the Republic of Uzbekistan, Tashkent, <www.eldis.org/static/DOC14876.htm>.

GEISS, P. G. (2002): Rechtskultur und politische Reform in Zentralasien, in: BOULANGER, CH. (ed.): Recht in der Transformation, *Potsdamer Textbuch 7*, Berlin, pp. 149-170.

INTERNATIONAL CRISIS GROUP (2002): The politics of police reform', *Asia Report, Vol. 42*, <www.crisisgroup.org/home/index.cfm?id=1444&I=1>.

JONES LUONG, P. (2002): Political obstacles to economic reform in Uzbekistan, Kyrgyzstan, and Tajikistan: Strategies to move ahead, *World Bank Working Paper,* Washington, D. C.

KHVAN, L. B. (2005): Administrative law, in: BANTEKAS, I. (ed.) (2005): Law and the legal system of Uzbekistan, Huntington, pp. 51-86.

PASHKUN, D. (2003): Structure and practice of state administration in Uzbekistan, *Open Society Institute Discussion Papers 27*, Budapest, <http://unpan1.un.org/intradoc/groups/public/documents/UNTC/UNPAN016104.pdf>.

PERLMAN, B., GLEASON, G. (2004): Uzbekistan public sector governance assessment, University of New Mexico.

RENGER, J., WOLFF, B. (2000): Rent seeking in irrigated agriculture: Institutional problem areas in operation and maintenance, Eschborn.

SAIDOV, A. (1998): The legal system of Uzbekistan, English translation by William E. Butler, Tashkent.

SCHOELLER-SCHLETTER, A. (2003): Einflussnahme auf Entscheidungen staatlicher Organe als Problem für Demokratie und Rechtsstaat. Rechtsreformen und Beitrag des Staats- und Verfassungsrechts zur Entwicklungsforschung, in: KAISER, M. (ed.): Weltwissen. Entwicklungsarbeit in der Weltgesellschaft, Bielefeld, pp. 275-310.

SCHOELLER-SCHLETTER, A. (2005): Ressourcennutzung und Lokalverwaltung in Usbekistan: Eine Gesetzessammlung, *ZEF Work Papers for Sustainable Development in Centra Asia 9*, <http://www.khorezm.uni-bonn.de/downloads/WPs/ZEF-UZ-PP09-Schoeller.pdf>.

SCHOELLER-SCHLETTER, A. (2007): Structural deficits in legal design and excessive executive power in the context of transition in Uzbekistan, in: SARTORI, P., TREVISANI, T. (ed.): Patterns of Transformation in and around Uzbekistan, Reggio Emilia, pp. 218-235.

SIMEK, O. et al. (2003): Legal status of local self-governments in Central Asian States: Key issues', *The Fiscal Decentralization Initiative for Central and Eastern Europe Proceedings*, Budapest.

TREVISANI, T. (2007): Rural communities in transformation: *Fermers*, *dehqons*, and the state in Khorezm, in: SARTORI, P., TREVISANI, T. (eds.): Patterns of transformation in and around Uzbekistan, Proceedings of the Asiac/Carn Conference, 5-6 November 2004, Rome, Special issue of the Journal *"Processi Storici e Politiche di Pace/Historical Processes and Peace Politics"*, pp. 167-195.

WEGERICH, K. (2004): Informal network utilization and water distribution in two districts in the Khorezm province, Uzbekistan, *Local Environment: The International Journal of Justice and Sustainability, 9 (4)*, pp. 337-52.

WEHRHEIM, P., WIESMANN, D. (2003): Food security in transition countries: Conceptual issues and cross-country analyses, *ZEF-Discussion Papers on Development Policy 62*, Bonn.

LAWS AND DECREES CITED

Constitution of the Republic of Uzbekistan, 8 December 1992, last amended 24 April 2003.

Civil Code of the Republic of Uzbekistan, No. 257-I, 1 March 1997, last amended 30 August 2001.

Land Code of the Republic of Uzbekistan, No 589-I, 30 April 1998, last amended 30 August 2003.

Law of the Republic of Uzbekistan on Agencies of Self-Government of Citizens, No. 758-I, 2 September 1993, last amended 14 April 1999.

Law of the Republic of Uzbekistan on Agricultural Cooperatives (*shirkat*), No 600-I, 30 April 1998, last amended 12 December 2003.

Law of the Republic of Uzbekistan on *dehqon* enterprises, No 604-I, 30 April 1998, last amended 23 May 2005.

Law of the Republic of Uzbekistan on Farmer Enterprises, No 602-I, 30 April 1998.

Law of the Republic of Uzbekistan on State Power on the Local Level, 2 September 1993, last amended 25 December 1998.

Law of the Republic of Uzbekistan on the Election of the Chairperson (Oqsoqol) of Assemblies of Citizens, No 609-II, 29 April 2004.

Law of the Republic of Uzbekistan on the Election to the Kengash of People's Deputies of Regions, Districts and Cities, 5 May 1994.

Decree of the President of the Republic of Uzbekistan on the Plan for Development of Farmer Enterprises in the years of 2004-2006, 27 October 2003.

SECTION 2

LAND USE PATTERNS

Continuity and change: Land and water use reforms in rural Uzbekistan
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 3, pp. 43-62.

CHAPTER 3

A MODEL-BASED ANALYSIS OF LAND AND WATER USE REFORMS IN KHOREZM: EFFECTS ON DIFFERENT TYPES OF AGRICULTURAL PRODUCERS

NODIR DJANIBEKOV[*]

ABSTRACT

The focus of this paper is an economic and model-based analysis of the effects of agricultural reforms such as commodity market liberalization, land and water use reforms on the agricultural sector of the Khorezm region (Uzbekistan). The impact analysis of these reforms on the regional crop and livestock production is carried out with a price-endogenous mathematical programming model developed for the agricultural sector of this region. The general results of various simulated scenarios are presented on the basis of a comparative static analysis vis-à-vis the base year values of 2003. The purpose of this paper is twofold. Firstly, it presents the major features of the agricultural sector model of this region which is typical for Uzbekistan. Secondly, it discusses the results of the selected simulations. Among other results, the model reveals the values for shadow prices for land and water in the baseline situation.

Keywords: Uzbekistan, agricultural sector model, state procurement system, water pricing, farm restructuring.

[*] Junior Researcher, Department of Economic and Technological Change, Center for Development Research (ZEF), University of Bonn, Germany. Email: nodir@uni-bonn.de.

МОДЕЛИРОВАНИЕ И АНАЛИЗ РЕФОРМ ЗЕМЛЕ И ВОДОПОЛЬЗОВАНИЯ В ХОРЕЗМЕ: ВЛИЯНИЕ РЕФОРМ НА РАЗЛИЧНЫЕ ТИПЫ СЕЛЬСКОХОЗЯЙСТВЕННЫХ ФЕРМ

НОДИР ДЖАНИБЕКОВ[*]

АННОТАЦИЯ

Основное внимание статьи уделено моделированию и экономическому анализу воздействия сельскохозяйственных реформ на аграрный сектор Хорезмской области Узбекистана. Список рассмотренных реформ включает в себя либерализацию рынка товаров и реорганизацию земле- и водопользования, Для анализа воздействия данных реформ на региональное производство продукции растение- и животноводства была разработана модель математического программирования с эндогенными ценами. Главные результаты смоделированных сценариев представлены в виде сравнительного статитеческого анализа с показателями за базисный 2003 год. Статья преследует две цели. Во-первых, в ней представлены главные особенности моделирования аграрного сектора Хорезмской области, которые могут быть применены и в отношении Узбекистана. Во-вторых, в статье проводится обсуждение результатов смоделированных сценариев. Среди прочих результатов, модель позволяет подсчитать показатели теневых цен на землю и воду при условиях за базисный год.

Ключевые слова: Узбекистан, модель аграрного сектора, система государственных закупок, ценообразование на воду, реструктуризация сельскохозяйственных предприяти.

[*] Младший научный сотрудник, Отдел Экономичеких и Технологических Изменений, Центр по Исследованию Развития (ZEF), Боннский Университет, Бонн, Германия. Эл. почта: nodir@uni-bonn.de.

1 INTRODUCTION

After 1991, a set of economic reforms was implemented in the agricultural sector of Uzbekistan affecting all agricultural production activities, the produced quantities and the commodity prices. This paper addresses a set of agricultural reforms such as farm restructuring, land reform, national self-sufficiency for wheat, developments in state procurement policy and agricultural subsidization which changed the agricultural sector of Uzbekistan since 1991. These changes are as sociated with the transition from plan to market which is, however, far from being complete. Hence, the continuation of the reforms in the agricultural sector is likely not to resemble anything for which historical examples exist in the country. The reforms addressed in this study include the *continuation of the farm restructuring process*, *the introduction of water charges* and the *abolishment of the state procurement system for cotton*.

The current farm restructuring process, namely transformation of large scale state farms into middle scale private farms has increased the number of individual producers in Uzbekistan. After the intensification of the farm restructuring process, the fragmentation of large state enterprises into private farms became the most tangible element of agricultural reforms in Uzbekistan. The final objective of this reform is to entirely transfer land and non-land production assets from so-called *shirkats* to private farms. Like any policy change, the substitution of large scale production technologies by medium scale ones will affect the level of production activities and thereby commodity prices. In 2003 the agricultural production in the Khorezm region was represented by three main types of agricultural producers. Each producer type was characterized by a specific set of resource endowments, land use rights, production activities and policies.

The agricultural cooperatives (*shirkats*) which are the successors of former state and collective farms during the farm restructuring process were given land for permanent possession. *Shirkats* were included into the system of state procurement quota and input subsidies. In general, *shirkats* have inherited the rights, obligations, input endowments, production targets and rural employment tasks of collective farms. As a result of the *shirkat* fragmentation in private farms, the average size of a *shirkat* in the Khorezm region decreased from 1,850 hectares in 1999 to 1,445 hectares in 2003. At the end of the first stage of farm restructuring process in 1998, *shirkats* cultivated 82 % of total sown area in the Khorezm region (OBLSTAT, 2004). In 2003, due to the increasing speed of farm restructuring, *shirkats'* sown area decreased to 50 % of total regional sown area. Nevertheless, in 2003 *shirkats* were still dominating in regional cotton and wheat production according to official statistics (OBLSTAT, 2004).

The second important type of farms is, according to the legislation in Uzbekistan, the so-called private farms, which are managed by individual families or groups

of families via implementing agricultural activities on land received under a long-term lease with a maximum of fifty years. The number of private farms in the Khorezm region increased significantly during the second stage of the farm restructuring process. This increase was largely due to the state program of abolishment of *shirkats* rather than improved infrastructure for private entrepreneurship in the agricultural sector. In 2003 there were 6,500 private farms in the Khorezm region occupying a total area of 85,000 hectares. The average size of a private farm in 2003 was around 13 hectares. In relation to the *shirkats*, these private farms are considered to be middle-scale producers.

In 2003, private farms cultivated 29 % of the total sown area in the Khorezm region. In the first year of the farm restructuring process, the private farming in the Khorezm region had a more commercial orientation. The area sown with rice in private farms amounted to one third of the total sown area of private farms, while the shares of cotton and wheat were only 25 % and 10 % of private farm land, respectively (OBLSTAT, 2004). Because the number and area of private farms grew at the expense of *shirkats*, private farms have substituted the *shirkats'* share in cotton and wheat production for state procurement.

The third type of agricultural producers in Uzbekistan is rural household producers (*dehqon* farm) which base their agricultural production on own labour and small household plots received on lifetime inheritable possession rights. The individual household, which averages about 6-7 persons in the Khorezm region, can be considered as the smallest agricultural entity. The *dehqon* farms are not included into the state procurement system. There were almost 200,000 *dehqon* farms in the Khorezm region in 2003 possessing in total 33,000 hectares of land (OBLSTAT, 2004). According to the legislation, within the irrigated areas the plot size of a *dehqon* farm can be up to 0.35 hectare. However, the average size of a *dehqon* farm in Khorezm is 0.17 hectare. The total area occupied by *dehqon* farms has been increasing simultaneously with the increase in the rural population in the region. In 2003, *dehqon* farms cultivated 17 % of the total arable area in the Khorezm region (OBLSTAT, 2004).

The reforms aimed at the transition to a market economy and achieving the grain self-sufficiency changed the cropping pattern in Khorezm considerably. Four major observations regarding the regional cropping pattern can be made for 1993-2003. First, the area of winter wheat increased significantly. Second, the area cultivated with cotton has remained unchanged (OBLSTAT, 2004). Hence, the increase in wheat area was achieved at the expense of perennial fodder crop production, and in particular lucerne. Fourth, except for the drought period in 2000 and 2001, the total regional crop area has been increasing steadily. These four points will be discussed below. In 2003, 80 % of the crop area in the Khorezm region was cultivated for cotton, wheat and rice. The production of other crops such as maize, potato, vegetables, melons, and fodder crops was less

significant as they covered only 18 % of total crop area (OBLSTAT, 2004). Animal production in Khorezm has been negatively affected by decreasing area of fodder production and lack of pastures. Nevertheless, the animal production has remained less sensitive to natural conditions, such as droughts in 2000 and 2001, compared to crop production.

Further reforms in the agricultural sector are related to shifts in the system of producer incentives via full abolishment of the state procurement system and the introduction of water fees in agriculture.

The management of water is currently transferred entirely to newly established, non-governmental organizations which deliver water and maintain and operate the irrigation and drainage system (see HIRSCH, Chapter 7 in this volume). At the same time, the role of the government in maintaining and operating the irrigation and drainage networks in Uzbekistan has been revised. Most importantly, the transfer of water management to newly established water user associations (WUAs) has been linked to the introduction of water fees. The charging of agricultural producers for water use is expected to affect the agricultural production levels towards lower levels of water consumption and possibly even result in the adoption of water saving irrigation technologies.

Concerning the abolishment of the state procurement system, it is believed that it will raise incentives for cotton production and lead to more profitable production patterns in Uzbekistan. It has been argued by many authors that the implicit taxation of the agricultural sector, via the state procurement system, deprived the agricultural producers in Uzbekistan of their profits (ROSENBERG et al., 1999; GUADAGNI et al., 2005; KHAN, 2005; SPOOR, 1999). However, MÜLLER (2007, Chapter 10 in this volume) shows that the taxation of agriculture was not always so straight forward, but was significantly influenced by exchange rate alterations, and the scenario of full abolishment of the state procurement system may create incentives to increase cotton production and lead to more profitable production pattern.

These agricultural reforms may create different questions on their reliability and effects on production pattern for different types of agricultural producers and districts in the Khorezm region. While the new policies may have a positive impact on total agricultural output, the magnitude of their impact is unclear. Furthermore, it is unclear how these different policies will affect the regional production of specific agricultural commodities. Hence, the issue can be reduced to two main questions: How will certain policy reforms affect the income of different types of agricultural producers; and what will be the effects of such policy changes on regional production? The task, as mentioned above, is to develop a quantitative model which will help to assess the direction and approximate magnitude of various policy changes.

The policy analysis for the agricultural sector of the Khorezm region is complex due to the fact that the regional agriculture includes on the one hand many commodities linked through various input-output relationships and, on the other hand, several types of agricultural producers and many districts with different resource endowments. To allow a well substantiated analysis of reforms, the model has to take these specific settings of the agricultural sector of Khorezm into account.

This analysis can be done using the mathematical programming models which are constructed in order to obtain better understanding of the functioning of the regional agriculture and to provide a tool for policy analysis. A well defined and documented model may provide valuable information to be used in evaluating policy effects.

2 THE KHORASM MODEL

To evaluate the impact of selected agricultural policies on the regional production pattern, a price-endogenous model for agriculture of the Khorezm region (KhoRASM) has been developed following closely the guidelines for non-linear agricultural sector models as presented by HAZELL and NORTON (1986).

KhoRASM is a comparative static model assuming that the adaptation of the agricultural sector on the intervention is simultaneous with no time lag. In the base run solution, the model replicates agricultural production technologies and economic conditions in the Khorezm region in 2003. KhoRASM model is a regional and partial equilibrium model as it is describes different states of equilibrium at endogenous prices and quantities only for the different sub-regional agricultural producers. It is not explicitly linked with other regions and other sectors of the economy of Uzbekistan.

The production side of the model includes eight cropping and three animal producing activities specified for three producer aggregates in five production districts. In the model, the producer aggregates are defined according to the legislation of Uzbekistan on the typology of agricultural producers.[1] Therefore, for each agricultural production activity the model consists of three different sub-models representing the main farm aggregates of the Khorezm region such as rural households (*dehqon* farms), private farms, and large agricultural enterprises (*shirkats*).[2] Following an approach used by WEHRHEIM and WOBST (2004) for

[1] The legislation on agricultural producers in Uzbekistan has distinguished three main agricultural producers such as large-scale agricultural cooperatives (*shirkats*), middle-scale private farms and rural households (*dehqon* farms).

[2] The aggregate for *shirkat*s also includes a small number of all other types of large-scale agricultural enterprises, such as the remaining collective farms (*kolkhoz*es) and state enterprises which specialize in livestock breeding and fodder production.

Russia, agricultural producers were differentiated by input-output relationships that are characteristic for their specific institutional set-up. This disaggregation of the agricultural sector by commodities and types of producers is innovative as it allows analysing the aggregated farm-level effects of changes in land and water use patterns.

In order to more explicitly analyze the effects of different exogenous changes on the production structure in different areas, the studied region is separated into five district aggregates according to their distance from the Amu Darya river. There are three different treatments of the demand for outputs of the various activities. The first group includes the production of cotton, which is purchased by the government at state-determined prices. The second group includes food crops with endogenous prices, determined by balancing implicit supply curves and explicit linear demand curves. The third group consists of fodder crops, which are sold at fixed prices but the demand of which is endogenously determined in the relation to the volume of animal production activities.

For the sake of simplicity and because of data scarcity, the commodity prices and balances are defined in a single regional commodity market rather than at a district level. Furthermore, it should be noted that this version of the model is still a rather stylized representation of the agricultural markets in the Khorezm region and is still "work in progress". For instance, no cross-price and income effects are yet incorporated in the objective function of the model. Moreover, the model does not incorporate the market imperfections, marketing, processing, transportation, exporting, importing, or home consumption activities. The structural framework of the model is presented in Figure 3-1.

The objective function of the quadratic programming model transforms price-dependent product-demand schedules into a measure of consumer surplus, plus the producer surplus, or maximizing net social benefit (TAKAYAMA and JUDGE, 1971).

$$max\ Z = \sum_{j}\left(\alpha_j - \frac{1}{2}\beta_j Q_j\right)Q_j + \sum_{j} w_j Q_j - \sum_{r}\sum_{f}\sum_{i}\sum_{j}\left(p_{rfij}a_{rfij} + c_{rfij}\right)X_{rfj} \quad (1),$$

where:

The observed values of exogenous constraints and parameters are as follows:

α_j Intercept of the regional inverse demand function for food crops;

β_j Slope of the regional inverse demand function for food crops;

a_{rfij} Input application per unit of activity, i.e. technology coefficients;

y_{rfj} Product yield per unit of activity;

p_{rfij} Exogenous prices of inputs;

c_{rfij} Exogenous constant costs of production;

w_j Exogenous prices for cotton and fodder crops;

b_{rfi} Input endowments on farm, district and regional levels;

s_{rfj} State target area of cotton cultivation.

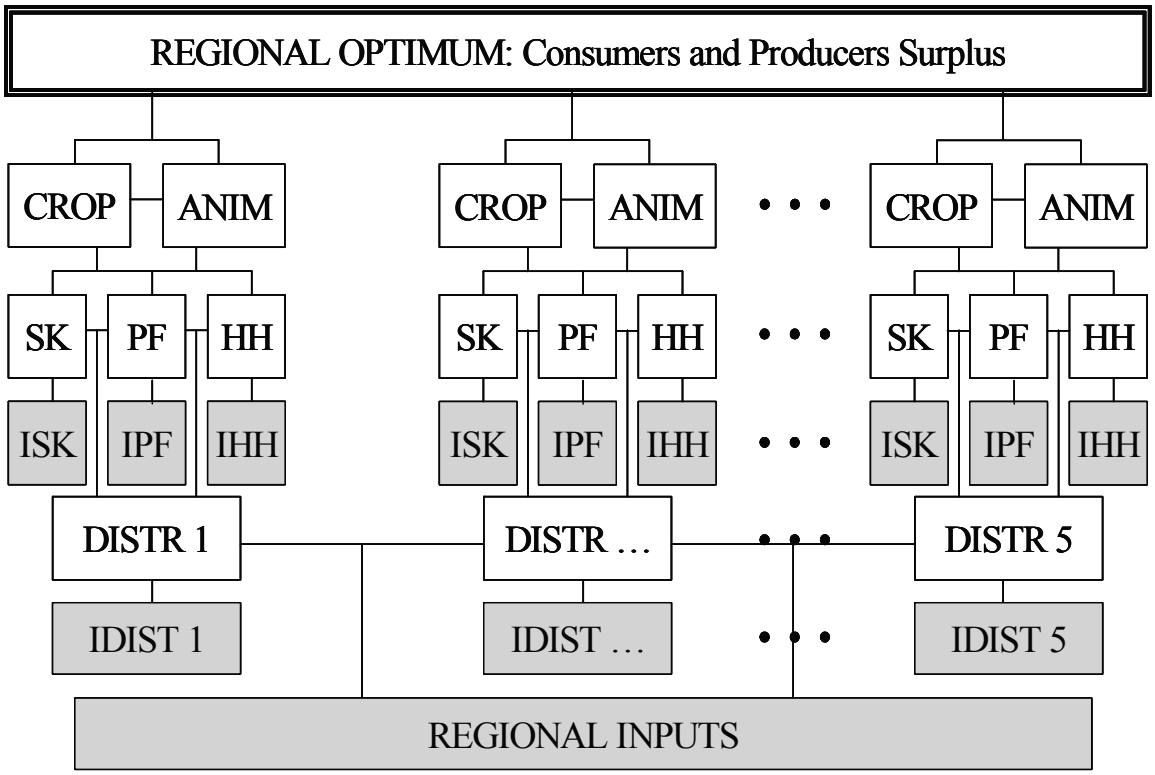
λ_{rfi} Shadow prices of the input constraints;

μ_{rfj} Shadow prices of the policy instrument constraints;

π_j Shadow price of the commodity balances.

The indices are: j, crop and animal products; i, input and production resources; f, agricultural producer aggregates; and r, district aggregates.

Figure 3-1: Structure of KhoRASM Model



Notes: SK = *Shirkats*. PF = Private farms. HH = *Dehqon* farms. ISK, IPF, IHH = Inputs endowments related to producer type. DIST = Producing district. DISTI = Inputs endowments related to producing district.

The constraints are imposed due to limited supplies of resources, food consumption needs and state policy instruments. In the model, the constraints are classified into three groups:

1. Resource constraints, which refer to the seasonal availability of land, labor, water, combine harvesters, nitrogen fertilizers, diesel and vehicles for transport. In the model the production technologies are initially specified in fixed proportions of land, labor, nitrogen fertilizer, diesel fuel and combine harvesters and vary between farm aggregates:

$$\sum_j a_{rfij} X_{rfj} \leq b_{rfi} \qquad \left[\lambda_{rfi}\right] \tag{2}$$

2. Commodity balances which are defined as the quantity demanded for each commodity is equal to the quantity supplied. In the KhoRASM model, there is one single regional market for agricultural products, which means that production in every agricultural producer aggregate in the different districts is balanced with the regional commodity demand at single set of commodity prices:

$$\sum_r \sum_f y_{rfj} X_{rfj} - Q_j \geq 0 \qquad \left[\pi_j\right] \tag{3}$$

3. In the model, the policies are determined exogenously and they are static and deterministic. Since, the annual land allocation targets for cotton are determined centrally, the main state policy implied in the model is the state production target for cotton. The state policy instrument constraint of the model requires that activity levels for cotton production in *shirkat* and private farm aggregates are not less than the assigned area in 2003:

$$X_{rfj} \geq s_{rfj} \qquad \left[\mu_{rfj}\right] \tag{4}$$

4. Non-negativity constraints for activities:

$$X_{rfj}, Q_j \geq 0 \tag{5}$$

where:

X_{rfj} Crop growing (in hectares) and animal keeping activities (in heads);

Q_j Regional production of crop and animal products (in tons), and eggs (in units).

3 DATABASE

The database is compiled from values for 2003 and consists of several categories such as social and political conditions of the region, regional prices, production pattern, household information, input-output coefficients, economic and natural

resource endowments. Due to the large data requirements for a sectoral model, the data base for KhoRASM was constructed in two parts.

The first part is based on field surveys. Much of the needed data was not available from secondary sources and had to be collected by means of farm and household surveys. For instance, there is an official record on large state-owned agricultural enterprises available in official statistical reports, but the data on households and newly emerging private farms is poorly available in the Khorezm region. There fore, private farm surveys and household surveys were conducted separately covering most production districts. The second part is based on desk research for the aggregated values such as regional production levels, input endowments and regional input and output prices. The aggregated data was obtained from the literature and from official statistical sources. The data compilation process and the specific sources for the data are described in more detail in DJANIBEKOV (2007, forthcoming).

4 BASE-RUN SOLUTION

The model was calibrated by modifying the technology parameters of input matrices to reproduce in its base run solution the actual observed situation for the agricultural activities represented in the model for the Khorezm region in 2003. The KhoRASM model was programmed in the GAMS modelling software which is adequate to solve non-linear problems using an optimization solver CONOPT3. The calibrated KhoRASM's baseline solution exactly reflects the production situation in the Khorezm region in the base year of 2003 where the values of prices and production activities for each commodity in various farm types and district aggregates are equal to their observed levels.

In addition to the comparison of production changes, a valuable feature of the model is that it allows comparing the shadow prices of input constraints with their actual prices. In fact, this can be used as an indicator for the plausibility of such optimization models (HAZELL and NORTON, 1986). If the calculated level of shadow prices is in a plausible range, this can be considered to be an indication of the consistency of the model. Moreover, the shadow prices of input constraints and on policy induced constraints provide information which may provide valuable information for decision-makers. The shadow prices of KhoRASM model refer to the factor utilization, and to the producer and consumer surpluses. Although the shadow prices are obtained for all binding production factors, the most interesting values refer to three basic production factors such as land, labor and water and the state procurement constraint.

The value of shadow prices for water obtained from the base-run solution of KhoRASM are in the range between 9 USD per 1000 m^3 and 58 USD per 1000 $\cdot m^3$ for irrigation water depending on commodities, farm-type and sub-regions. The

validation of the values of shadow prices for irrigation water is problematic for the Khorezm region, since the water charging mechanism is not introduced in agriculture of Uzbekistan yet. Nevertheless, the calculated values of shadow prices for water are comparable to those calculated by MÜLLER for the same region (2006). Additionally, the shadow prices are comparable to those estimated for volumetric water pricing in agriculture in Morocco in 2003 (CHOHIN-KUPER et al., 2003) which was in the range of 20 USD per 1000 m³ to 50 USD per 1000 m³ of irrigation water. According to DINAR and SUBRAMANIAN (1997), water charges in Namibia (3.8 USD per 1000 m³ to 28 USD per 1000 m³), Algeria (19 USD per 1000 m³ to 220 USD per 1000 m³), Tunisia (20 USD per 1000 m³ to 78 USD per 1000 m³), Brazil (4.2 USD per 1000 m³ to 32 USD per 1000 m³), Portugal (9.5 USD per 1000 m³ to 19.3 USD per 1000 m³), United States (12.4 USD per 1000 m³ to 43.8 USD per 1000 m³) and Spain, all in 1996 (0.1 USD per 1000 m³ to 28 USD per 1000 m³).[3]

The value of the shadow price for land obtained from the base-run solution of KhoRASM is in the range between 79 USD/ha and 288 USD/ha for arable land. The shadow prices for land are validated using the information on unofficial rents observed during the farm and household surveys in Khorezm in 2003. According to the case-study data, the approximate value of unofficial rent of land for rice cultivation in the region was in the range of 100 USD and 300 USD per hectare depending on soil quality, field location and water availability. Consequently, the shadow prices for land obtained in the model's optimal solution in the base run are in the range of the observed values.

In most cases, the shadow prices of labour are in the observed range of labour wages, i.e. between 0.1 to 0.75 USD per working hour. The labour shadow prices are zero for households since they basically have unlimited supply of labour. The shadow prices of labour in shirkats and private farms are compared to actual wages in the agriculture of the Khorezm region. The actual values for wages were obtained from personal interviews during farm and household surveys in the region in 2003 and 2004. In some cases the shadow prices for labour are higher which may be due to the fact that actual wages were monetary ones without taking into account payments in kind which play an important role. The values of shadow prices which exceed this range can be explained by the fact that the payments in kind are widely used by agricultural producers for remuneration of labour services.

The shadow price of state procurement has no direct observable values. However, the shadow prices of state procurement constraint on cotton production can be compared to marginal productivity of land sown under vegetables, melons and rice. Additionally, the shadow prices of procurement constraint are in the range of the unofficial rents of land for a full year, which may include the possibility

[3] For further details on shadow prices obtained with this model see DJANIBEKOV, chapter 3.

of double cropping such as rice cultivation after winter wheat. Since cotton is considered as one of the less profitable crops in the Khorezm region, the minimum restriction on its production has negative shadow prices, implying that an increase in cotton procurement will decrease producer profits. The shadow prices of the state procurement constraints for cotton are, as expected, generally negative and in the range between -85 USD/ha and -809 USD/ha of arable land which must be allocated to cotton production.

5 AGRICULTURAL POLICY SIMULATION

The comparative static analysis with the values of the base year of 2003 is used to identify the cause and the extent of relationships within the model by exogenously changing individual policy variables. Only the comparison of major aspects in the agricultural sector of the Khorezm region is presented in this study. First, we present the levels of variables, obtained in the policy simulation runs of KhoRASM model and compare them to their level in the basic solution of the model. Next, the consumer and producer surplus at regional level, land and water use are compared with the model's base run solution.

The selected set of agricultural policies includes the most discussed possible policies, which have been implemented or will be implemented in the regional agricultural sector. First policy simulation is introduction of water charges which was discussed recently as a tool for reforming the state budget expenditures. The second experiment simulates the abolishment of the state procurement system for cotton. The third policy simulation tests a scenario with which a complete conversion of *shirkat* producers into private farms is simulated.

5.1 Introduction of water charges

Because the regional irrigation water scarcity is the key constraint for regional agricultural production like in the period of 2000-2001, there is a need to achieve a substantially more efficient and productive use of water in irrigation. As discussed by TSUR et al. (2004), one method for increasing the efficiency of water use is to implement water user fees. Water charges can be expected to generate revenue, improve efficiency of the supply and supplier, manage demand, facilitate economic development and improve public welfare and equity (TSUR et al., 2004). However, before implementing such a policy in a given context one should analyze the likely effects of such a policy change. The price-endogenous mathematical programming model presented here can be used to estimate the impact of such a water charging policy on regional crop production and commodity prices as well as on consumer and producer surplus.

The current institutional set-up does not encourage the efficient use of water in Uzbekistan. The irrigation water in Uzbekistan is delivered to agricultural producers without any charges to cover water supply costs. According to the present legislation, the water charges are included into the land tax, which does not reflect the marginal value of water.

With the intensification of the farm restructuring process, state policies on financing the maintenance and operation system for irrigation and drainage infrastructure in Uzbekistan were revised. According to the cost recovery policy, the responsibility for operating and maintaining the irrigation system will be partially transferred to water user associations (WUAs); these associations will also be responsible for the introduction of water user fees (see HIRSCH, Chapter 7 in this volume).

Hence, the main purpose of introducing water charges in the Khorezm region is to ensure that the costs incurred by public suppliers of water, such as operation, maintenance, replacement costs, and capital costs in the form of amortization charges, will be fully or at least partially recovered from agricultural producers.

With flexibility of its charges, the crop-based charging combines social objectives with the economic objective of a water charging policy (HAMDY, 2002). Having the main objective of long-term sustainability of the irrigation and drainage system, the objective of water charging policy includes economic efficiency, fairness, equality, correcting imbalances in the distribution of income and wealth of different groups of agricultural producers. Moreover, the water charging objectives include the reduction of administrative costs, conflict resolution and local autonomy and control (HAMDY, 2002). Besides, it may provide incentives to economize water use if the charged value will be sufficiently high to change the relative profitability between crops and, as a result, if producers indeed will be allowed to change their production patterns from high to low water consuming crops. Hence, it is expected that the introduction of such a charging mechanism may lead to shifts in cropping patterns towards more water efficient crops and increase the marginal output per unit of water consumed by individual user. Most importantly for the Khorezm region, the crop-based charges are relatively simple to administer, and their transaction costs are low since no volumetric measurement or definition of rights is required.

The difference in the value of the water charge between crops will induce increased savings of irrigation water and reduce the production of water intensive crops. Furthermore, variations in the values of water charges between districts would induce the reallocation of water between upstream and downstream districts. The disparity in values of water charges among agricultural producers within a district will keep the concept of equitable distribution among producers of different production scales and will help to avoid large burdens on small-scale household producers.

5.2 Abolishment of state procurement system

Like in all transitional countries, which experienced reforms of price and subsidy policies, the abolishment of a state procurement system, state control over input and output prices, and the practice of selective subsidization has been one of the issues discussed since the first years of independence in Uzbekistan. During the first years of independence in Uzbekistan, the agricultural output prices were administratively increased. Additionally, the output volume sold under state procurement was decreased and the number of private entrepreneurship increased. Nevertheless, agricultural markets were not fully liberalized and the state procurement system remained in place for the entire production of cotton and to some extent for wheat.

According to the current state procurement system and subsidization policy, the large and medium sized agricultural producers are obligated to fulfil production quotas for cotton and wheat at below-market prices, and in return receive inputs at subsidized prices. Hence, the main question of the simulation in this section is what changes will occur in production activities and prices when the state program on agricultural markets liberalization will abolish the state procurement system, eliminate price controls on agricultural commodities, phase out subsidies on fertilizer and other inputs.

The abolishment of the state procurement system is considered to be a substantial change in economic policy as it is expected to increase producer surplus while reducing the revenues of the state from cotton production.[4] The removal of the state procurement quota for cotton would imply that the production level for this crop will be purely determined by the optimization behaviour of agricultural producers. As a result, cotton prices would not be administered by the state anymore but instead be increased to the level of farm-gate prices. For this simulation experiment the cotton and input prices were set at the level of farm gate prices observed in Kazakhstan in 2003.

5.3 Completion of farm restructuring process

Since 1998, the farm restructuring process became one of the major issues in the agricultural sector of the Khorezm region. Indeed, farm restructuring was the most notable agricultural reform in the region in 2003. The farm restructuring

[4] The fact to which extent revenues of the state would change depends on the degree of taxation/subsidisation of the cotton sector. While most western observers have been of the opinion that the Government of Uzbekistan has effectively taxed cotton production and thereby withdrawn substantial revenues from the agricultural sector. MÜLLER (2007, in Chapter 10 of this volume) argues that taxation of the cotton sector may in the past decade not have been as straightforward. Instead he shows that much depends on the exchange rate at which foreign exchange earnings from exports of cotton are being converted into domestic currency.

process is implemented in Uzbekistan via dissolution of *shirkats*. Their land and other assets will be transferred to newly established private farms. As a final result of this farm restructuring process, agricultural production in Uzbekistan will be done by two types of agricultural producers: Private farms and household plots.

Like any policy change, the substitution of large scale producers by middle scale ones will bring changes in regional production and commodity prices. Therefore, the question which arises after the accomplishment of farm restructured process is to which extent production patterns, quantities and prices would change if *shirkats'* production is entirely replaced by production from private farms given that all other domestic parameters remain unchanged. Consequently, the analysis of the respective policy experiment focuses on the changes in cropping pattern and animal keeping activities, commodity quantities and regional prices, and land and water use at selected level of farm restructuring.

6 SIMULATION RESULTS

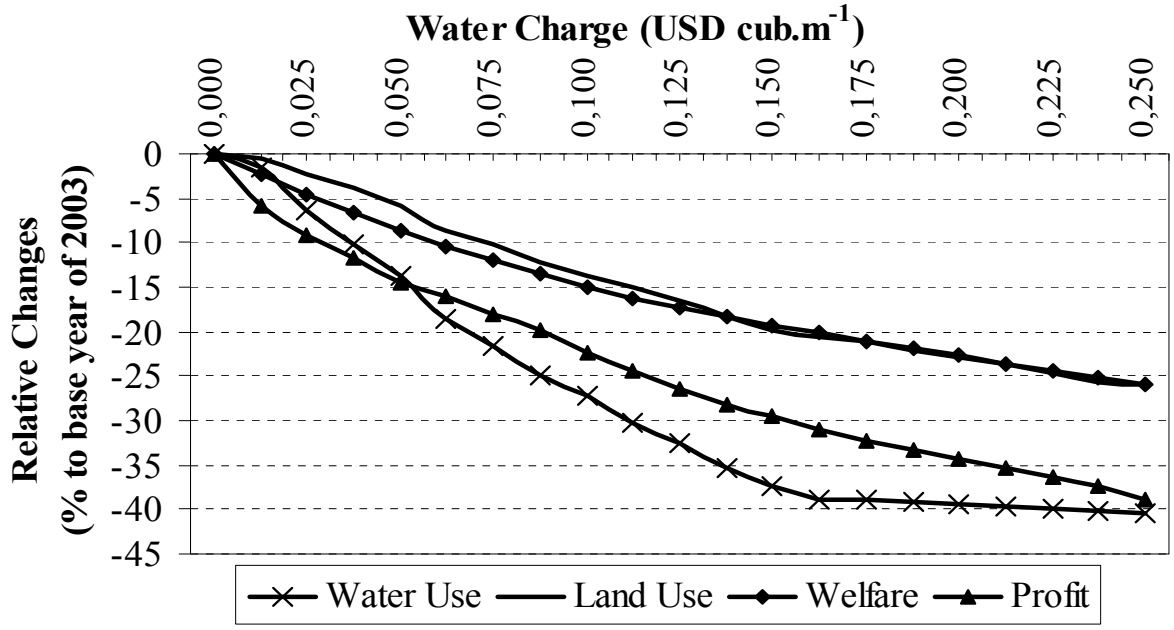
In the following section the results of the three simulation experiments which have been described above will be presented. Again it should be born in mind that the simulation has been carried out with a rather stylized model which represents "work in progress". Hence, the results should be interpreted with caution.

The first policy simulation looks into the effects of introducing water user fees. The results support what one would expect a priori: Under the given assumptions (e.g. the state procurement system for cotton remains in place) the introduction of water pricing will decrease the total production of rice, which is the most water intensive crop in the region (Table 3-1). Additionally, production of most crops will decrease in the region. As result, there is a price increase for the commodities with endogenous prices which also reduces consumer surplus. Moreover, the introduction of water charges shifted the regional cropping pattern towards the less water demanding crops. While the latter is positive and associated with a general decline in the level of water and marginal land use, the results of the simulation on economic indicators are rather negative. Higher production costs caused by the water charges decrease the producer surplus. Hence the total regional welfare decreases (Figure 3-2). However, these results are strongly determined by the rigid structure of the model economy. If in reality the economy would be more open and, hence, more flexible, such policy changes could be accommodated more easily by a restructuring of respective trade flows. Furthermore, the economic welfare function in this model does not take into account the social benefits which are expected from discontinuation of high-intensive agricultural production on marginal land and the reduction of scarce water resources.

Table 3-1: Deviation of regional production in scenarios compared to observed values, %. Simulation with KhoRASM model

Commodity	Introduction of water charges	Abolishment of state procurement system	Accomplishment of farm restructuring process
Cotton	0,0	-1,7	7,2
Wheat	-1,4	-0,3	-11,3
Rice	-13,4	-2,0	-7,8
Potato	-0,7	0,4	0,1
Vegetables	-0,6	0,4	-0,2
Melons	-0,5	0,4	-0,4
Maize	26,2	71,2	175,8
Fodder maize	8,1	1,6	-9,1
Milk	0,6	0,2	1,9
Eggs	0,1	1,5	-0,3
Meat	-0,3	-0,3	-1,0

Figure 3-2: Introduction of water charging. Simulation with KhoRASM model



Policy simulation 2 deals with the abolishment of the state procurement system and input subsidies for the cotton sector. Technically this is done by increasing cotton and input prices to the level of farm gate prices in Kazakhstan. The results show that the cotton production area would remain almost at the observed level in the base year (2003). This implies that given the base year values of prices,

input endowments and technology coefficients, the positive effects of abolishing the state procurement system will outweigh the negative impact of the removal of input subsidies. Furthermore, the simulation support another argument frequently raised against agricultural policy schemes in favour of cash crops: The abolishment of the rigid state procurement system for cotton would increase prices and therefore relative profitability of food crops. In response, rational farmers which are free to decide what to crop would increase the production of food crops (Table 3-2). From a national point of view this would have the advantage to reduce import dependency ratios for food crops further. However, the impact on the production quantities of some traditional food commodities such as rice, vegetables and melons is rather insignificant.

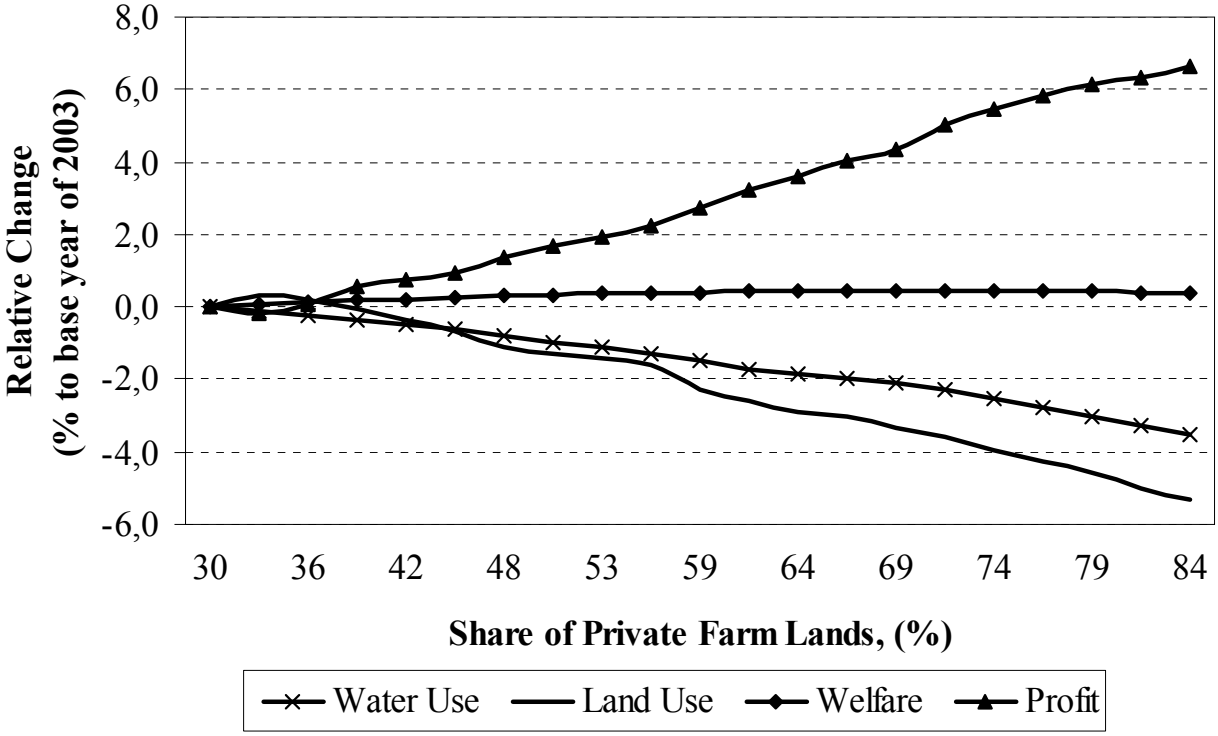
Policy simulation 3 looks into the effects of completing the fragmentation of *shirkats* into private farms. Against the prices, production technologies and input endowments used for the model's base year (2003) such a policy change would have positive effects on regional welfare and profits while at the same time less water and land would be utilized (Figure 3-3). A decomposition of regional welfare indicates that both regional consumer and producer surplus would increase in response to such a policy change. Consequently, the hypothesis is supported that one possibility to increase efficiency of land and water use is to enhance the flexibility with which the most important farm production factors, i.e. land and water, may be shifted between different farms.

Table 3-2: Deviation of regional parameters in scenarios compared to base run, %

Parameter	Introduction of water charges	Abolishment of state procurement system	Accomplishment of farm restructuring process
Regional welfare	-4,7	3,1	0,4
Regional profit	-9,1	0,5	6,6
Regional sown area	-2,2	-0,7	-5,3
Regional Water used	-6,2	-1,8	-3,5

Source: Simulation with KhoRASM model.

Figure 3-3: Farm restructuring process



Source: Simulation with KhoRASM model.

7 SUMMARY AND CONCLUSIONS

The paper aims at comparing the impact of a hypothetical set of agricultural policy reforms which are currently discussed and could be implemented in the future in the region of Khorezm. The analysis in the paper is based on a stylized model which represents "work in progress" but which is a first theoretically and statistically consistent representation of the agricultural sector if this region in such a model framework. Therefore, the results should be treated with caution. Nevertheless, it is believed that these results are solid enough to contribute to the discussion on how the selected policies may affect the regional agricultural production system.

The analysis presented in this paper suggests that the introduction of water charging as a single policy will decrease the regional welfare affecting the regional production levels simply because of contributing to higher production costs. However, it should be born in mind that the model is comparative static and the negative welfare effects may well turn positive if long-term effects would be taken into account. For instance, if the collected water charges would be invested into technological improvements of the regional irrigation and drainage system this would enhance regional water productivity. Furthermore, the reduction of excessive water use is likely to yield positive effects on the environment which again would contribute to converting the long-term effects into positive ones.

Also the negative effects of introducing water pricing such as increase in production costs and decline of production volumes can be reduced by opening domestic markets for imports.

Furthermore, the simulation results suggest that the abolishment of the state procurement system including input subsidies and the accomplishment of the farm restructuring process would increase the regional welfare and profits while at the same time using less water and land. This supports the hypothesis that liberalization and privatization in the agricultural sector of the Khorezm region generally would make the agricultural economy of Khorezm more flexible and therefore more responsive to relative changes of economic variables. In fact both policy changes would induce higher welfare as if compared to the base year of 2003. Additionally, the model analysis suggests that further shifts of land and water resources to private farms will bring positive effects. Hence, inter-farm shifts of land, such as restructuring of *shirkats* into private farms, is one possibility to increase efficiency of land and water use.

ACKNOWLEDGEMENTS

This study was funded by the German Ministry for Education and Research (BMBF; project number 0339970A).

REFERENCES

GUADAGNI, M., RAISER, M., CROLE-REES, A., KHIDIROV, D. (2005): Cotton taxation in Uzbekistan: Opportunities for reform, *ECSSD Working Paper 41*, <http://siteresources.worldbank.org/INTUZBEKISTAN/Resources/COTTON_TAX_NOTE.pdf>.

HAMDY, A. (2002): Water pricing in agricultural sector, charging mechanisms and implementation, in: Agadir Conference "Irrigation water policies: Micro and macro considerations", June 15-17, Agadir.

HAZELL, P., NORTON, R. (1986): Mathematical programming for economic analysis in agriculture, New York.

HIRSCH, D. (2007): Problems and perspectives of water user associations in Uzbekistan, in: WEHRHEIM, P., SCHOELLER-SCHLETTER, A., MARTIUS, C. (eds.): Continuity and change: Land and water use reforms in rural Uzbekistan, *Studies on the Agricultural and Food Sector in Central and Eastern Europe, Vol. 43,* Halle (Saale).

KHAN, A. R. (2005): Land system, agriculture and poverty in Uzbekistan, <http://www.cer.uz>.

MÜLLER, M. (2007): Cotton, agriculture, and the Uzbek government, in: WEHRHEIM, P., SCHOELLER-SCHLETTER, A., MARTIUS, C. (eds.): Continuity and change: Land and water use reforms in rural Uzbekistan, *Studies on the Agricultural and Food Sector in Central and Eastern Europe, Vol. 43,* Halle (Saale).

REGIONAL DEPARTMENT OF THE MINISTRY OF MACRO-ECONOMICS AND STATISTICS OF THE REPUBLIC OF UZBEKISTAN IN THE KHOREZM REGION [OBLSTAT] (2004): Data on agricultural indicators for the Khorezm region for 1998-2003, Urgench.

ROSENBERG, C., RUOCCO, A., WIEGARD, W. (1999): Explicit and implicit taxation in Uzbekistan, *Regensburger Diskussionsbeitrage 325*, <http://www-cgi.uni-regensburg.de/Fakultaeten/WiWi/Wiegard/start/publications/wiegard_a064_(1999)_taxation-uzbekistan.pdf>.

SPOOR, M. (1999): Agrarian transition in former Soviet Central Asia: A comparative study of Kazakhstan, Kyrgyzstan and Uzbekistan, *Institute of Social Studies Working Paper 298*, The Hague, <http://adlib.iss.nl/adlib/uploads/wp/wp298.pdf>.

TAKAYAMA, T., JUDGE, G. (1971): Spatial and temporal price allocation models, Amsterdam.

TSUR, Y., ROE, T., DOUKKALI, R., DINAR, A. (2004): Pricing irrigation water: Principles and cases from developing countries, Washington, D. C.

WEHRHEIM, P., WOBST, P. (2004): The economic role of Russia's subsistence agriculture in the transition process, *Agricultural Economics, 33 (1)*, pp. 91-105.

Continuity and change: Land and water use reforms in rural Uzbekistan
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 4, pp. 63-85.

CHAPTER 4

OPTIMAL CROP ALLOCATION AND CONSEQUENT ECOLOGICAL BENEFITS IN LARGE-SCALE (*SHIRKAT*) FARMS IN UZBEKISTAN'S TRANSITION PROCESS

IHTIYOR BOBOJONOV[*], *INNA RUDENKO*[**], *JOHN P. A. LAMERS*[***]

ABSTRACT

After independence, Uzbekistan introduced far-reaching structural reforms including the transformation of the least profitable *shirkats* (cooperative farms based on the former *kolkhoz*[1] and *sovkhoz*[2]) into private farms. Since this low profitability was caused by a combination factors, the following work investigates the influence of state policies on the profitability of *shirkats* using a static linear programming (LP) model developed for improved crop allocation in large scale *shirkats*. Several scenarios were analysed to understand producers' choice under different policy options. The results showed that government interference in the form of state orders and fixed (low) procurement prices hindered a more profitable production, and obstructed proper decision-making and improved efficient resource use. The low gross margins of alternative crops combined with the dominance of the state crops cotton and wheat as chief pillars of the national agricultural production plans, explained the reluctance of producers to change presently cropping patterns. It is argued that there is potential for increased efficiency in resource use if reforms come as a full package and not in isolation. The developed LP model can serve as a template also for the new private farms since these differ only in size and ownership from the former *shirkat* structure, but still face an imposed state procurement for cotton and winter wheat.

Keywords: Uzbekistan, agriculture, linear programming, state order, cotton, market prices.

---

[*] Junior Researcher, Center for Development Research, University of Bonn, Germany. Email: ihtiyor@zef.uzpak.uz.

[**] Junior Researcher, Center for Development Research, University of Bonn, Germany. Email: irudenko@mail.ru.

[***] ZEF/UNESCO Khorezm Project Coordinator. Email: jlamers@zef.uzpak.uz.

[1] *Kolkhoz*, collective farm, the main agricultural producing unit during the Soviet Union era.

[2] *Sovkhoz,* state farm, another main agricultural producing unit during the Soviet Union era.

ОПТИМАЛЬНОЕ РАЗМЕЩЕНИЕ СЕЛЬСКОХОЗЯЙСТВЕННЫХ КУЛЬТУР И ПОСЛЕДУЮЩИЕ ЭКОЛОГИЧЕСКИЕ ВЫГОДЫ В (ШИРКАТНЫХ) ХОЗЯЙСТВАХ ПРИ ПЕРЕХОДЕ ОТ СИСТЕМЫ ГОСЗАКАЗА К СИСТЕМЕ РЫНОЧНЫХ РЕФОРМ В СЕВЕРО-ЗАПАДНОЙ ЧАСТИ УЗБЕКИСТАНА

ИХТИЁР БОБОЖОНОВ[*], *ИННА РУДЕНКО*[**], *ДЖОН П. А. ЛАМЕРС*[***]

АННОТАЦИЯ

После приобретения независимости Узбекистан встал на путь широкомасштабных и далеко идущих структурных преобразований, включая трансформацию низкорентабельных ширкатных хозяйств (кооперативные хозяйства напоминающие бывшие колхозы и совхозы) в частные фермерские хозяйства. Поскольку низкая рентабельность ширкатных хозяйств была вызвана многими факторами, включая социально-экономические и природные, влияние государственного регулирования на показатели деятельности ширкатных хозяйств были проанализированы с помощью статической модели линейного программирования, которая была разработана для оптимального размещения сельскохозяйственных культур в ширкатных хозяйствах. Несколько сценариев были рассмотрены в рамках модели для более глубокого понимания поведения производителей в ответ на проводимые реформы. Результаты показали, что государственное вмешательство в форме гос заказа на хлопок и фиксированные (низкие) закупочные цены на продукцию препятствовали получению производителями более высоких доходов и не способствовали принятию ими оптимальных решений и поиску более эффективного использования имеющихся ресурсов. Предположенный моделью низкий маржинальный доход от выращивания альтернативных культур в совокупности с господством хлопка и пшеницы в нацинальном сельскохозяйственном производственном плане объяснили нежелание производителей изменить имеющуюся структуру культур. Аргументируется мнение о том, что эффективное использование ресурсов может быть достигнуто

[*] Младший научный сотрудник, Центр по Исследованию Развития (ZEF), Боннский Университет, Бонн, Германия. Эл. почта: ihtiyor@zef.uzpak.uz.

[**] Младший научный сотрудник, Центр по Исследованию Развития (ZEF), Боннский Университет, Бонн, Германия. Эл. почта: irudenko@mail.ru.

[***] Координатор проекта ЦЭФ/Юнеско в Ургенче, Эл. почта: jlamers@zef.uzpak.uz.

только в проведении совокупности целенаправленных реформ. Разработанная модель может служить в качестве образца для новых частных фермерских хозяйств, отличающихся от структуры бывших ширкатов размерами и типом собственности, однако все ёще осуществляющих обязательное снабжение государства хлопком и озимой пшеницой.

Ключевые слова: Сельское хозяйство, линейное программирование, гос заказ, хлопок, мировые цены.

1 INTRODUCTION

Since the collapse of the Soviet Union (SU) in 1991, the Republic of Uzbekistan was cut off from the former SU support system, resulting in the collapse of various farming support services mandatory for farming such as laboratories, research stations, phyto-sanitary and food safety controls. At present, Uzbekistan, like other Central Asian Republics (CARs), is an agrarian country, with an economy heavily dependent on agricultural production using irrigated arable land (BUCKNALL, 2003; SAIFULIN, 1999). The agrarian sector makes up about one third of the country's Gross Domestic Product (GDP) (ADB, 2003). More than 30 percent of the able-bodied population (CENTER FOR EFFECTIVE ECONOMIC POLICY, 2002) is engaged in the agrarian sector, while the rural population comprises 60 percent of the total 25 million inhabitants of the Republic (CENTRE FOR ECONOMIC RESEARCH, 2004). Agricultural products are the main and largest source of the country's exports and currency inflow. Exports of cotton fibre alone accounted in for about 18 percent of the GDP in 2004 (CENTER FOR EFFECTIVE ECONOMIC POLICY, 2004). The situation in the agrarian sector of the economy determines not only the standard of living of the largest share of the population, but the prosperity of the whole nation.

Khorezm[1] is an administrative district located in the lower reaches of the Amu Darya River in North-west Uzbekistan, covering 680,000 ha of land, or roughly 270,000 ha of which are used for irrigated agriculture. The region is located between 41°08′ till 41°59′ N latitude and 60°03′ till 61°24′ E longitude. The soils of the area originate from alluvial deposits, are heterogeneously stratified, and dominated by clayey, loamy and sandy-loamy textures. The region is surrounded by the Karakum and Kyzyl Kum deserts, which determine the extremely arid, and continental climate that is characterized by pronounced fluctuations in light intensity, day-length and temperature between seasons (GLAZARIN et al., 1999). The Khorezm region is home to 1.4 million people, 77.6 percent of which are rural (OBLSTAT[2], 2005). From the total area of 680,000 ha, roughly 270,000 ha can be used for irrigated agriculture. The distance to the country's capital Tashkent is about 1200 km by road. The remote location of the Khorezm region from the country's capital and most industrial centres implies an even higher importance of agriculture for the region's well-being.

The long-term annual precipitation in the Khorezm region amounts to about 100 mm per year, which falls predominantly during the fall-winter period and thus outside

---

[1] This study is part of a research program conducted by the Center for Development Research (ZEF) at the University of Bonn (Germany) in the Khorezm region of Uzbekistan on *"Economic and Ecological Restructuring of Land- and Water Use in the Region Khorezm (Uzbekistan). A Pilot Project in Development Research"*, <http://www.uni-bonn.de/khorezm>.

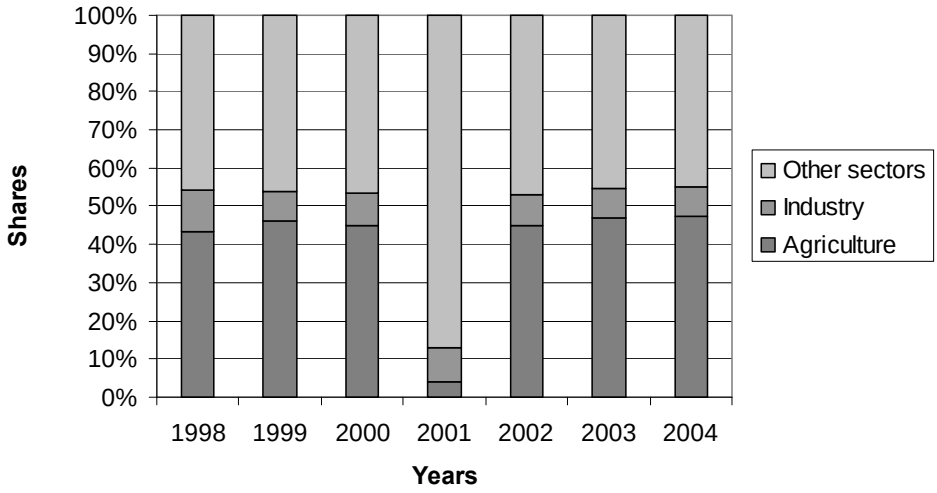
[2] *OblStat* is the local Branch of Uzbekistan's Statistical Office in Khorezm region.

the main vegetation period. This annual precipitation is by far exceeded by an evapo-transpiration of 1,400-1,600 mm/year (GLAZARIN et al., 1999), which renders cultivation feasible through irrigation only. Consequently, the Khorezm region is heavily dependent on irrigation water (extracted from the Amu Darya) and is in need of more effective water management than exists at present.

The existing irrigation network in Khorezm suffers from critical problems owing to technical shortcomings and the planning and distribution of the water delivery (MARTIUS et al., 2004). The state of the infrastructure has reached such critical levels that Khorezmian farmers face insecure water supply in the quantities needed. Previous analyses showed that at present roughly four out of ten years farmers would face a water shortage, which is much more than in the rest of Uzbekistan, and which has increased during the last decade (MÜLLER and WEHRHEIM, 2006). This represents a high long-term risk to agricultural producers.

The Khorezmian agricultural sector accounts for more than 40 percent of the regional GDP (OBLSTAT, 2005). However, in the years 2000 and 2001, this share was substantially lower owing to a severe drought and the resulting low agricultural output (Figure 4-1). Depending on the year, the share of employment in agriculture ranges between 35-45 percent (Figure 4-2).

Figure 4-1: Composition of GDP of the Khorezm region

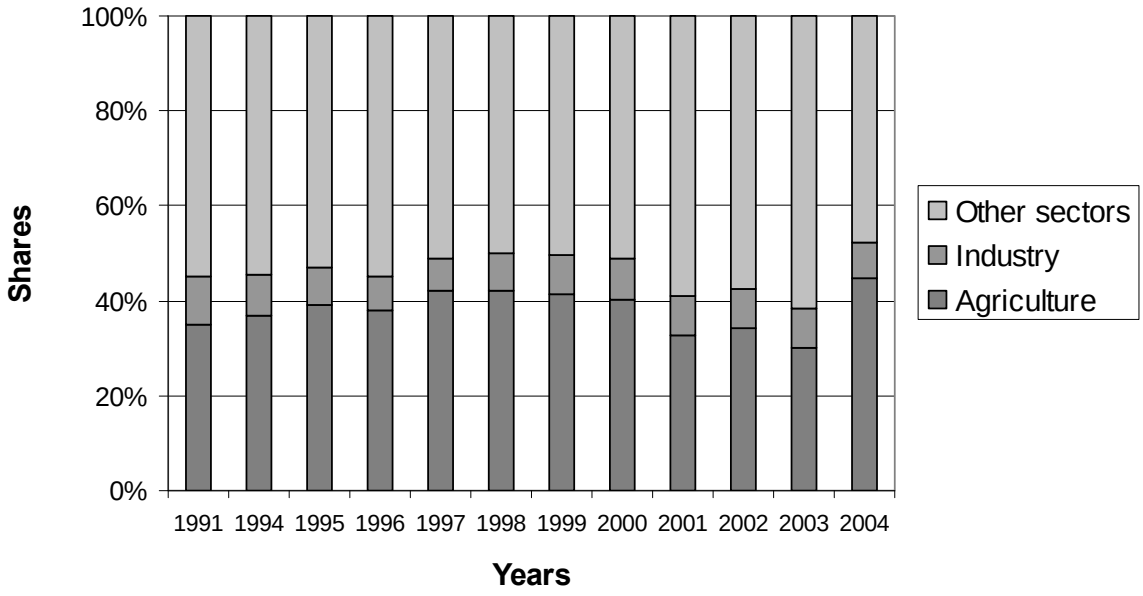


Source: OBLSTAT, 2005; own representation.

The agricultural sector has undergone various changes since the dissolution of the FSU in 1991. Agricultural producers have had to cope in particular with structural transformations. In 1993, the former state and collective farms (*sovkhoz* and *kolkhoz*) were renamed into *shirkats*, which in fact is the Uzbek name for collective and joint-stock agricultural enterprises. In 1998 the law on agricultural

cooperatives (*shirkat*), on private and on *dehqon*[3] farms, was adopted, resulting in the emergence of three types of agricultural producers (RUZMETOV et al., 2003). *Dehqon* farms are small-scale producers, subsistent in nature thus mainly producing for the rural household, whereas private farms *(fermers)* are medium-scale producers with some market potential. *Shirkats* are large-scale producers, almost identical to the former collective and state farms.

Figure 4-2: Share of the agricultural sector in total labour employment in the Khorezm region



Source: OBLSTAT, 2005; own representation.

A *shirkat* is an independent enterprise with all rights of a legal entity, however, land still is owned by the state. The *shirkat* is basically a voluntary union of workers, producing agricultural products. All members participate in all activities of the union, whereas profits are distributed according to the property share each member holds. Each *shirkat* is subject to specific legal regulations and fully responsible for its banking accounts. However, due to the para-statal character of the *shirkats*, they benefited frequently from debt relief granted by government-owned banks and/or suppliers.

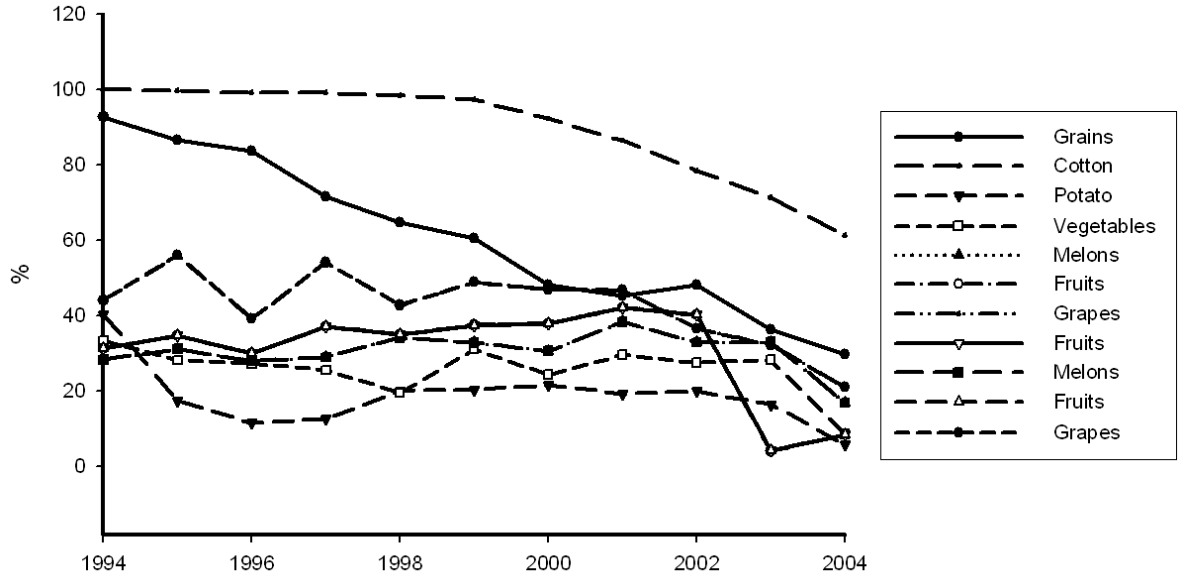
The regulations for *shirkats* set the economic and organizational framework including rights and responsibilities of its members, land use and distribution, property rights, management, future reorganization and a possible liquidation. *Shirkats* need to be registered with the regional *hokim*[4].

---

[3] *Dehqon* farms are rural households in Uzbekistan, involved in small-scale agricultural production, often dedicated exclusively to subsistence production.

[4] *Hokim* is the highest administrative body in the region or the district in Uzbekistan.

Figure 4-3: Shares of *shirkats* in total agricultural output of the Khorezm region



Source: OBLSTAT, 2005.

Until 2004, *shirkats* occupied the largest cropping areas and hence supplied the main share of the two state target crops: Cotton and winter wheat (Figure 4-3). The key role *shirkats* have played in agriculture is expected to change since the Government of Uzbekistan (GoU) has decided to dissolve all *shirkats* by the end of 2006.

The newly established *shirkats* inherited all production factors and infrastructure from the collective farms. However, despite the seemingly favourable working environment, such as the availability of an agricultural machinery park, privileges in the acquisition of inputs, priority in water use, and governmental support, agricultural production in *shirkats* did not become profitable (OBLVODKHOZ, 2003). The share of unprofitable *shirkats* in the Khorezm region was more than 90 percent in 2002 and 2003. Such a high percentage of loss-making *shirkats* may be explained by exogenous factors such as climate and land, as well as by endogenous factors, such as old machinery parks of poor quality with high maintenance and operation costs, an endemic shortage of spare parts, and inefficient organization and administration. As shown in Azerbaijan (LAMERS et al., 2000), an inefficient administration and organization are of high importance to farm entrepreneurship since in turn they lead to low performance levels. Likewise a problem with existing *shirkats* is a lack of flexibility in making managerial decisions, including an insufficient control by the *shirkat* management over internal agreements with contractors, the poor and undeveloped corporate management. Furthermore, the strong intervention of local governments into business operations of *shirkats* has led to significant losses in productivity (CENTER FOR ECONOMIC RESEARCH, 2004).

Six years after their establishment, *shirkats*, as an agricultural production structure, have become obsolete. *Shirkats* with the highest losses were transformed into private farms on the basis of a Presidential Decree issued on March 3rd, 2003. The decree provided the legal basis, transparency and momentum for land privatization but land users did not gain the right to sell, exchange, and mortgage the land. Private applicants had to submit a request for each field to the committee mandated by the government to coordinate the restructuring process. In addition, auxiliary documents such as copies of passports, schooling and education diplomas, bank accounts, and evidence of ownership of agricultural equipment needed to be submitted together with the request. The applicants were indeed tested for their knowledge on agriculture before the committee approved or disapproved an application. A final decision on each application was than taken by the regional *hokim*. The transfer thus involved considerable effort, resources and time from both the state and the agricultural producers. The novelty of this procedure for administrators and applicants and the lack of transparency in decision-making caused many misunderstandings. Although the GoU envisaged a reform to meet free market principles, this process was delayed and it was hardly possible for *shirkats* to fulfill this expectation. Also, a profound lack of knowledge on agricultural entrepreneurship prevailed among *shirkat* management.

This section presents the results of a decision-making support tool developed for optimal resource allocation and higher income generation at the farm level. At the onset of the study mainly *shirkat* farms existed and, therefore, long-term data was available for these farm structures only. Consequently, the LP tool was elaborated for this farm type only. However, since the newly created private farms in Uzbekistan operate under similar conditions as the previous *shirkat* farms, the decision-support tool developed can be employed for the private farms and used for a more accurate interpretation once sufficient data are available. The following discussion also sheds light on why *shirkats* were considered unprofitable, thus allowing lessons to be learned for increasing the management of the newly created production units.

2 THEORETICAL BACKGROUND

Economic production theory suggests that independent decision-making is a central factor for the economic success of an enterprise (COLMAN and YOUNG, 2002). Benefits from activities as indicated by gross margin and/or profits, and the availability of resources and technology, are key indicators for decision-making about the type and the extent of activities. Within irrigated agricultural, land, and in particular water, are the resources which recurrently are most limiting. Hence, allocating additional inputs to production activities depends on the expected

additional benefit (marginal revenue) from using additional units of an input (COLMAN and YOUNG, 1995).

Crop and water allocation models (WANG and ZHOU, 2004; SONMEZ and ALTIN, 2004; EVENS et al., 2003) have been widely used to identify the optimal resource allocation options resulting in optimal benefits subject to resource limitations at the farm and region level. These studies have used mathematical programming methods that allocate the constraining resources among competing activities in order to optimize profits or gross margins of agricultural production (HAZELL and NORTON, 1986). Such models have been successfully used under conditions of water allocation restrictions (EVANS et al., 2003).

Numerous models have used the principle of linear programming (LP) for optimal resource allocation. The assumed linearity of the objective function is recurrently mentioned as a shortcoming of this method and substantial evidence has supported that LP approaches were useful tools when striving to improve the basis for agricultural production decisions and thereby increasing resource efficiency in Russia or Turkmenistan, countries with similar agro-ecological and political conditions as in Uzbekistan (SVETLOV, 1999; MARTIN, 2006). Despite various shortcomings, the arguments in favor of using LP models are its comparatively low data-demand and its flexibility in the elaboration of scenario building.

This study follows the practice of water and land allocation models aimed at optimizing the gross margin of an average *shirkat* farm on the basis of the resources available to this *shirkat,* and subject to various current changes in the agricultural sector of Uzbekistan. Since the key production conditions for the new farms are similar to the recently established private farms, the LP model can be used for the private farms as soon as the relevant information becomes available.

2.1 Optimization model and the objective function

The objective function of the optimization model maximized the *shirkat*'s gross margin as the sum of all crop gross margins in one growing season.

The mathematical formulation of the objective function can be presented as:

$$\max Z = \sum_{i}^{n} A_i \, GM_i$$

where:

A_i : optimum planting area of *i*th crop

GM_j : gross margin of *i*th crop, calculated as a difference between market turnover and variable costs:

$$GM_i = Y_i \cdot P_i - VC_i - WP \cdot IR_i$$

where:

Y_i : the yield of crops in the model

P_i : product prices

VC_i : the variable costs like labour, machinery, fertilizer, seeds and others

WP : The price of one cubic meter water, it was equal to zero in the first solution, but different price levels were tested in scenarios to see the impact of different price levels

IR_i: irrigation water requirement of *i*th crop, including leaching water demand.

2.2 Activities: A decision variable

All cropping activities such as soil preparation, leaching, levelling, seeding, cultivating, fertilizing, irrigating, weeding, harvesting and transporting were accounted for during gross margin (GM) estimations. The LP model optimized area allocation to each crop in the *shirkat* and the accumulated GM resulting from this optimal crop allocation. Crops included in the model were cotton, winter wheat, vegetables, sugar beet, melons and fruits which were produced by the former *shirkat* structures and presently also by the private farmers (BOBOJONOV and LAMERS, 2006). The state order regulations for cotton and wheat were taken into account, which allowed the marketing of wheat which is also similar to the present private farms (RUDENKO and LAMERS, 2006). Therefore, the production of winter wheat was divided into two activities: Winter wheat production for the state order and winter wheat production for the market.

2.3 Constraints

Total available land and water, upper bound for fruit trees, minimum area for cotton and wheat to fulfil the state orders were constraints in the model. Diesel for agricultural equipment such as tractors, combiners and fertilizers were considered fixed resources, as the GoU provided these resources to fulfil the state orders to *shirkats* and will continue this practice for private farmers (RUDENKO and LAMERS, 2006).

2.4 Data collection and technical coefficients in the models

Data was collected step-wise (Table 4-1). During a survey conducted between 2001 and 2003, input use and costs per ha of all crops was collected from four *shirkats*. Output prices were derived from the accounting files of the *shirkat* for 2001, since the price data was available for that year only. Although the combination of data from different years is a "second best solution", given the situation in the Uzbekistan's agricultural sector, no alternative dataset was available or could be obtained. Future datasets will by-pass this restriction. The amount of water applied per ha for each crop had not been recorded as default and hence the irrigation water

norms, as stated by *OblSelVodKhoz*[5], were used as a proxy for water use per ha of each crop. This assumption is justified given that the irrigation water norms are still used for the planning of water supply in the Khorezm region as more precise measuring points are still absent. Crop yields were estimated as the average yield obtained in the *shirkat* over a six year period (1998-2003).

For the strategic crops, including cotton and winter wheat as well as the contract crop sugar beet, state procurement prices were used during simulation runs. For all other crops, market prices were derived from various sources. Market prices for sunflower, melons and vegetables were provided by the *OblStat* market price database. In the absence of necessary details, fruit market prices were estimated as the average price for apples during the harvest period of 2001. This decision seemed justified since existing tree plantations in Khorezm are dominated by fruit trees, where apples take the lions' share of 57 % compared to mulberry (15 %) and apricot (12 %) (TUPITSA, 2005).

In contrast, the market price for vegetables detailed even individual varieties, thus allowing the estimation of an average market price for carrots, cabbage and tomatoes in 2001. Prices for rice and winter wheat sold at the market were provided by the surveyed *shirkat*. A cross-check with market prices confirmed their reliability. All market prices were deducted with 20 percent to account for the transportation and other market access costs to obtain the farm gate prices. Other direct costs such as machinery and fertilizer costs were derived from statistical data sources.

In 2001, the modelled *shirkat* spanned 602 ha of cropping area and used 7,186.8 thousand m^3 of water, excluding conveyance losses. Other key data used in the model are shown in Table 4-1.

Table 4-1: Main data used in the different model simulations

Item	Cotton	WWG	WWM	Rice	Vegetables	SBTG	Sun-lower	Melon	Fruit
Yield (t/ha)	2.4	4.9	4.9	3.0	15.5	22.4	1.0	11.4	3.3
Actual prices (*soum*/kg)	79.1	41.8	120.8	169.2	12.00	11.61	255.86	23.83	35.40
Market prices (*soum*/kg)	–	–	–	–	44.8	–	348.8	42.4	131.2
Seeds (t/ha)	56	500	500	130	4	4	24	4	0
Fertilizer (t/ha)	0.31	0.61	0.61	0.02	0.29	0.29	0.25	0.29	0.00
Fuel use (t/ha)	0.28	1.06	1.06	0.50	1.60	0.30	0.50	0.76	0.27
Estimated water use (m^3/ha)	10166	8205	8205	30755	13128	10122	8055	8542	9743

Note: WWG – Winter wheat production for the state order, WWM – Winter wheat production for the market, SBTG– Sugar beet.

[5] *OblSelVodKhoz* is the Khorezm regional Agriculture and Water Resources Management Office.

2.5 Scenarios and assumptions

Aside from the baseline scenario, nine different scenarios were simulated with the LP model, each aimed at different combinations of cropping patterns subject to various ecological and socio-economic changes (Table 4-2). In the base line scenario, data for 2001 was used as a complete data set, including crop output, input prices and use were available for this particular year and from the surveyed *shirkat*.

The minimum cropping area for cotton and wheat were bound in several scenarios to account for the state orders. An upper bound for fruit production was included due to the lack of information on initial investment costs for establishing orchards.

According to the information provided by the *shirkat* management and statistical records, the total GM of the *shirkat* in 2001 was 38022.8 thousand *soum*. This information as well as the GM of individual crops, variable costs and data on state order plans, was included in the base line scenario. The difference between the "actual" situation and the base line scenario 1 is the decision-making principle: The LP model estimated the optimal crop allocation compared to the *shirkat* manager. The purpose of the second scenario was to test the hypothesis if increased output prices for vegetables, melons, sunflowers and fruits would provoke any change in crop allocation. Therefore, in the second scenario, market prices instead of the prices received by the *shirkat* in 2001 were used. All other parameters remained unchanged (Table 4-2).

As in scenario 2, under scenario 3, the same quantity of production factors, including the water amount and access to the market prices for alternative crops were used. However, in this scenario, a reduced state order was introduced. Given that in various pilot regions throughout Uzbekistan a reduced state order by 75 percent was tested, only 75 hectares were kept for the state order allocation to cotton.

Table 4-2: Scenario description for the baseline and eight simulation runs

Scenario	Detailed description
1	Base scenario, with data of 2001
2	Market prices for vegetables, sunflower, melons and fruits; state orders
3	Market prices for vegetables, sunflower, melons and fruits, state order for cotton is decreased by 75 %
4	Water price 10 *soum*6; state prices for all crops; state orders
5	Water price 10 *soum*; market prices for vegetable, sunflower, melons and fruits; state orders
6	Water price 10 *soum*; market prices for vegetables, sunflower, melons and fruits; state order for cotton is decreased by 75 %
7	Decrease of water availability by 20 %; state prices; state orders
8	Decrease of water availability by 20 %; market prices for vegetables, sunflower, melons and fruits; state orders
9	Water price 10 *soum*; market prices for vegetables, sunflower, melons and fruits; state order for cotton is decreased by 75 %; no input (diesel, fertilizer) constraints

[6] Model results of the all simulated scenarios are summarized in Table 3.

Scenario 4 examined changes in crop allocation when water would be priced, and while assuming that the state order and the system of state procurement prices remained unchanged. Ten *soums*/m^3 of water was introduced as a water pricing charge since previous studies suggested that such a price level is most realistic for cost recovery, and may offer the highest potential for a change in the cropping pattern (BOBOJONOV and LAMERS, 2006).

Scenario 5 analysed the potential impact of introducing water pricing in case producers would receive the market price for alternative crops instead of the commodity prices the *shirkat* received in 2001. In scenario 6, market output prices and water charges remained unchanged, but the state order for cotton was decreased by 75 %, up to 75 hectares. In scenario 7 all conditions were like those in the base scenario except for total water availability, which was decreased by 20 percent. Scenario 8 simulated the crop allocation under an assumed water limit of 20 percent of the actual amount used in 2001 and with market prices for the alternative crops. Scenario 9 tested for potential changes in crop allocation assuming that producers have access to inputs in unrestricted amounts (except water and land), can sell their products at the market, but pay for the water they use.

3 RESULTS AND DISCUSSIONS

3.1 The baseline scenario: Model results vs. the reality of 2001

The model computed 300 ha sown to cotton cultivation, which was the area the *shirkat* in 2001 had to allot to this crop and which was included as a constraint in the model.[7] The results of the area allocation of this scenario were very much in line with the reality of 2001, where approximately 70 percent of the regional cropping area was allocated to cotton, wheat and rice. Area allocation remained virtually unchanged, since most resources were spent on these crops and hence the area allocated to alternative crops was limited.

When simulating a baseline scenario with the information provided by the *shirkat* for 2001, the GM increased to 64021.2 thousand *soum*. This is a strong indication of the low resource use efficiency by the *shirkat* management and confirmed the conclusions of low profitability of *shirkats* (OBLSELVODKHOZ, 2003). The outcomes from the base scenario however allocated cotton, wheat and rice to 490 of the total 602 ha of land (Table 4-3). The remaining 122 ha dropped out of the production process because of the constraints in fuel and water.

[7] Model results of the all simulated scenarios are summarized in Table 3 including the area of fodder crops and sugar beet.

Whereas in 2001, in reality 23 ha were allocated to rice, the model findings indicated that with the resources available at that time, even 114.3 ha of rice could have been cultivated. This indicated that the relative profitability of wheat and rice was higher than for the other crops in the model. In contrast to the reality of 2001, the model findings showed that a much higher GM could have been obtained, with even less area cultivated, and thus keeping fields fallow. Yet, when simulating a baseline scenario with the information provided by the *shirkat* according to 2001, the GM increased to 64021.2 thousand *soum*. This is a strong indication of the low resource use efficiency by the *shirkat* management and confirmed the conclusions of low profitability of *shirkats* (OBLSELVODKHOZ, 2003). The outcomes from the base scenario however allocated cotton, wheat and rice to 490 of the total 602 ha (Table 4-3). The remaining 122 ha dropped out of the production process because of the constraints in fuel and water.

Surprisingly, the solution in this baseline scenario did not include an increase of the land area allotted to vegetables, melons or sunflower. At first, these results did not appear to match the expectations and even contradicted suggestions that crop diversification will automatically lead to improved land use and higher profits (PROHENS et al., 2003). However, the analysis showed that despite the high yields and comparatively low resource use, the GM from vegetables, sunflower and melons (as evidenced by the accounting documents) were very low. One reason for this low GM in the baseline scenario could have been the low wholesale prices received by the *shirkat* in 2001. On the other hand, prices received by *shirkats* were significantly lower than the market prices monitored by the central authority *OblStat* and another study in the region (BOBOJONOV, 2004). As long as state orders dictate farmers' decision-making and price setting, it concurrently leads to forgone income of farmers under such production plans and market control. The model results of the base scenario along with results from other studies (e.g. BUCKNALL et al., 2003) indicate that the low GM of alternative crops as well as the dominance of state ordered cotton, wheat, and rice as the prime pillars of the national agricultural production plans, are key explanations for the presently encountered reluctance and resistance of agricultural producers to change their cropping pattern.

Table 4-3: Crop and area (ha) allocation resulting from model simulations under the assumptions of the different scenarios: WWG = Winter wheat production for the state order, WWM = Winter wheat production for the market, SBTG = Sugar beet, Veg = Vegetables

Scenarios	Cotton	WWG	WWM	Rice	Vegetable	Sun-flower	Melon	Fruit	GM (million *soum*)	Total crop area (ha)	Water (1000 m^3)
Actual 2001	300	38	0	23	1	10.5	7.5	4	38[8]	602[9]	7187
Base	300	38	37.9	114.3	0	0.0	0	0	64	490.1	7187
2	300	38	0.0	98.2	0	95.1	0	4	71.5	535.3	7187
3	75	38	0.0	154.6	0	163.9	0	4	112.7	435.4	7187
4	300	38	53.2	81.4	0	0	0	0	-7.1	472.6	6303
5	300	38	0.0	15.9	0	0.0	115.7	4	3.6	473.6	4877
6	75	38	0.0	0.0	0	318.4	0	4	54.6	435.4	3678
7	300	38	53.7	63.3	0	0.0	0	0	48.5	455.0	5749
8	300	38	0.0	43.1	0	74.7	49.2	4	60.7	509.1	5749
9	75	38	62.4	0.0	426.6	0	0	0	143.5	602	7187

3.2 New prices but old constraints

Scenario 2 tested if increased output prices for the alternative crops such as vegetables, melons, sunflower and fruits would change the accumulated *shirkat* GM and resource allocation. Although higher prices for these commodities indeed resulted in an increased GM due to an increased area alloted to these crops, changes were not substantial (Table 4-3, scenario 2 *vs.* scenario 1). As shown by the simulation results of scenario 1, the imposed share of the state target crop cotton in the cropping area obstructed alternative crops, thereby preventing a GM increase with the same amount of resources.

[8] Sugar beet and fodder crops are not shown in this table, as they did not appear in any scenario results because of low GM.

[9] Sugar beet and fodder crops are not shown in this table, as they did not appear in any scenario results because of low GM.

3.3 New prices and new constraints

How therefore would crops have been allocated if the state order for cotton was reduced? The outcome of scenario 3 indicated that under these assumptions a crop diversification would occur with a substantial increase of the total GM. Part of the land, which was released from cotton, was allotted to sunflower and rice production resulting in an increase of the total GM with 66 percent whilst concurrently 27 percent less arable land was allocated. Hence this scenario would have allowed the *shirkat* not only to generate capital for investments in their enterprises, but it also offered a more sustainable basis for crop production in a region known for an advancing soil degradation (MARTIUS et al., 2004).

Obviously one could argue that the increase in sunflower allotment seems in reality hardly feasible. Although the focus of this study was on the crop production processes and excluded the processing and marketing aspects of crops, an increased production of sunflower seeds may indeed face obvious bottlenecks such as the availability of harvesters or sufficient storage and transportation facilities, which have been identified as chief bottlenecks for increased vegetable production (BURIEV, 2005). Additional constraints, such as the marketing of these crops, may emerge since the local markets would be rapidly saturated as monitored under similar conditions (HAU and VON OPPEN, 2002). Despite these reflections, the results underlined the existing potential of increasing income generation of farmers even under a controlled change of the state order since a reduced state order allowed for crop diversification and would render more land available for crop rotation.

The increased area allocated to rice in scenario 3 is explained by the availability of sufficient water and while implying the absence of water charges. However, water charges are to be introduced soon in Uzbekistan (MAHMUDOV, 2004; SAIFULIN, 1999). Furthermore, rice is cropped mainly on very specific, clay-type soils that are not widespread among the soil types in the Khorezm region. This may restrict the predicted mushroom type of development in rice cultivation once the state order would be eased (VELDWISCH, 2007).

3.4 Water pricing as a policy option for the future

When analysing the potential changes in crop allocation with water pricing, the results of scenario 4 did meet only partially the hypotheses (Table 4-3: Scenario 4 *vs.* scenario 1 or the actual situation and the results of the baseline scenario 1). An expected result was a significantly reduced GM owing to the remaining low revenues combined with the additional costs of water use. Previous research doubted whether water tariffs and pricing *per se* could be an effective managerial tool to bring about a change in water use as long as prices introduced were insufficient to recover maintenance and operational costs (BOSWORTH et al., 2002). Also SAIFULIN et al. (1999) argued that agricultural producers in Uzbekistan would

not be able to pay for water charges in light of the low prices received for their products. Finally, RUDENKO and LAMERS (2006) showed that the introduction of an isolated measure such as the much discussed and advocated water pricing will not likely provide sufficient incentives to the farming population to grow less water-intensive crops, as alternatives to cotton and wheat, as long as the state orders and low output prices for these alternative crops prevail.

3.5 More incentives when change is introduced as a package

Would the crop allocation pattern change with the combined introduction of water pricing and free market prices? The outcomes (Table 4-3) showed indeed a clear change in the cropping pattern as evidenced by the landslide shift from the cultivated rice area in favour of melon. Furthermore, cultivating melons was not only more beneficial than rice cropping but it also required 32 percent less irrigation water compared to previous scenarios (Table 4-3: 4.9 million m^3 *vs*. 7.2 million m^3). Therefore, these findings support the hypothesis that if producers will be offered the higher market prices, the necessary incentive for water savings may occur even in combination with water charges. On the other hand, under the combined assumption of water charges and market prices, the overall GM turned out to be quite low, again due to the presence of the compulsory cotton state order in the cropping pattern. Also of interest is the negative GM for cotton when using a water price of 10 *soums* m^{-3} under the assumption that producers will not alter their cropping practices.

3.6 The burden of the state order for the production process

Which crops are most attractive given free market conditions? The decreased state order did induce an increased allotment for the alternative crops, as well as a considerable increase in GM; there was also a decrease in the overall water use (Table 4-3). In scenario 6, all available resources and half of the cropping area were redirected from cotton to sunflower. Fruits continued to be an attractive alternative, as in most of the scenarios tested. These results underlined once more that an efficient water policy will yield effect in case producers, and gain concurrently the right to sell their products at market prices as was previously suggested (SAIFULIN, 1999).

3.7 Less water but also less income

Crop allocation also depended on water availability but what changes in crop allocation can be expected under water limitations? The resulting cropping pattern from scenario 7 resembled the model results in the base scenario 1. Obviously, much less rice was chosen under this scenario since rice is the most water-intensive crop. In addition to a reduction in rice cultivation, the total GM was reduced under this scenario. Under the current state price regulations, rice is still a highly

profitable crop in Khorezm and, therefore, even under the assumptions of water limitations, agricultural producers will not be inclined to cultivate alternative crops as long as alternative crops result in lower GM.

3.8 A win-win situation under state order

The relatively modest increase in output prices compared to the ones used in scenario 1 resulted in a drastic reallocation of the total cropping area to sunflower, melons and fruits (Table 4-3, scenario 1 *vs* scenario 8). Even when assuming water scarcity, the highest GM among all scenario simulations were obtained while concurrently less area needed to be cropped. This suggested, therefore, potential for a win-win situation for both farmer/producers and the deteriorated environment. However, the state order for cotton remained the prime obstacle for a further shift to alternative crops, thus under-exploiting options for reducing the adverse land degradation i.e., introducing crop diversification and rendering more land available for crop rotation (MARTIUS et al., 2004).

The results of the various scenarios underline the potential of introducing crops other than the presently dominating cotton and winter wheat, but under two conditions: First, producers should enjoy market prices and secondly the state order should be eased. Although the latter is a much advocated option (WORLD BANK, 2003), in case of a decreased state order in cotton and wheat, the GoU may be deprived also of the opportunity to provide agricultural producers with inputs on preferential terms, including free irrigation water as previously cautioned (RUDENKO and LAMERS, 2006). Charging for irrigation water may be presently a widely debated remedy for Uzbekistan to initiate an increase in water use efficiency (MAHMUDOV, 2004), but without first a decrease in the state order, there is reduced incentive for farmers to move towards water saving crops and changing behaviour.

3.9 Almost free market environment

The results of this scenario 9, which tested how resource allocation would be altered if different measures were to be introduced in a mix, showed a sharp increase in GM despite the additional water costs. The productivity of water use in this scenario turned out to be the highest of all scenarios tested, underlining that more income is generated for each cubic meter of withdrawn water. The outcomes indicated in addition an increas in land allocated to vegetables. Yet, as argued for scenarios 3 and 6, a large increase in sunflower production may not be realistic at present owing to the absence of adequate agricultural machinery, output markets and availability of seasonal labour (BURIEV, 2005). Furthermore, there may be structural constraints such as the deficiencies in processing facilities, or bottlenecks in service providing institutions such as credit or extension, which showed to be of key importance in farm development in Azerbaijan (LAMERS et al., 2000).

One may underscore that the findings are valid for an abandoned farm type. However, even though *shirkat* farm types have been privatized since 2006 and instead private farms have been created, these new production units differ from the previously dominating *shirkat* production system mainly in size and ownership of land and agricultural machinery. Yet, at present the newly created private farms in Uzbekistan operate based on input use norms which were developed in the FSU period, state orders and state procurement of strategic crops as was the case before the privatization, and fixed purchase prices determined by monopolistic state structures; and a centrally managed supply of agricultural inputs provided for use on the strategic cotton and wheat crops only (MÜLLER, 2006). Therefore, as long as the newly emerged private farms face similar production conditions as the former *shirkats*, the results obtained from this analysis are applicable to the private farm structures as well. However, in the absence of key empirical data, the use of the available information from *shirkat* farms justified the procedures applied for the analyses. Hence the same LP tool for optimal resource allocation and higher income generation can be used for these newly created agricultural units – farms or even rural households – with the same aim of optimal resource allocation and profit maximisation. Irrespective of the present trend of agricultural reforms in Uzbekistan, the model results underscored the need for decisive agricultural reform in Uzbekistan, including decision making powers at the farm level in order to maximise profitability and sustainability of individual farms and hence the entire agricultural sector.

4 CONCLUSIONS

The model results revealed poor management, state procurement levels and low orders and low prices resulted in a less profitable production pattern in 2001 in the Khorezm region, with too little flexibility in the decision-making of *shirkat* managers. The results also provide evidence that similar limitations and restrictions will for the newly created farm types since they too will be bound by similar production conditions and restraints. There are several differences between *shirkats* and private farms, including ownership and size of the farm; private types of ownership may induce more incentives for better land management options and small scale fields will be easier to control and cultivate. However, the influence of the former and present state regulations and state production policies will impact on the private farms as they have on *shirkat* farms, ultimately resulting in little difference in the amount of income between farm types.

Crop diversification in Uzbekistan is one option to prevent falling incomes, under scarce resources. However, such a generalization needs careful consideration. For example, many factors have to be considered, including cropping pattern under controlled state prices, and potentially low prices for alternative crops due

to state-imposed prices. The findings showed that crop diversification indeed offers the scope for more efficient land and resource use, but prevents an income increase unless the output prices for these alternative crops increase and producers have an increased flexibility in the decision-making process. When introducing alternative crops into existing cropping patterns, environmental as well as economic factors need to be considered. High yields and relatively moderate resource requirements should be combined with greater liberalization of market conditions.

The step-by-step introduction of a market economy in Uzbekistan over the past 15 years has to a large extent prevented an abrupt and complete breakdown of the social security system as experienced in other FSU countries (SPOOR, 1999). However, the present pace of progress in farm and agricultural reforms is slowing down the economic restructuring and results in further degradation of the natural resources in general and of soil and water in particular. Khorezmian farmers are currently missing out on the benefits of reform because they fail to come to grips with the discrepancy between the aim of the state and exploring their own potential with the resources given to them by the same state. But, the present agricultural production facilities hardly allow more changes than exist at present. If agricultural producers continue cultivating the strategic crop, namely cotton and rice, they risk further deteriorating the environment and natural resources. There is room for increasing the efficiency of resource use in the region, but only if socio-economic reforms come as a full package and not in isolation.

A change particularly towards increased resource use efficiency is feasible when national standards could be redefined further. Initial steps have been taken, but there still is a long road ahead. Improving cultivation conditions for the farming population, including less state order influence in cropping decisions and price regulations, would represent an unprecedented upheaval of the deteriorating environment in the Khorezm region, where food, environment and demographics are at stake.

ACKNOWLEDGEMENTS

This study was funded by the German Ministry for Education and Research (BMBF; project number 0339970A). The authors acknowledge the critical review by Jennifer Franz.

REFERENCES

ASIAN DEVELOPMENT BANK [ADB] (2003): Uzbekistan. Key indicators, <http://www.adb.org/Documents/Books/Key_Indicators/2004/pdf/UZB.pdf>.

BOBOJONOV, I. (2004): Market analysis of agricultural products in irrigated areas. Exemplified by the Khorezm region for limited number of commodities, Tashkent Institute of Irrigation and Melioration [Master thesis].

BOBOJONOV, I., LAMERS, J. P. A. (2006): Optimization of crop allocations based on comparative economic advantages for various scenarios in the Khorezm province of Uzbekistan, in: MINISTRY OF WATER RESOURCES AND AGRICULTURE OF UZBEKISTAN (ed.): Proceedings of transition toward market economy conditions in the water resource management and land melioration sector in Uzbekistan (Section 1 and 2), University of TIIM, Tashkent, November 16-18, 2005, pp. 70-76.

BOSWORTH, B., CORNISH, G., PERRY, C., VAN STEENBERGEN, F. (2002): Water charging in irrigated agriculture. Lessons from the literature, *Report OD 145*, Wallingford.

BUCKNALL, L., KLYTCHNIKOVA, I., LAMPIETTI, J., LUNDELL, M., SCATASTA, M., THURMAN, M. (2003): Irrigation in Central Asia. Social, economic and enviromental considerations, Washington, D. C.

BURIEV, H. C., ZUEV, V. I., MEDZHITOV, S. M. (2005): Status, problems and development perspectives of potato, vegetable and melon production in Uzbekistan, in: KALB, T. J., MAVLYANOVA, R. F. (eds.): Vegetable production in Central Asia: Status and perspectives. Proceedings of the workshop, 13-14 June, 2003, Almaty, Kazakhstan. AVRDC – The World Vegetable Center, Shanhua, Taiwan, pp. 117-128.

CENTRE FOR ECONOMIC RESEARCH [CER] (2004): Reorganization of cooperative agricultural enterprises (*shirkats*) into farming business entities, Report prepared with the assistance of the Uzbekistan Economic Reform Project, Uzbekistan, <http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN021608.pdf>.

CENTRE FOR ECONOMIC RESEARCH [CER] (2004): Main stages of economic reforms in Uzbekistan, Tashkent, <http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN021608.pdf>.

CENTRE FOR EFFECTIVE ECONOMIC, POLICY MINISTRY OF ECONOMCY OF UZBEKISTAN [CEEP] (2002): Uzbekistan economy statistical and analytical review for the year 2002, <http://www.uzbearingpoint.com/php/index.php?mnuitem=3&rightitem=1>.

CENTRE FOR EFFECTIVE ECONOMIC POLICY, MINISTRY OF ECONOMCY OF UZBEKISTAN [CEEP] (2005): Uzbekistan economy statistical and analytical review for the year 2004, <http://www.uzbearingpoint.com/php/index.php?mnuitem=3&rightitem=12>.

COLMAN, D., YOUNG, T. (2002): Principles of agricultural economics. Markets and prices in less developed countries, Cambridge.

COLMAN, D., YOUNG, T. (1995): Principles of agricultural economics. Markets and prices in less developed countries, Cambridge.

EVANS, M., LEE, D., BOISVERT, R., ARCE, B., STEENHUIS, T., PRAN, O. M, POATS, S. (2003): Achieving efficiency and equity in irrigation management: An optimization model of the El Angel watershed, Carchi, Ecuador, *Agricultural systems, 77*, pp. 1-22.

GLAZIRIN, G. E., CHANISHEV, S. G., CHUB, V. E. (1999): Kratkie polojeniya klimata Uzbekistana, Tashkent.

HAZELL, P. B. R., NORTON, R. D. (1986): Mathematical programming for economic analysis in agriculture, New York.

HAU, A. M., VON OPPEN, M. (2002): Market access and agricultural productivity in Doi Inthanon Villages, in: International Symposium on Sustaining Food Security and Managing Natural Resources in Southeast Asia. Challenges for the 21st Century.

KHOREZM DEPARTMENT OF LAND AND WATER RESOURCES OF THE MINISTRY OF AGRICULTURE AND WATER RESOURCES [OBLSELVODKHOS] (2003): Annual reports of the Khorezm district Agriculture and Water Resources Management Office, Urgench.

LAMERS, J. P. A., DÜRR, G., FEIL, P. R. (2000): Developing a client-oriented, agricultural advisory system in Azerbaijan. Human resources in agricultural and rural development, FAO, Rome, pp. 104-117.

MAHMUDOV, E. J. (2004): Problems of increasing agricultural water use efficiency in transition to market economy, in: Proceedings of problems and methods of reforming of interaction of water and agricultural sector under conditions of improving market reforms, Tashkent, 20-21 December.

MARTIN, R. (2006): Economic principles and criteria of management of private farm and water users' associations, in: MINISTRY OF WATER RESOURCES AND AGRICULTURE OF UZBEKISTAN (ed.): Proceedings of Transition Toward Market Economy Conditions in Water Resource Management and Land Melioration Sector in Uzbekistan (Section 1 and 2), University of TIIM, Tashkent, November 16-18, 2005, pp. 67-69.

MARTIUS, CH., LAMERS, J. P. A., WEHRHEIM, P., SCHOELLER-SCHLETTER, A., ESHCHANOV, R., TUPITSA, A., KHAMZINA, A., AKRAMKHANOV, A., VLEK, P. (2004): Developing sustainable land and water management for the Aral Sea basin through an interdisciplinary approach, in: SENG, V., CRASWELL, E., FUKAI, S., FISCHER, K. (eds.): *Water in Agriculture, ACIAR Proceedings No. 116*, Canberra, pp. 45-60.

MÜLLER, M. (2006): A general equilibrium approach to modeling water and land use reforms in Uzbekistan, University of Bonn [Dissertation].

PROHENS, J., RUIZ, J. J., NUEZ, F. (2003): Vegetable crop diversification in areas affected by salinity: The case of pepino (solanum muricatum), *ISHS Acta Horticulturae, 618*, pp. 267-273, <http://www.actahort.org/books/618/618_30.htm>.

SPOOR, M. (1999): Agrarian transition in former Soviet Central Asia: A comparative study of Kazakhstan, Kyrgyzstan and Uzbekistan, *Institute of Social Studies Working Paper 298*, The Hague, <http://adlib.iss.nl/adlib/uploads/wp/wp298.pdf>.

REGIONAL DEPARTMENT OF THE MINISTRY OF MACRO-ECONOMICS AND STATISTICS OF THE REPUBLIC OF UZBEKISTAN IN KHOREZM *OBLAST* [OBLSTAT] (2005): 14 Years statistical collection of Khorezm, Urgench.

RUDENKO, I., LAMERS, J. P. A. (2006): The comparative advantages of the present and future payment structure for agricultural producers in Uzbekistan, *Central Asian Journal of Management, Economics and Social Research, 5 (1-2)*, pp. 106-125.

RUZMETOV, B., RAHIMOV, Z., RUDENKO, I. (2003): Analysis of farmer enterprises and agricultural markets, *ZEF Work paper for Sustainable Development in Central Asia No. 2*, pp. 36-39, 53.

SAIFULIN, R., RUSS, S., FAZYLOVA, M., FAKHRUTDINOVA, N., PETRENKO, Y. (1999): Problems of rational water use and methods of their solution in Uzbekistan, Central Asia Mission USAID.

SONMEZ, K., ALTIN, M. (2004): Irrigation scheduling and optimum cropping pattern with adequate and deficit water supply for mid-sized farms of Harran Plain, *Pakistan Journal of Biological Sciences, 7 (8)*, pp. 1414-1418.

SVETLOV, M. (1999): Econometric application of linear programming: A model of Russian large-scale farm (the case of the Moscow Region), <http://econwpa.wustl.edu>.

TUPITSA, A. (2005): Application of remote sensing to forest inventory in the Khorezm region, Uzbekistan, Conference Book of the 6th Open Meeting of the Human Dimensions of Global Environmental Change Research Community by IHDP and UNESCO, Bonn, p. 318.

VELDWISCH, G. J. (2007): Changing patterns of water distribution under the influence of land reforms and simultaneous WUA establishment. Two cases from Khorezm, Uzbekistan, *Irrigation Drainage Systems*, DOI 10.1007/s10795-007-9017-3.

WANG, Z., ZHOU, Z. (2004): Optimization of water allocation in canal systems of Chengai irrigation area, *Nature and Science, 2 (1)*, <http://www.sciencepub.net/0201/17wang.pdf>.

WEHRHEIM, P., MÜLLER, M. (2006): Agricultural water use efficiency in an environmental disaster region: The case of the region Khorezm in Uzbekistan, Contribution for the annual conference of the Central Eurasian Studies Society (CESS), Harvard University, Boston, October.

WORLD BANK (2003): Republic of Uzbekistan. Country economic memorandum, *Report No. 25625-UZ*, pp. 1-68.

SECTION 3

WATER ALLOCATION

Continuity and change: Land and water use reforms in rural Uzbekistan
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 5, pp. 89-104.

CHAPTER 5

WHERE HAS ALL THE WATER GONE?

MARC MÜLLER[*]

ABSTRACT

This paper addresses a problem widely known in agricultural economics; especially in the case of developing countries: Input-output relationships are often poorly recorded despite the importance of agriculture for many regional and national economies and the related ecological systems. With the exception of allocated area, it is hardly possible to acquire information on inputs used for the different crops in an agricultural production system; this limitation is especially grave in terms of disaggregated production data. This paper highlights a method of dealing with limited data supply in an efficient manner, by employing a mixed estimation approach. This allows us to estimate crop-specific water input based on aggregate data via the inclusion of an informative prior for water demand at the field level.

Besides introducing this methodological approach, a second objective of this paper is to quantify quantify the allocation of water to different crops in this region, and to gain information about possibilities of reducing water demand. Khorezm is a region of interest because of the reliance of the regional economy on agriculture and the supply of irrigation water from the river Amu Darya.

Keywords: Uzbekistan, water allocation, Mixed Estimation Method, data recovery.

[*] Until 10/2006, Senior Research Fellow, Center for Development Research, University of Bonn, Germany; Currently European Commission, Joint Research Centre, Sevilla. Email: marc.mueller@JRC.europa.eu.

Куда утекла вода?

Марк Мюллер[*]

Аннотация

Данная работа преследует, главным образом, две цели. Первая – изучение широко известной проблемы в сельскохозяйственной экономике, в особенности, в развивающихся странах – взаимосвязь между ресурсами и производством остается без должного учета, несмотря на значимость сельского хозяйства для региональной и национальной экономики и соответствующих экологических систем. За исключением отдельных районов, здесь очень трудно приобрести информацию о затратах (например, орошения) на различные виды культур в сельскохозяйственной производственной системе, в то время как информация об общем количестве более доступна. Для того, чтобы максимально использовать ограниченные данные, применяется метод комбинированной оценки. Этот метод позволяет оценить расходы воды для культуры, основываясь на совокупных показателях, путем изучения водопотребления на уровне поля. Второй целью данной работы является определение количества распределяемой воды для различных культур в регионе и сбор информации о возможностях сокращения водопотребления. Хорезмская область представляет большой интерес в силу зависимости уровня экономического развития в регионе от сельского хозяйства и обеспечения оросительных систем водой из реки Амударья.

Ключевые слова: Узбекистан, водораспределение, метод комбинированной оценки.

[*] Старший научный сотрудник, Центр по Исследованию Развития, Боннский Университет, Германия до 10/2006; в настоящее время сотрудник Центра Совместных Исследований при Европейской Комиссии, Севилья. Эл. почта: marc.mueller@ec.europa.eu.

1 BACKGROUND AND RATIONALE

The years 2000 and 2001 marked the most severe water-shortage in Uzbekistan recorded over the last two decades. While the entire country felt the impact of this drought, the downstream regions Khorezm and Karakalpakstan, located in north-west of Uzbekistan, south of the Aral Sea, were affected most heavily. The annual flow of the main provider of irrigation water for this part of the country – the Amu Darya River – amounted to only 40 % and 34 % of the long-term average in 2000 and in 2001, respectively. For the first time since the early eighties, the total harvested area in Uzbekistan declined in response to a lack of irrigation water. In the most harshly affected regions, like Khorezm, the total real output value of the plant-producing sector dropped by 33 % in 2001, compared to recorded output for 1998. Given the fact that the regional incomes depend mainly – be it directly or indirectly – on irrigated agriculture, the drought in 2000/2001 caused serious harm to the economic welfare of the population in the Khorezm region, and Uzbekistan as a whole.

Farmers in Uzbekistan have been using the water flows from Amu Darya and Syr Darya to irrigate their fields since ancient times. The provision of water in sufficient quantities has never been a certain event in the past nor will it be in the future. But due to population growth and the extension of the irrigated area the probability to receive adequate amounts of water has decreased to a level that raises concern about the sustainability of the current agricultural production system. (e.g. MÜLLER, 2006).

A major obstacle for analysts attempting to develop strategies to decrease the regional agricultural production systems' reliance on irrigation water is the lack of available data on water allocation across different crops and on the losses of irrigation water during the conveyance from the source to the fields. Farmers are usually not in a position to provide the required information due to a lack of water measurements at the field level, and official statistical departments often make aggregate data on irrigation water and allocated areas available, but crop-specific water inputs are difficult to obtain. As this issue occurs frequently in applied studies, it has been addressed by several scholars in the past and a variety of methods to recover the missing data from available sets of information has been suggested; ranging from approaches based on sample information only (e.g. JUST et al., 1990) to approaches which allow for the includsion of additional information within a generalized maximum entropy framework (GME, see e.g. LENCE and MILLER, 1998; GOLAN et al., 1996). The study presented here aims at the recovery of information about crop-specific irrigation water on the basis of aggregate water usage and average per-hectare requirements of main crops in the region Khorezm by employing a "mixed estimation method" (MEM) that allows the usage of prior information about the parameters to be estimated but does not rely on the formulation of support points like GME. The main objective is to gain

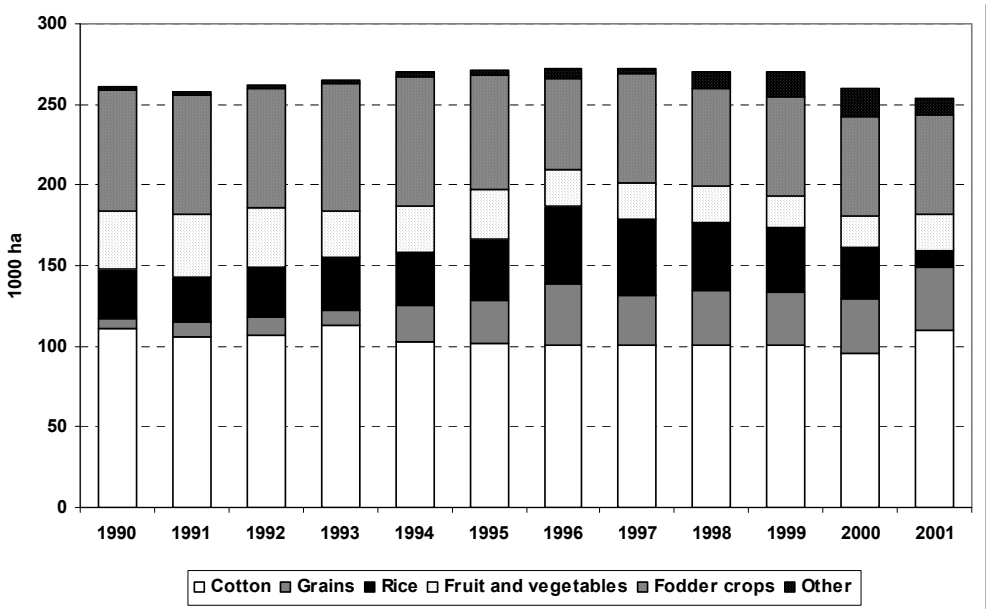
insights into the actual water demands of the main crops and crop-aggregates, as well as into the patterns of water usage in different districts, as they differ in their proximity to the source of irrigation water, the Amu Darya River.

The following section 2 will outline the general characteristics of irrigation and crop production in the region of Khorezm and its sub-regional districts. In section 3, a mixed estimation approach following JUST et al. (1990) is applied in order to estimate the missing crop-specific water inputs; the results are discussed in section 4. Section 5 summarizes the main findings and states some cautious implications for mandatory policy change as well as suggestions for further research on the topic.

2 AGRICULTURE AND IRRIGATION IN THE KHOREZM REGION

Plant production in the Khorezm region is characterized by the high share of cotton (Figure 5-1), mainly because of the fact that cotton is a strategic crop in Uzbekistan and its production is largely determined by governmental interventions. These interventions range from the administration of production targets to the subsidization of core inputs (e.g. fertilizers) to cotton growers. The same applies to a lesser extent to wheat (largest component within the category "grains" in Figure 5-1). The Uzbek government has fostered the domestic production of wheat since 1994 as a strategy to substitute wheat imports with domestic produce (IMF, 2000), and the area allocated to wheat has increased in the Khorezm region, although its share in the total area cropped is still comparatively low. Rice is the third major single crop in Khorezm and the regional output contributed in 1999 was around 30 % of the national supply (OBLSTAT, 2002b and FAOSTAT, 2007).

Figure 5-1: Harvested crop area in the Khorezm region, 1990 to 2001, in 1000 ha



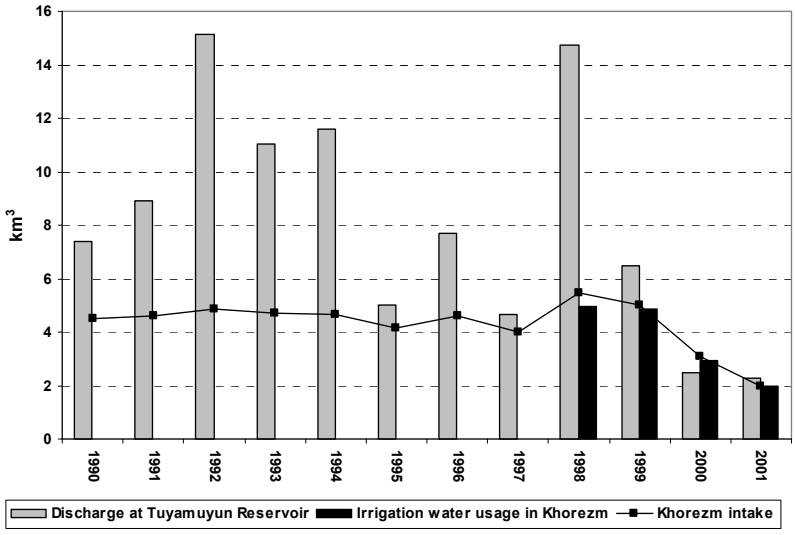
Sources: OBLSTAT, 2002a; OBLSTAT, 2002b.

The commodity group "fruit and vegetables" comprises melons, orchards, grape plantations, and vegetables like onions and carrots. The production takes place mainly on household plots.

The water supply for the six crops and crop-aggregates described above depends mainly on the flow of the lower Amu Darya, which is collected in the Tuyamuyun reservoir south-east of the Khorezm region and released during the irrigation period. As illustrated in Figure 5-2, the water intake of the Khorezm region during the irrigation period of approximately 4.5 km^3 is in most years below the discharges from Tuyamuyun, except in the drought years 2000 and 2001, during which Khorezm received apparently all of the water available. The decline of harvested area (Figure 5-1) in those years indicates that the supply of water was well below the actual demand and underlines the dependence of Khorezm's agriculture on irrigation water. However, Figure 5-2 also illustrates that drought years are a rather exceptional event; occuring twice since 1990.

When comparing the feedback between available irrigation water and harvested area (Figure 5-1 and 5-2), it appears that water scarcity has the largest impact on the harvested rice area while the other five crop categories are affected to a much lesser extent. This is not only because of the high water demand of rice, but also because the level of rice production was restricted during the drought years by governmental regulations in order to ensure the availability of water for cotton and wheat. Cotton and wheat production are mostly determined by state orders (OBLSTAT, 2002b, household plot are an exception from the state order); fruit and vegetables have to satisfy subsistence demand and fodder is required by the animal stock whose annual output value is approximately as high as the total plant output value (OBLSTAT, 2002a). Other crops like potatoes and sugar beet represent only a small segment of the production system. The details of agricultural producers' behavior in the Khorezm region are, however, beyond the scope of this study and are addressed in current works by DJANIBEKOV (2007, Chapter 3 in this volume) and BOBOJONOV, RUDENKO and LAMERS (2007, Chapter 4 in this volume). The main objective here is to identify the actual distribution of irrigation water across districts and crops.

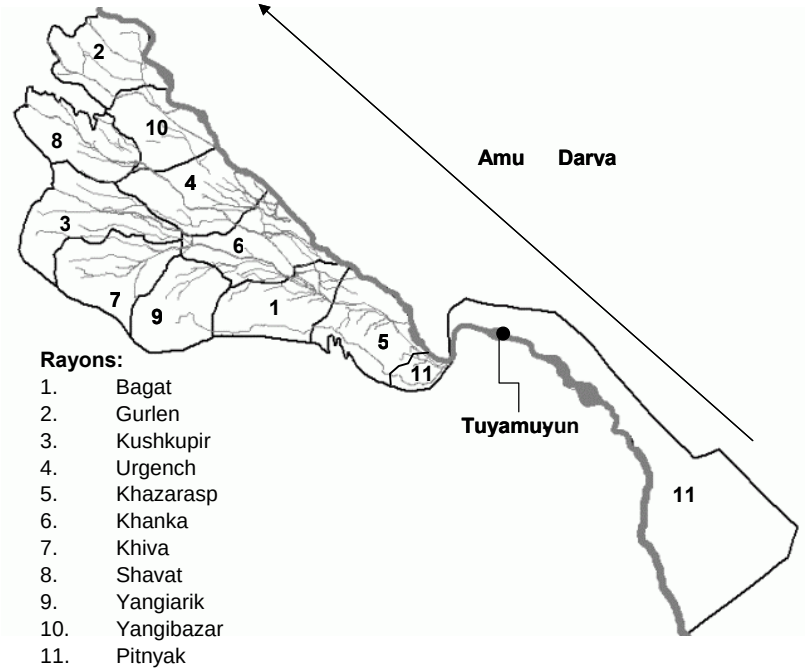
Figure 5-2: Water demand and supply in the Khorezm region, 1990 to 2001, in km³



Source: HYDROMET, 2002; OBLSELVODKHOZ, 2002a; OBLSELVODKHOZ, 2002b; real.

Data available for the Khorezm region is divided between 10 or 11 districts, depending on the year for which data is recorded: The district Pitnyak (no. 11 in Figure 5-3) is in some years merged with Khazarasp (no. 5 in Figure 5-3), probably because its larger part (the area east of the Tuyamuyun) consists only of unirrigated desert land. Four districts do not border the Amu Darya directly (Kushkupir, Shavat, Khiva, and Yangiarik), of which Shavat has the comparative advantage that a major irrigation channel provides water to the district's farmers.

Figure 5-3: Irrigation network and districts (rayons) in the Khorezm region

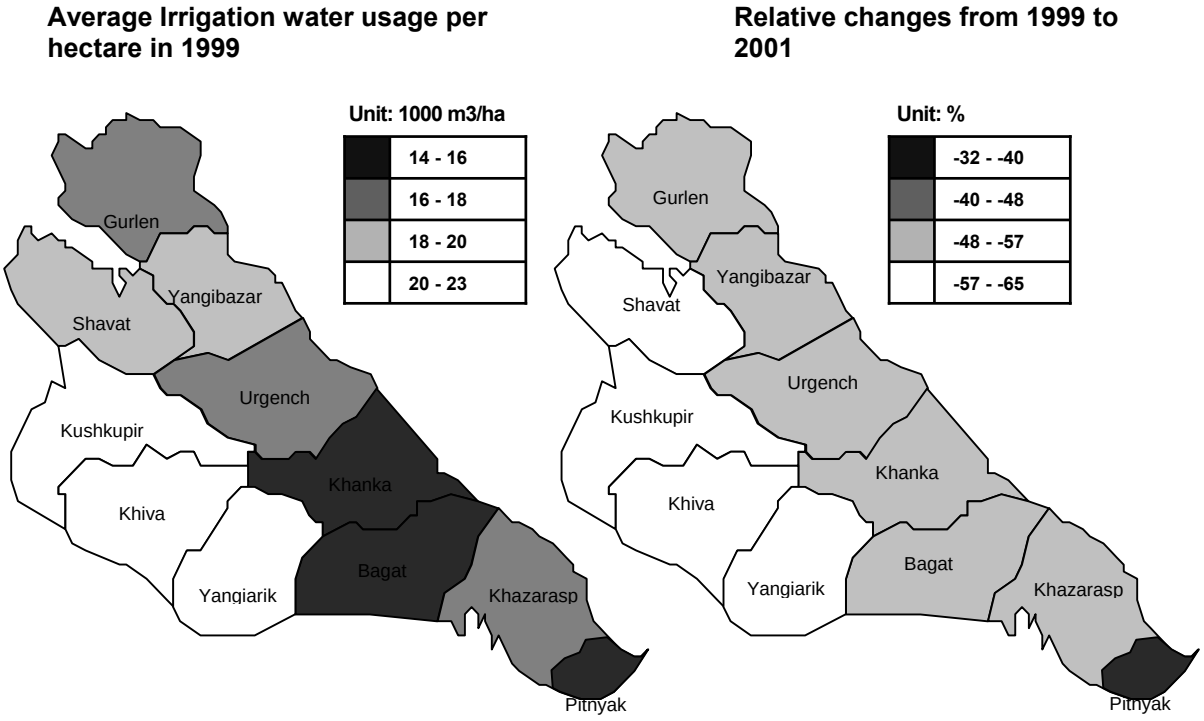


Source: Project data.

For these districts, the following sets of information are available: First, the annual total usage of water during the irrigation period (April to September) from 1998 to 2001 (OBLSELVODKHOS, 2002, depicted in Figure 5-2 on Khorezm level) and the areas allocated for the different crops in the same period (OBLSTAT, 2002b). When comparing average gross water consumption among districts (Figure 5-4), it appears that the values for the remote districts are considerably higher than the values in the districts closer to the Amu Darya. This may demonstrate higher conveyance losses, but could also be explained by a higher share of water intensive crops in those districts. In addition, the decline of gross water usage per hectare from 1999 to 2001 in the remote districts ranges between 57 % and 65 % and is remarkably higher than in the other districts (Figure 5-4).

In order to identify crop-specific water demand in the absence of actual data it is necessary to have an informed guess or applicable expert knowledge. Such information is available in the context of the following scenario:

Figure 5-4: Average gross irrigation water per hectare in 1999 and relative changes from 1999 to 2001



Source: OBLSTAT, 2002b; author's presentation.

The regional department of the Ministry for Agriculture and Water Resources calculates the expected requirement for irrigation water in a future period based on assumed (formerly "planned") areas and "norm" values for the water-demand of different crops. These "norm" values are calculated according to a hydrological model (HYDROMODRAY, 2002) which was developed during Soviet times. This model provides estimates for the on-field demand of irrigation water for several crops at different dates during the vegetation period. It distinguishes categories of

irrigated land, so that the calculated "norm" values for each crop differ depending on the model's land classification. Table 5-1 shows the weighted average norm values for the regarded crops and crop-aggregates in the Khorezm region.

Table 5-1: Average norm water requirements in the Khorezm region

	Water requirement during the irrigation period [1000 m^3/ha]
Grains	4.5
Rice	26.2
Fruit and vegetables	6.3
Other market crops	8.4
Fodder crops	6.7

Source: HYDROMODRAY, 2002.

3 ESTIMATION OF CROP-SPECIFIC WATER ALLOCATION

Statistical sources for agricultural production systems often provide data about produced quantities and harvested areas, but data about inputs are usually only available at an aggregate level. The recovery of missing information on inputs allocated to different crops is a crucial step for the quantitative assessment of the agricultural production system's efficiency, as a first step towards deriving policies promoting possible omprovements. The best source for crop-specific information on applied irrigation water would be detailed measurements, but those are of limited availability in developing countries and conducting one's own measurements requires time and monetary resources that are not readily available. The second-best option is, therefore, to take advantage of any source of readily available information and systematically combine all available data during the estimation process.

The approach followed here is based on JUST ET AL. (1990), who suggest splitting the water allocation per unit of area in a crop effect, a regional effect, and an annual effect. Here, the water usage per hectare can consequently be expressed as in Equation (1):

$$\mathbf{CSW}^{\mathbf{est}}_{\mathbf{c,r,t}} = \mathbf{ccrop}_{\mathbf{c}} + \mathbf{cray}_{\mathbf{r}} + \mathbf{cyear}_{\mathbf{t}} \qquad (1)$$

with:

CSW^{est}:	Estimated crop-specific water	[1000 m^3/ha]
ccrop:	Parameter covering the crop effects	[1000 m^3/ha]
cray:	Parameter covering the regional effects	[1000 m^3/ha]
cyear:	Parameter covering the annual effects	[1000 m^3/ha]

r:	Index for Rayons (districts)	{Gurlen, …, Pitnyak}
t:	Index for time	{1998, 1999, 2001}
c:	Index for crops	{Cotton, …, Other}

Following JUST et al. (1990), the total water usage in each region equals the per-hectare values multiplied by allocated areas. The estimation model is as seen in Equation (2):

$$TAW_{r,t} = \sum_{c} \left(ccrop_{c} + cray_{r} D_{r}^{ray} + cyear_{t} D_{t}^{year} \right) \cdot AREA_{c,r,t} + \varepsilon_{r,t} \qquad (2)$$

with:

TAW:	Total available water [1000 m^3]
AREA:	Allocated area [ha]
D:	Binary (Dummy) variables covering regional and annual effects
ε:	Error term
ray:	Index for Rayon Dummies
year:	Index for year Dummies

The needed data for TAW and AREA are available for the 11 Rayons in Khorezm: For the years1998 to 2001, 12 crops and crop-aggregates are included and are summarized here in six categories. In total, there are 44 observations for TAW, and as many for the areas of the different crops. The model was normalized for the year 1998 and the Rayon Bagat in order to avoid singularity of the matrix of explaining variables (X). The number of parameters to be estimated is consequently:

ccrop:	6
cray:	10
cyear:	3
Total:	19

Thus, Equation (2) can be estimated with 25 degrees of freedom only; therefore, the different effects for crops, district, and years cannot be isolated at a satisfying level of statistical significance and the validity of the results are questionable. Indeed, it turned out that the results for the crop-effects by estimating (2) with ordinary least squares (OLS) were unreliable: They did not agree with the available "norm" values for each input and became negative in some cases, which is unrealistic since physical input quantities cannot have values below zero. The source of this problem is most likely the comparatively limited number of available observations.

In order to address the aforementioned problem, an alternative estimation method was used, the "mixed estimation method" proposed by THEIL and GOLDBERGER (1961). This approach allows for the inclusion of additional information on the parameters

to be estimated. The general idea of this approach is to combine the sample-distribution of a parameter-vector **b** with prior information about the mean and variance of the respective parameter. The model was formulated according to GREENE (2003):

$$E[\boldsymbol{\beta}_{MEM} \mid \sigma^2, \mathbf{TAW}, \mathbf{X}] = \left(\boldsymbol{\Sigma}_0^{-1} + \left(\sigma^2 (\mathbf{X'X})^{-1}\right)^{-1}\right)^{-1} \left(\boldsymbol{\Sigma}_0^{-1}\boldsymbol{\beta}_0 + \left(\sigma^2 (\mathbf{X'X})^{-1}\right)^{-1}\mathbf{b}\right) \quad (3)$$

$$\mathbf{b} = (\mathbf{X'X})^{-1}\mathbf{X'TAW} \quad (4)$$

$$\mathbf{e} = \mathbf{TAW} - \mathbf{Xb} \quad (5)$$

$$\sigma^2 = s^2 = \frac{\mathbf{e'e}}{(n-k)} \quad (6)$$

with: E[ ] Expected value

$\boldsymbol{\beta}_{MEM}$: Vector of parameters to be estimated (ccrop, cray, cyear)

σ^2: Variance of β (obtained from OLS regression, s^2)

X: Matrix of area and dummy variables

$\boldsymbol{\Sigma}_0$: Prior information about variances of β

$\boldsymbol{\beta}_0$: Prior information about expected values of β

b: Parameter vector obtained from OLS regression

e: Error term of OLS regression

k: Number of parameters to be estimated (19)

n: Number of observation (44)

The crucial point of this method is to determine the prior information about expected values of the parameters ($\boldsymbol{\beta}_0$) and their variances ($\boldsymbol{\Sigma}_0$) accurately. Especially when the sample is comparatively small, the weight of the prior information in the estimation process will be very high. Consequently, $\boldsymbol{\beta}_0$ was constructed by using the "norm" values for the inputs in the case of the parameter group covering the crop-effects (ccrop). Prior information for regional effects (cray) was not available and was therefore set to the average difference between net and gross water usage based on the sample and recommended data. The annual effects (cyear) were set to equal the average decreases of water availability throughout the Khorezm region. In the case of crop effects, the variances $\boldsymbol{\Sigma}_0$ were assumed to be at a level to make negative values very unlikely. This was achieved by setting the standard errors to one-third of the norm values. Variances of the regional and annual effects were taken from the OLS regression.

4 RESULTS

The results from the estimation are shown in Table 5-2. It turns out that the crop effects deviate substantially from the prior information, indicating that the recommendations from HYDROMODRAY (2002) do not match the actual irrigation practice on the fields. The annual effects on the other hand do not deviate signifycantly and show plausible results with negative values for 2000 and 2001, which were the drought years. The regional effects from the MEM estimation convey in principle the same message as the prior information, including that the water usage per hectare in the regions not bordering the Amu Darya is higher than in the regions along the river. As would be expected, in the off-stream regions, more water is needed per hectare in order to compensate for the losses associated with transporting water from the river to the respective regions.

The MEM estimation for total water consumption across the districts of Khorezm replicates the sample information with an R^2 of 0.96; the fit of estimated and observed values is displayed in Figure 5-5. It appears that the estimates for 2000 and 2001 show slightly higher deviations from the observations than in the other years. The reason is the rigid formulation of the estimated model that does not include dynamic adjustments of the crop-effects on total consumption (ccrop). Annual patterns are covered by a different parameter (cyear), which measures the absolute average deviation from the irrigation water usage per hectare in 1998. Although the actual adjustment of on-field application of irrigation water is done in a more complex manner than expressed in the estimated model, the results are surprisingly accurate even for 2001.

The estimated average water application levels for the included crops and crop-aggregates are, in all cases, higher than those recommended by HYDROMODRAY 2002 (Figure 5-6). Cotton showed the largest relative deviation of 86 %. This result has to be interpreted cautiously in the context of the estimation model, because the high area-share of cotton increases the explanatory power of the associated parameter, but it nevertheless indicates that the on-field losses are comparatively high. The second highest deviations can be observed in the case of fodder crops (72 %). This finding is due most likely to the fact that the officially recorded levels of fodder production are below the actual acreage, as fodder is also produced in small household plots which are not monitored in the same way as former state farms and newly established private farms. Rice production is estimated at 35000 m^3 per hectare and is the most water demanding crop. Despite the comparatively low area-share, rice is the largest water consumer in the Khorezm region (31 % of total water usage in 1999, Figure 5-7).

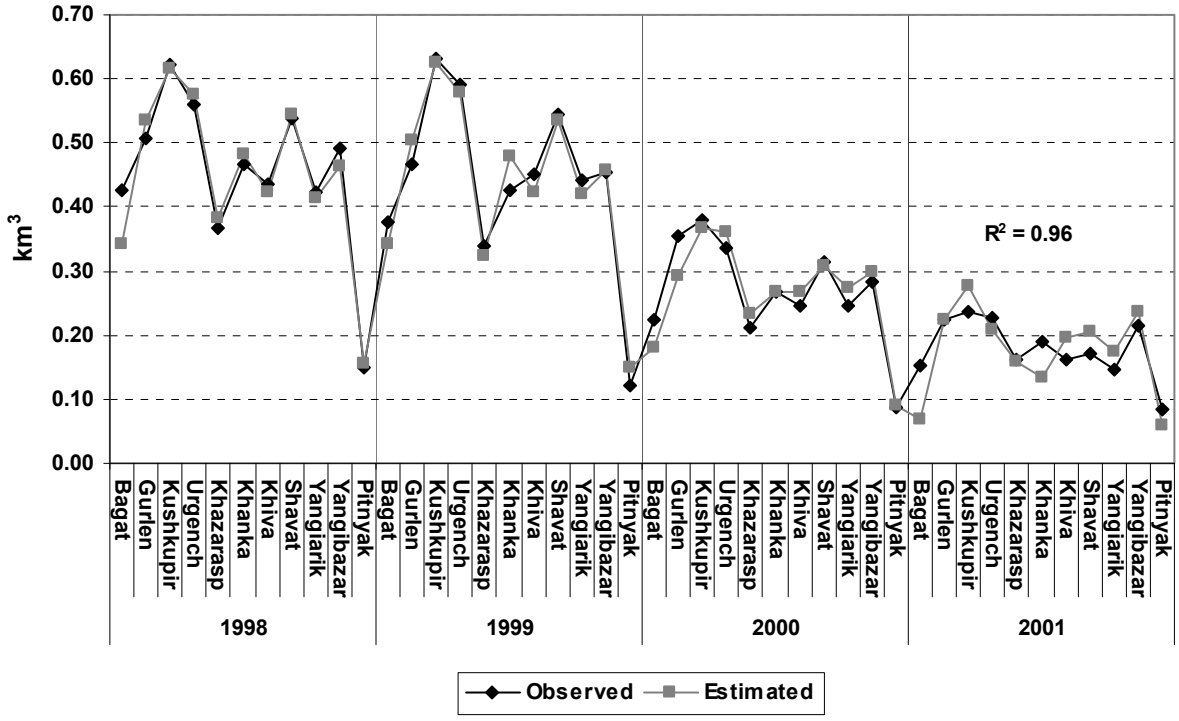
Table 5-2: Estimation results and prior information

		OLS		Prior		MEM		
	[1000 m^3/ha]	**b**	**σ**	β_0	$\sqrt{\Sigma_0}$	β_{BAY}	σ_{BAY}	t_{BAY}
Crop Effects	Cotton	**41.61**	13.71	**5.62**	1.87	**10.47**	1.56	**6.72**
	Grains	**-5.55**	19.08	**4.49**	1.50	**6.10**	1.46	**4.17**
	Rice	**4.44**	12.26	**26.20**	8.73	**36.71**	4.47	**8.22**
	Fruit and vegetable	**-4.11**	20.60	**6.29**	2.10	**7.78**	2.06	**3.77**
	Fodder crops	**16.58**	19.95	**8.42**	2.81	**14.44**	2.42	**5.97**
	Other crops	**-19.52**	35.30	**6.72**	2.24	**7.72**	2.22	**3.47**
Rayon Effects	Gurlen	**-0.26**	3.05	**3.77**	3.05	**1.61**	0.84	**1.91**
	Kushkupir	**0.52**	1.37	**7.84**	1.37	**6.79**	0.55	**12.41**
	Urgench	**-0.35**	1.85	**4.39**	1.85	**2.89**	0.56	**5.20**
	Khazarasp	**-1.11**	1.33	**5.84**	1.33	**4.80**	0.67	**7.20**
	Khanka	**-2.82**	1.39	**2.40**	1.39	**0.90**	0.55	**1.64**
	Khiva	**1.32**	1.52	**6.66**	1.52	**5.64**	0.65	**8.66**
	Shavat	**-0.10**	1.04	**5.82**	1.04	**4.92**	0.52	**9.50**
	Yangiarik	**3.63**	1.40	**7.97**	1.40	**6.90**	0.69	**9.94**
	Yangibazar	**1.24**	1.80	**6.76**	1.80	**5.38**	0.67	**8.03**
	Pitnyak	**4.89**	3.59	**1.60**	3.59	**-0.47**	1.71	**-0.27**
Annual Effects	1999	**0.03**	0.95	**-0.54**	0.95	**-0.18**	0.39	**-0.46**
	2000	**-6.27**	1.21	**-7.12**	1.21	**-6.03**	0.42	**-14.50**
	2001	**-12.58**	1.76	**-10.68**	1.76	**-7.45**	0.66	**-11.29**

Source: OBLSELVODKHOZ, 2002; author's results.

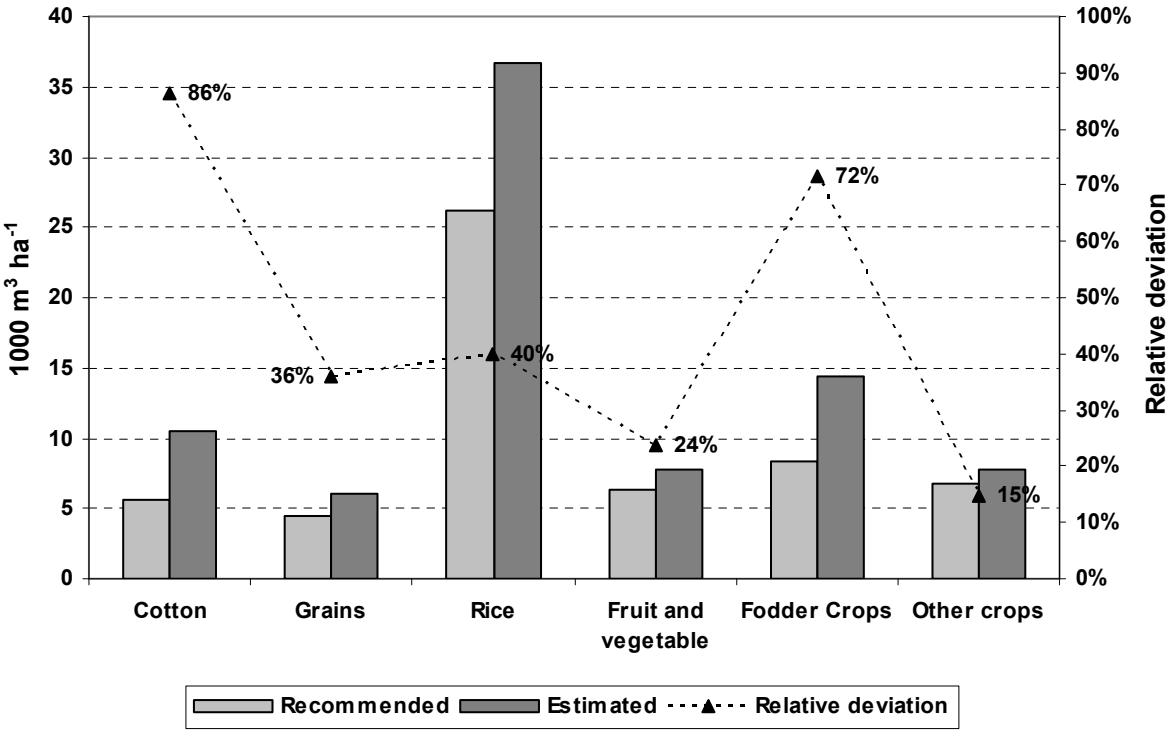
Net conveyance losses amounted to 20 % of total water consumption in the Khorezm region (Figure 5-7) during the years with sufficient water supply. When interpreting the deviations between recommended and estimated on-field usage of irrigation water as losses due to sub-optimal irrigation practice, the losses on field amounted to 29 % in 1998 and 1999.

Figure 5-5: Observed and estimated water usage in the Khorezm region, 1998 to 2001, in km3



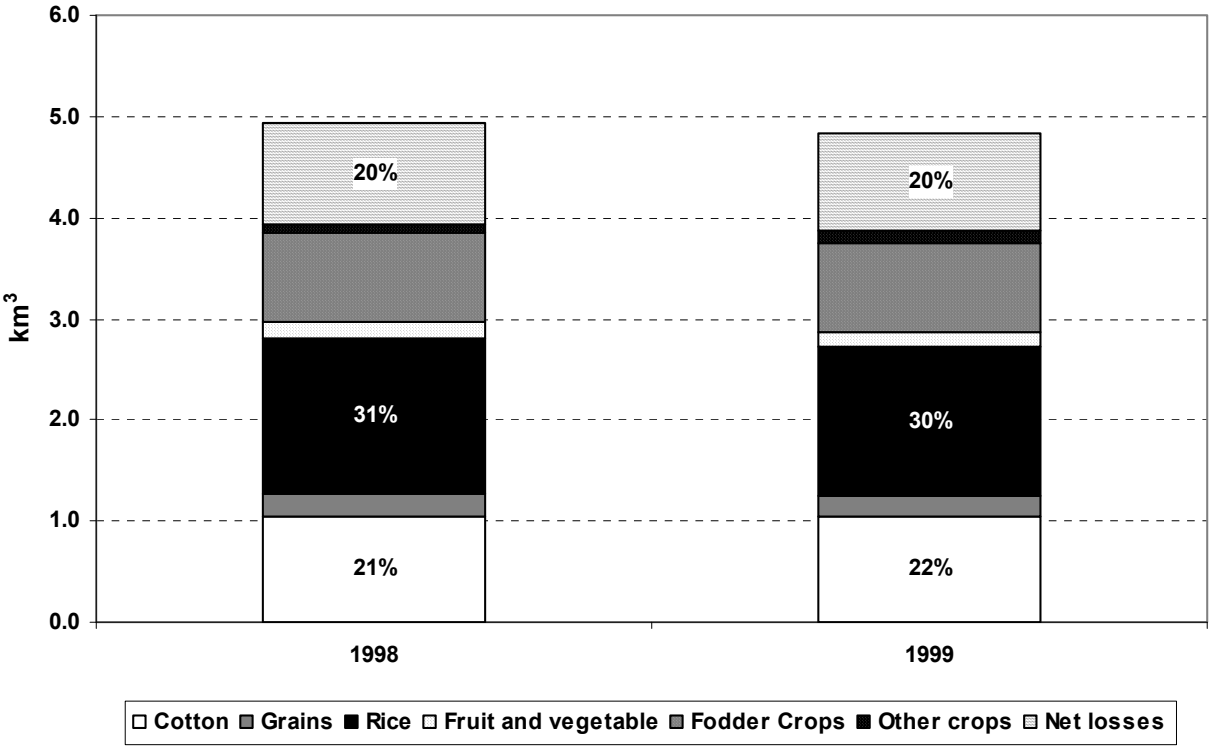
Source: OBLSTAT, 2002b; author's results.

Figure 5-6: Recommended and estimated application of irrigation water on field, in 1000 m^3/ha



Source: HYDROMODRAY, 2002; author's results.

Figure 5-7: Distribution of irrigation water in the Khorezm region during 1998 and 1999, in km³



Source: Author's results.

5 CONCLUSIONS

The aim of this study was to derive crop-specific application rates of irrigation water based on information about aggregated water supply, harvested areas, and recommended values for on-field demand of the various crops grown. (The crops are grouped into six crops and crop aggregates for this study). In order to combine all types of information, a Mixed Estimation Method based on THEIL and GOLDBERGER (1961) was employed. It was shown that the estimated actual water application on the fields is systematically higher than recommended by a regional hydrological model. The highest deviation was calculated for the dominant crop, cotton, while the largest consumer of irrigation water in the Khorezm region during the observed period was rice. When interpreting the estimated rayon-effects as conveyance losses and the deviations between recommended and estimated on-field applications as results of a sub-optimal management of the irrigation system, it appears that conveyance losses amount to 20 % of the total water supply in the region, with on-field losses as high as 29 %.

These results are of relevance when developing strategies to decrease the total demand for irrigation water in the Khorezm region in order to mitigate the region's dependency on the naturally given water supply from the Amu Darya river. The

results demonstrate that reduction of conveyance losses by appropriate maintenance of the regional channels, as well as investment in infrastructure, would have a potentially lower impact than improvement of the irrigation system on the fields. In particular, a higher irrigation efficiency of cotton production through appropriate preparation of the fields and adequate timing of the irrigation events throughout the irrigation period could be a less costly and feasible measure. The same applies basically for all crops included in this study, but cotton production appears to have the highest potential for efficiency gains.

The fact that rice production has the highest share in regional water consumption suggests that the administrative restriction of rice areas is a cheap and effective way of reducing total water demand – this policy was employed during the drought years 2000 and 2001. The permanent application of such a policy, however, would further decrease the farmers' already limited entrepreneurial freedom and cause significant welfare losses within the agricultural sector of the Khorezm region. An alternative for farmers to save water would be the introduction of irrigation fees, which would directly affect the profitability of rice production, but such a political measure has also to consider the ability of farmers to pay such fees.

The formulation of feasible strategies to improve the efficiency of the irrigation system in Khorezm requires a better understanding of the hydrological, agronomical, and institutional dimensions. The main objective of this study was to shed light on the actual water usage patterns in the Khorezm region based on available data, and the results indicate improvement of on-field irrigation efficiency (especially for cotton) as a reasonable starting point for further studies in this domain.

ACKNOWLEDGEMENTS

This study was funded by the German Ministry for Education and Research (BMBF; project number 0339970A).

REFERENCES

GREENE, W. H. (2003): Econometric Analysis, 5th ed., New York.

INTERNATIONAL MONETARY FUND [IMF] (2000): Uzbekistan: Recent economic developments, *IMF Staff Country Report 00/36*, Washington, D. C.

JUST, R. E., ZILBERMAN, D., HOCHMAN, E., BAR-SHIRA, Z. (1990): Input allocation in multicrop systems, *American Journal of Agricultural Economics, 72 (1),* pp. 200-209.

KHOREZM DEPARTMENT OF LAND AND WATER RESOURCES OF THE MINISTRY OF AGRICULTURE AND WATER RESOURCES [HYDROMODRAY] (2002): Average requirements for labour and energy of different crops in Khorezm, Urgench.

KHOREZM DEPARTMENT OF LAND AND WATER RESOURCES OF THE MINISTRY OF AGRICULTURE AND WATER RESOURCES [OBLSELVODKHOS] (2002): Data on norms, limits and usage of irrigation water from 1997 to 2001, Urgench.

LENCE, S. H., MILLER, D. J. (1998): Estimation of multi-output production functions with incomplete data: A generalised maximum entropy approach, *European Review of Agricultural Economics, 25 (2),* pp. 188-209.

MAIN DEPARTMENT FOR HYDROMETEOROLOGY [HYDROMET] (2002): Monthly river discharges from 1980 to 2001, Urgench.

REGIONAL DEPARTMENT OF THE MINISTRY OF MACRO-ECONOMICS AND STATISTICS OF THE REPUBLIC OF UZBEKISTAN IN KHOREZM OBLAST [OBLSTAT] (2002a): Socio-economic indicators for Khorezm, 1991-2000, Urgench.

REGIONAL DEPARTMENT OF THE MINISTRY OF MACRO-ECONOMICS AND STATISTICS OF THE REPUBLIC OF UZBEKISTAN IN KHOREZM OBLAST [OBLSTAT] (2002b): Agricultural indicators for Khorezm *Oblast*, 1998-2001, Urgench.

THEIL, H., GOLDBERGER, A. S. (1961): On pure and mixed statistical estimation in economics, *International Economic Review, 2 (1)*, pp. 65-78.

Continuity and change: Land and water use reforms in rural Uzbekistan,
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 6, pp. 105-127.

CHAPTER 6

ANALYSIS OF WATER USE AND ALLOCATION FOR THE KHOREZM REGION IN UZBEKISTAN USING AN INTEGRATED ECONOMIC-HYDROLOGIC MODEL

TINA SCHIEDER[*] AND XIMING CAI[**]

ABSTRACT

Sustainable management of water resources is important for social and economic development in Khorezm, a region in the Amu Darya region (Aral Sea Basin), Central Asia; Republic of Uzbekistan. Due to historical and recent expansion of irrigation projects, the region highly depends on water for irrigation. However, inefficient water management results in severe ecological, social, and economical problems such as rising soil and water salinity, waterlogging (high groundwater levels), declining crop yields and health problems. The increasing competition among water users within the region and between up- and downstream areas along the river calls for a more efficient water allocation and management approach. In this paper an integrated economic-hydrologic model is developed for water allocation analysis in the Khorezm region, which is used to 1) determine water use patterns according to physical and agronomical basics; and 2) explore strategies for more efficient allocation and management of water resources through the analysis of alternative water policy scenarios. The model consists of a system of non-linear equations programmed in GAMS (General Algebraic Modeling System). The model integrates various disciplines (natural sciences, economics, and social sciences) to search for efficient, equitable, and environmentally sustainable water allocation mechanisms for the study area. This modeling study can serve as an example for Uzbek river basins and irrigation areas as a whole.

Keywords: Irrigation, Uzbekistan, optimization model.

---

[*] Junior Fellow, Center for Development Research, University of Bonn, Germany, Bonn. Email: tina.schieder@uni-bonn.de.

[**] Assistant Professor, 2535c Hydrosystems Laboratory, Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign. Email: xmcai@uiuc.edu.

АНАЛИЗ ПОТРЕБЛЕНИЯ И РАСПРЕДЕЛЕНИЯ ВОДЫ В ХОРЕЗМСКОЙ ОБЛАСТИ РЕСПУБЛИКИ УЗБЕКИСТАН С ПРИМЕНЕНИЕМ ИНТЕГРИРОВАННОЙ ЭКОНОМИЧЕСКО-ГИДРОЛОГИЧЕСКОЙ МОДЕЛИ

ТИНА ШИДЕР[*] И КСИМИНГ КАЙ[**]

АННОТАЦИЯ

Устойчивое управление водными ресурсами является весьма важным фактором социального и экономического развития в Хорезмской области, которая расположена в дельте реки Амударьи в Приаралье (Республика Узбекистан, Центральная Азия). Вследствие развития ирригационных работ в прошлом и на современном этапе, регион сильно зависит от водных ресурсов для оросительных целей. Однако нерациональное использование водных ресурсов приводит к таким экологическим, социальным и экономическим проблемам, как повышение степени засоленности почвы и воды, заболачивание (высокий уровень грунтовых вод), понижение урожайности культур и возрастающие проблемы со здоровьем. Усиливающаяся конкуренция среди водопользователей в пределах самого региона а также районов, расположенных выше и ниже по течению реки в этой области, требует более эффективного подхода к распределению и управлению водными ресурсами. Авторами разрабатывается интегрированная экономичко-гидрологическая модель для анализа водораспределения в Хорезмской области, которая будет использоваться, во-первых, для установления схем водопользования согласно физическим и агрономическим показателям и, во вторых, для изучения стратегий более эффективного распределения водных ресурсов и их управления путем анализа сценариев альтернативной водохозяйственной политики. Модель, состоящая из системы нелинейных уравнений, запрограммирована по Системе общего алгебраического моделирования (GOAM). Разработка такой модели – это шаг к интегрированию различных дисциплин таких, как естествознание, экономика и социология, для улучшенного управления водными ресурсами, включая эффективные, справедливые и экологически

[*] Младший научный сотрудник, Центр по Развитию Исследования, Боннский Университет, Германия, Бонн. Эл. почта: tina.schieder@uni-bonn.de.

[**] Доцент, 2535c Гидросистемная лаборатория, Факультет Гражданского и Экологического Строительства, Университет Иллинойс в Урбана-Шампейн. Эл. почта: xmcai@uiuc.edu.

устойчивые механизмы водораспределения в изучаемом регионе. Данное исследование может послужить примером для регионов речных бассейнов и орошаемых земель по всему Узбекистану.

Ключевые слова: Интегрированная гидрологическо-экономическая модель, орошение, модель оптимизации, распределение воды.

1 INTRODUCTION

In the Khorezm region of Uzbekistan, water consumption and management for irrigated agriculture is inefficient and unsustainable. Like in much of Uzbekistan, irrigated agriculture is a primary source of income and has resulted in drastic ecological, social, and economical problems, which continue to worsen. To improve water management and minimise the negative effects of existing practices on the local and national ecosystem and livelihoods, a more efficient water allocation and water use management strategy is needed.

In the following study, a regional analysis was carried out for the Khorezm region to analyze water allocation and use at various spatial scales and the impacts of alternative water management strategies and policies on hydrologic cycles, plant growth, yields and areas. The main objective of this study was to detect water supply and demand balance as a consequence of the water availability and water use patterns in the study region. The method could be applicable to all irrigated areas in Uzbekistan. Based on agronomic, hydrologic and climatologic data and calculations, economic consequences of optional, more effective water use, management and allocations were estimated. The results could be used to inform policy makers of more efficient water use strategies in the region.

Hypotheses for the research that arise from the given situation include:

- The complex interdisciplinary relationships between hydrology, agronomy, and socio-economy can only be effectively acquired and manifested within an integrated modeling tool.
- With modified cropping patterns, reduced cropping areas, improved water management and increased water use efficiency, it should be possible to reduce environmental damage while enhancing agricultural production levels.
- Measures like taxes, subsidies, permits and rights have a positive impact on more effective water use and allocation, which will be beneficial to both local ecosystems as well as the economy.

2 REGIONAL CONDITIONS AND CASE STUDY AREA

2.1 Uzbekistan

The case study area is situated within the Republic of Uzbekistan. During the Soviet time, Uzbekistan became the largest cotton producer in the U.S.S.R. and ultimately a key supplier for the rest of the Soviet Union. Poor water management during that period brought decades of water stress, lack of drinking water and sewage treatment facilities, heavy use of pesticides, herbicides, and fertilizers in

the fields; the construction of industrial enterprises has resulted in significant impacts on human society and the environment. Cotton production throughout Uzbekistan is characterized by large-scale use of chemicals, inefficient irrigation systems, low water use efficiency, and poor drainage systems that have resulted in a high filtration of salinized and contaminated water back into the soil (CURTIS, 2004). Combined, these processes have threatened the water quality for drinking water supply and irrigation. The Khorezm region illustrates the notorious "Aral Sea Crisis" in Central Asia associated with the excessive expansion of the irrigated cotton agriculture in Central Asian republics (GIESE, 1998; CAI et al., 2003a).

After its independence in 1991 Uzbekistan's government started to alter the Soviet-style command economy of central planning, a system characterized by large subsidies and control over production and prices. During this period of transition, Uzbekistan has nonetheless retained many elements of Soviet economic planning. Economic policies remain under state control; the government has limited foreign direct investment and little privatization has occurred aside from small enterprises (CURTIS, 2004). Intended structural changes and imperative measures to protect the environment have been slow or absent due in large part to ongoing state controle over the economy and thus on the environment. Additionally, high population growth rate have led to increasing pressure on the environment and natural resources such as the Amu Darya River and the Aral Sea (UNITED NATIONS, 2001).

2.2 Amu Darya River and the Khorezm Region

During the past 30 years, the Amu-Darya River, the largest river in Central Asia, has been used for large-scale irrigation projects.[1] There exist hundreds of canals and lift stations to supply and distribute water from the Amu Darya for irrigation. In this process, a number of water storage reservoirs were generated and have resulted in a nearly 100 % rate of consumption of the water from the Amu Darya. At present, less than 10 % of pre-1960 levels of water is arriving at the Aral Sea (2-5 km^3 per year). In some years, no water arrives at all.

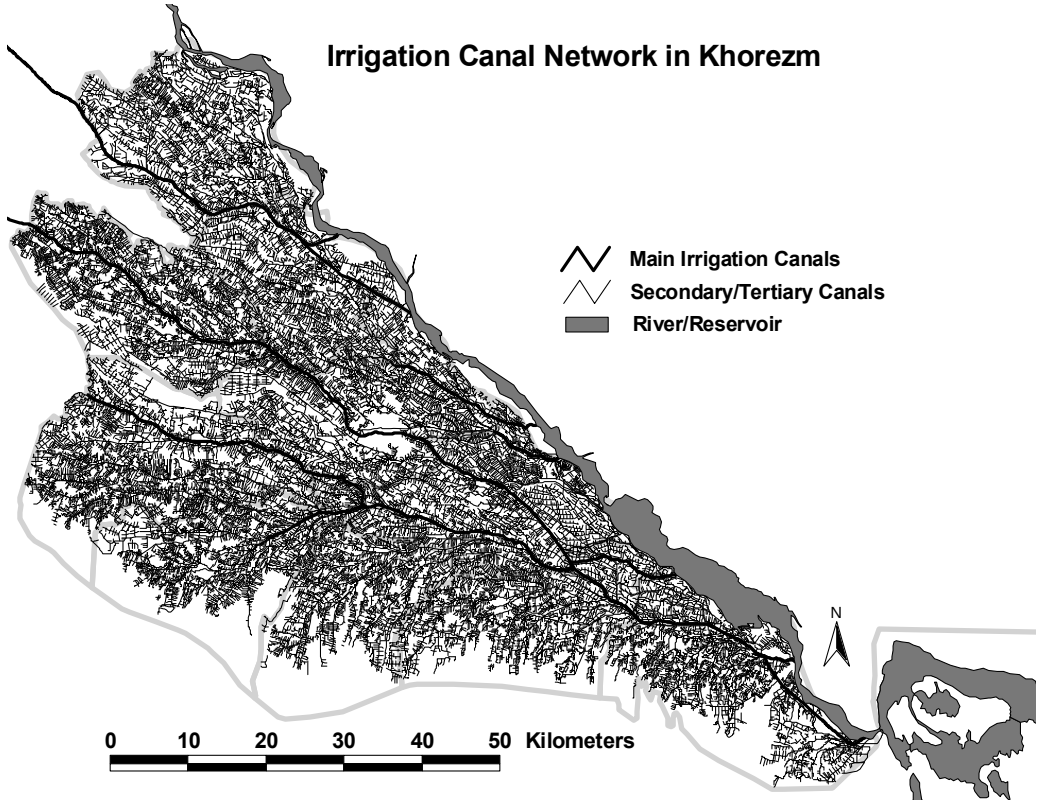
The Khorezm region is dominated by large-scale irrigation (Figure 6-1). The Province is situated in the north-western part of Uzbekistan at the lower reaches of the Amu Darya. Its total area is around 6300 square kilometers. The climate is continental, with moderately cold winters and dry hot summers. The Aral Sea basin experiences less than 150-200 mm of annual precipitation,[2] but potential evapotranspiration is as high as 1700 mm/year.

---

[1] There are more than two million hectares of irrigated land in the Amu Darya basin, approximately one half of the total irrigated area in Uzbekistan.

[2] Khorezm denotes an average annual precipitation below 100 mm.

Figure 6-1: Irrigation system in the Khorezm region



Current figures estimate the population in the Khorezm region exceeds 1.2 million, with about 80 % living in the rural areas. The province is divided into 10 administrative districts with Urgench as the administrative center. The Amu Darya provides irrigation water to some 270 thousand hectares of land in the Khorezm region (of which >12 % is highly salinized). The region accounts for 15 % of all water withdrawls in Uzbkistan and water consumption for agriculture is estimated at 94 % of the total regional water budget.

The main strategic crop in the Khorezm region is cotton, occupying more than 45 % of all sown area in the period 1998-2001. Other basic crops in the Khorezm region include wheat, rice, potato, vegetables, melons, fruits and grapes. After 1993 the government started a new policy aimed at independence in grain supply and, more specifically, self-sufficiency in wheat. During the same period, cereal production has increased mainly through state orders, subsidies and direct credits. These policies have led to a decline in vegetable and fodder crops, which in turn has negatively affected livestock breeding and productivity, as well as the quality and productivity of agricultural lands due to the elimination of crop rotation.

Costs of cotton and wheat production in the Khorezm region and Uzbekistan were still higher than at the international level; yields did not increase and new, more effective technologies were not introduced (UNITED NATIONS, 2001). The average water use per hectare is up to 12000 m^3; for wheat, rice and cotton it is around 5000, 30000, 12000 m^3, respectively (UNESCO, 2000; FAO, 1997).

One of the central problems of the irrigation system seems to be its poor efficiency and maintenance. Water application efficiency in the field averages just 40 %, while water distribution efficiency to the fields is approximately 50 % (UNESCO, 2000; FAO 1997). The annual discharge of collector and drainage water in the Khorezm region goes directly to evaporation ponds, natural salt lakes, or is re-used for irrigation. High water consumption and high loss rates require better management and restructuring of the farming system; but one has to bear in mind that due to the transition to a market economy there is a lack of economic incentives and financial resources to improve the irrigation system, and neither land-use nor water-use practices at the moment encourage improved efficiency in water use. For these aforementioned reasons, models can serve as an instrument to assess alternatives for future strategies.

3 METHODOLOGY

Economic-hydrologic models

Sustainable and efficient management of water resources requires an interdisciplinary approach. To analyze the management policies, natural, economic and social aspects have to be integrated into a consistent model. The economic components are driven by the hydrologic and agronomic system that is based on physical parameters and principles while the hydrologic components and their operation is driven by socio-economic (and environmental) objectives.[3]

Khorezm Water Management Model

The aims of the modeling analysis include:

- The detection of water supply and demand balance resulting from water availability and water use patterns in the region of Khorezm;
- The evaluation of economic and environmental consequences (costs, benefits, tradeoffs and complementarities) of water use in the region and the detection of water based or related constraints to agricultural and economic development;
- The exploration of the impacts of economic incentives such as water prices, irrigation investment; salinity control measures on crop pattern change, water use and hydrology;
- The identification of strategies and policies for more efficient water allocation among users, agricultural development and water resource demand management in the Khorezm region.

---

[3] For further details see MCKINNEY et al., 1999; CAI et al., 2003b.

The regional water management model is built up as a system of nonlinear equations. The model components and the interactions among them are based on hydrologic, agronomic, economic and institutional relationships. The model is developed in the context of the Khorezm region, where the agricultural demand for irrigation purposes plays the most important role (other sectors are marginal). The allocation of water via irrigation canals of different orders to the field level will be of special consideration, including water distribution and conveyance and field application efficiencies, irrigation network and canal lining.

The model is comprised of:

- Hydrologic components (water flow and salinity transport and balances, groundwater balances, crop field water and salinity balances);
- Economic relationships and incentives (production and profit functions for different crops and water uses, costs, welfare, water prices and taxes);
- Agronomic components (crop parameters, yields, soil characteristics);
- Irrigation management (efficiency) and environmental conditions (salinity control);
- Institutional rules and policies (water and salinity regulations).

Structure, components and modules of the model

The Amu Darya river water is distributed to the main irrigation canals in the Khorezm region. As the model is static, the water is exogenously given to the region and then distributed to the districts. Within the districts the water is distributed for industrial/municipal consumption and to the different agricultural demand sites. Here the water is allocated to a number of crop fields according to their water requirements and profitability and according to different soil types. The water from the river, local water from precipitation, drainage re-use and groundwater are all considered as sources for irrigation. The major fraction of irrigation water is consumed by crops via evapotranspiration; the rest is percolated to the downward layer and to groundwater; part of the percolation is drained and delivered to evaporation ponds or is re-used for irrigation. Due to increasing groundwater levels and the deliberate afflux of irrigation and drainage water within the canals, the influence of groundwater pumping, as well as leaching, and groundwater exchange with the crop root zone (via seepage losses and capillary rise) is simulated in the modeling framework.

The cropping areas and yields are determined within the optimization model within a given set of boundaries that represent historical cropping patterns and yields. At the regional scale, the general hydrologic operation and water allocation to districts is determined for the purpose of maximizing agricultural gross margins for the single districts and for the whole region. For water allocation at the

sub-regional and district level, efficiency of the water distribution system and the groundwater and drainage system are taken into consideration. The allocation among crops and among different soil types is determined with consideration of soil parameters, cropping pattern and crop characteristics.

The demand of water is determined endogenously within the model by using empirical agronomic production functions. Water supply is determined through hydrologic water balances (surface water, groundwater balance, drainage water, soil water) in the region with extension to the irrigated crop fields at each of the irrigation demand sites.

Water demand and water supply are then integrated into an endogenous system; the valuation of revenues, crop market prices, and gross margins is implemented in an economic objective function, which is constrained by hydrologic, agronomic, and institutional relations. In particular, crop yield that relates water demand and supply is determined by the requirement of evapotranspiration and water allocated to particular crops.

One of the important purposes in this study is to apply economic incentives (like subsidies taxes, water prices and water rights) to obtain alternatives for efficient water allocation and pollution control. To perceive whether those alternatives have an effect on the current system, the analysis of those economic incentives and their influences on profits and costs, the hydrologic system operations and the water use will be undertaken using a scenario analysis.

The model consists of 10 districts, 8 different crops (cotton, wheat, rice, other grain, alfalfa, vegetables, fruits, potatoes) in each of the districts, and 3 main soil types.

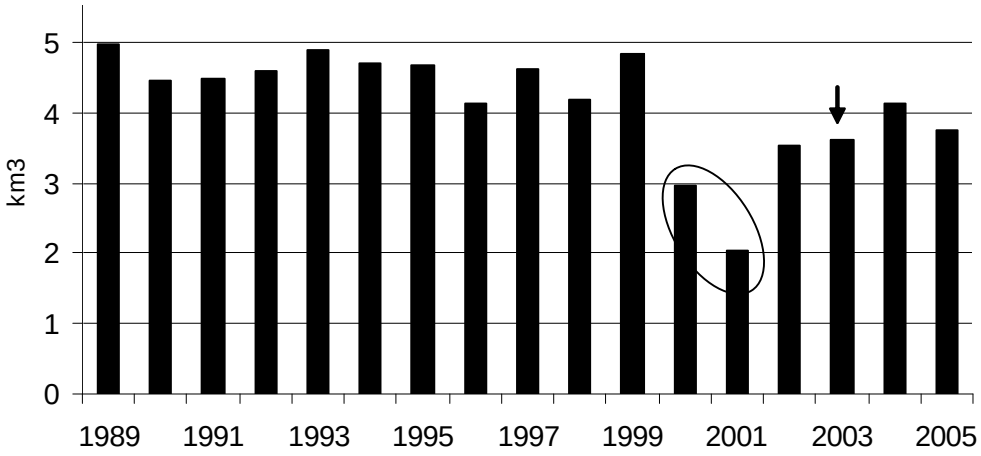
Salt concentrations for surface and subsurface water, groundwater and crop fields, drainage and return flow are calculated within the model and shall provide a basis for environmental analysis, i.e. the future development of the irrigation system under increasing levels of salinity in the irrigation water and subsequent salinity accumulation in the soil.

The model is coded in a modeling language provided by General Algebraic Modeling System (GAMS) (BROOKE et al., 1988), a package for mathematical programming problems. The modeling horizon covers a hydrologic year with 12 one-month intervals.

Data, data interpretation and model parameters

The modeling framework requires multidisciplinary data sets and programs covering hydrology, climatology, agronomy, economy, social aspects; crop, soil, and ground-water-related parameters are also involved. In this section a short description of hydrologic, economic and agronomic conditions within the area will be given, which serves as the basis for the modeling work and finally for policy analyses.

Figure 6-2: Water availability in the Khorezm region by year, 1989-2005

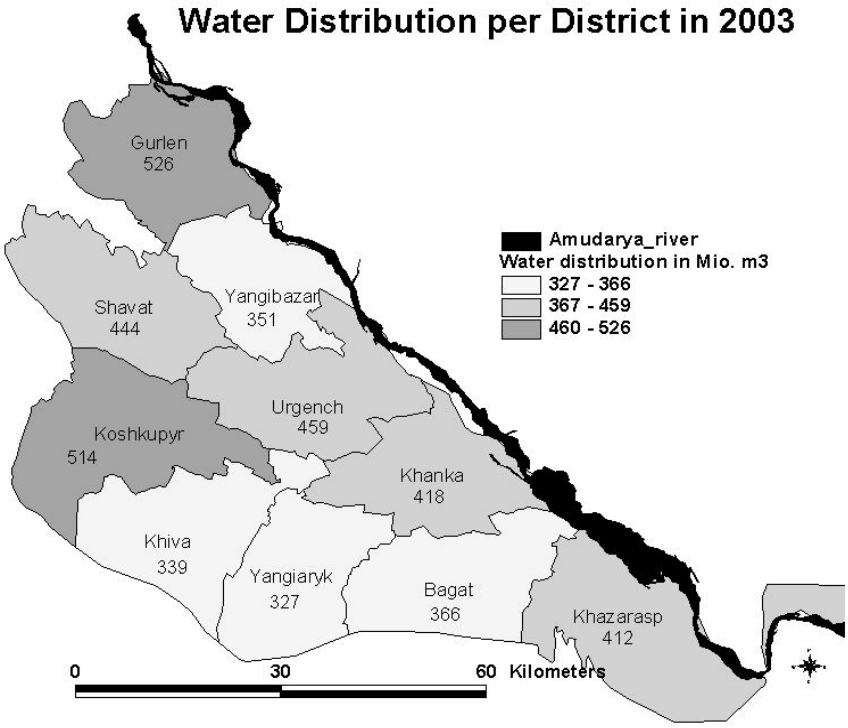


Source: OBLVODKHOZ (2004), UPRADIK 2001/2004, OBLSELVODKHOS 2002, SIC ICWC 2005.

Notes: Encircled are drought years. The arrow indicates the 2003 data which were used in this study.

The annual water availability (Figure 6-2) during 1989-2005 shows that 2000-2001 was a period of particular water scarcity, especially so within the vegetation period. This affected crop yield, acreage and profits (MÜLLER, 2006). The following years showed an upward trend but water supply did not come back to the level of the 1990s. The model presented here is validated based on data for year 2003 (arrow) as this year seems to be a year "typical" for the medium water availability after 1999.

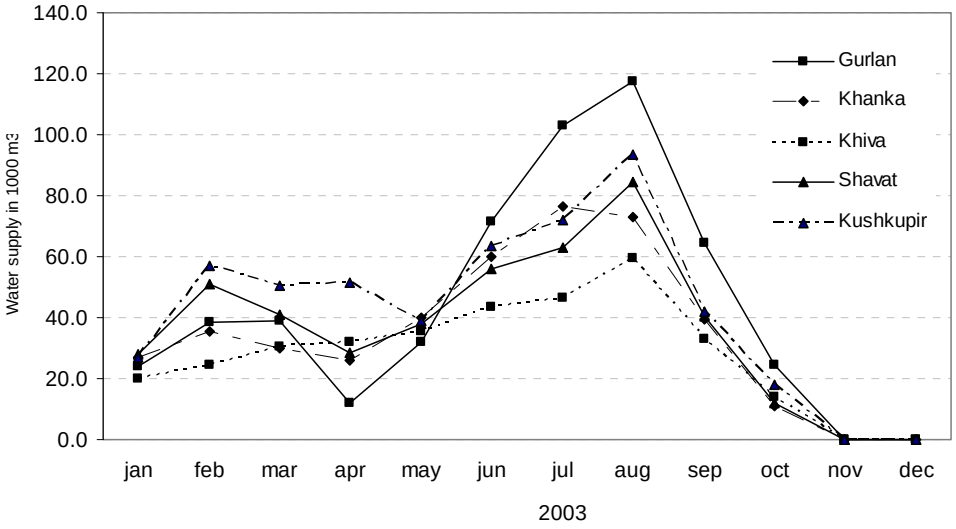
Figure 6-3: Water allocation to districts in the Khorezm region



Source: OBLWODKHOZ, 2004.

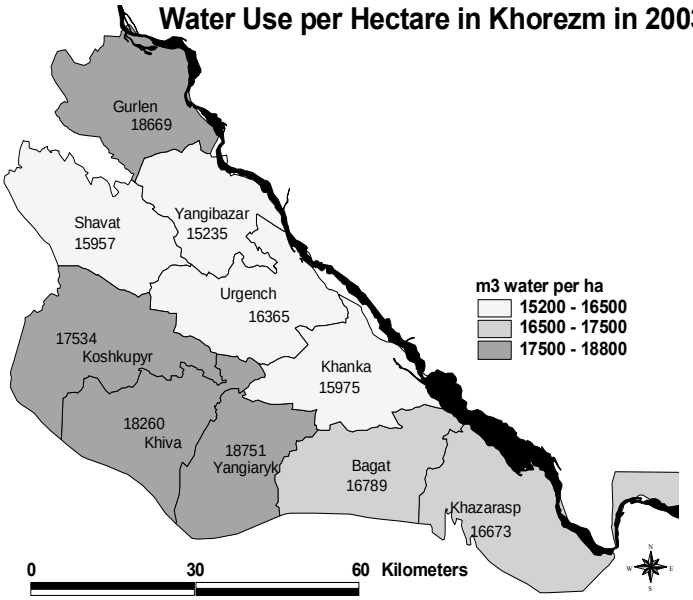
Water proportioning by district in 2003 (Figure 6-3) shows that districts located downstream of the river received less water than those upstream. The exception is Kushkupir, here the high amount of leaching water in February to April contributes to a very high cumulative water supply (see also Figure 6-4).

Figure 6-4: Monthly water supply for selected Khorezm districts in 2003



Monthly water supply by district (Figure 6-4) is characterized by high water inputs in the main crop growth periods (June to September) with peaks in July and August. A relatively high amount of water flowing into the system in non-vegetation periods (Oct-March) is used mainly for filling up the channel system (Jan-Feb) and leaching of salts out of the soil (Feb-March). For this reason, leaching is also considered in the model.[4]

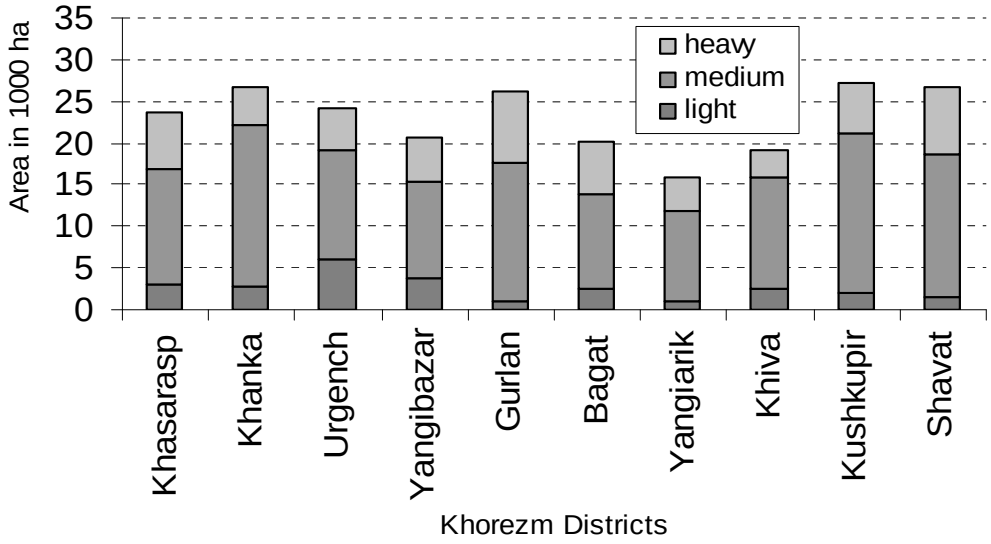
Figure 6-5: Per hectare water use and district averages



[4] Up to 25% of total water supply is used for leaching in 2003.

Water use per hectare in among individual districts shows a relatively uniform distribution, with an average water consumption range (Figure 6-5) between 15.200 and 18.700 m^3 per hectare. In Gurlan, a district dominated by cotton and rice cultivation, higher levels of water were consumed. The other districts of greater distance from the river (Khiva, Yangiarik) show higher water consumption per hectare, which may be due to high water losses within the irrigation canal system. In contrast, the canal network for Urgench, Khanka and Yangibazar is well extended and close to the Amu Darya River whereby lower water use per hectare could be explained due to higher distribution efficiencies and better utilization of water supply.

Figure 6-6: Irrigation-soil-areas in the Khorezm region



Source: SOYUZNIHI UZASHI, 1992.

To account for the different soil types in the dataset, the model differentiates so-called hydro-module zones, a differentiation of soils based on soil texture and groundwater table levels. Light soils comprise sandy and sandy-loamy soils (clay fraction under 35 %), medium soils are defined by light and moderately textured loamy soils, and heavy soils comprise the heavy loamy and loamy soils, with homogeneous and heterogeneous texture and a clay fraction of minimum 45 % (SOYUZNIHI, 1992). Soil texture classes determine important parameters such as soil moisture, hydraulic conductivity, and storage capacity, parameters which have a strong influce on soil water balance and crop yields.

4 ANALYSIS, VALIDATION, SENSITIVITY

Positive, descriptive model

For the purpose of model validation, first a so called "Positive Model" was established to assess the model consistency with the reality. A positive model analyzes "what is", unlike a normative model that analyzes "what should be". For the positive model, all relevant input parameters of water supply, cropping areas and yields were taken from actual data obtained in 2003 and fixed in the model. This allows a "base-line" scenario to be established and thus illustrates if the outcomes underlying the model formulation and data for water balances and crop production processes stand in a realistic range. Subsequently, the fixation will be released to crosscheck the impact of some relevant parameters and to obtain a validated optimization model with appropriate constraints.

With fixed water supply, cropping areas and yields, it is possible to calculate de-facto economic values like gross margins of agricultural crops based on underlying hydrologic and agronomic model fundamentals. This is a way to evaluate model structure, equations and data by outcome, like crop production and profit, that are based on evapotranspiration and (ground, drainage and surface) water balances.

The determination of actual evapotranspiration (ETa) is one of the most important procedures as crop growth, soil moisture and soil water balance, yields and corresponding agricultural profit and benefits form a chain of causation. Monthly ETa is determined for all 10 districts, 8 crops, and 3 soil types. ETa ranges between 340 (wheat) to 1055 (rice) mm, with an annual average of 680 mm in 2003 (see Figure 6-7). Due to the high water consumption requirement and the type of irrigation in use, rice has an exceptionally high ETa rate. Winter wheat, as it grows in winter and spring, has the slightest evapotranspiration (Figures 6-6 and 6-7). Differences between crops are relatively high due to crop specific properties like crop development stages, plant height, leaf area, ground coverage and water management (ALLEN et al., 1998). Also differences of ETa between soil types are not negligible (see Figure 6-8), which depend on soil characteristics like humidity, storage capacity, porosity and matrix potential.

Figure 6-7: Calculated ETa for the district Gurlan (by crop type)

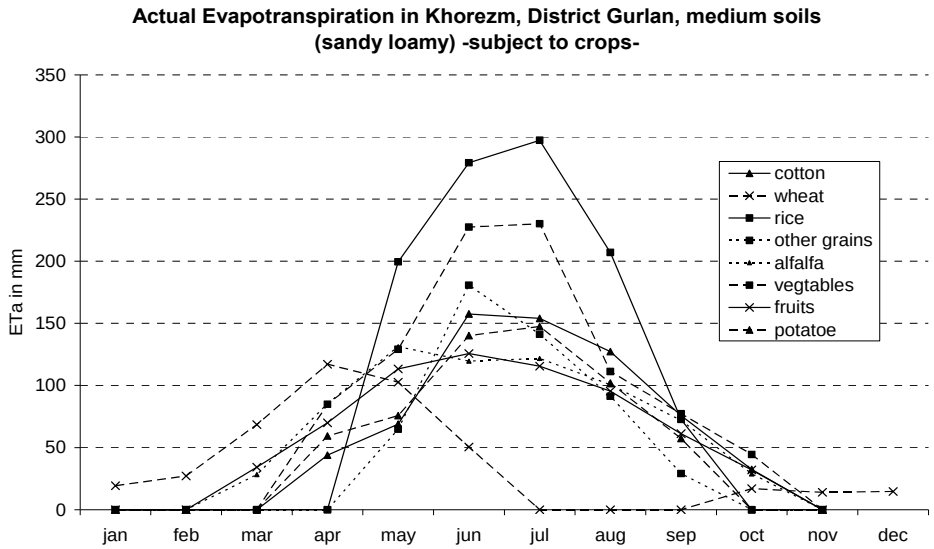
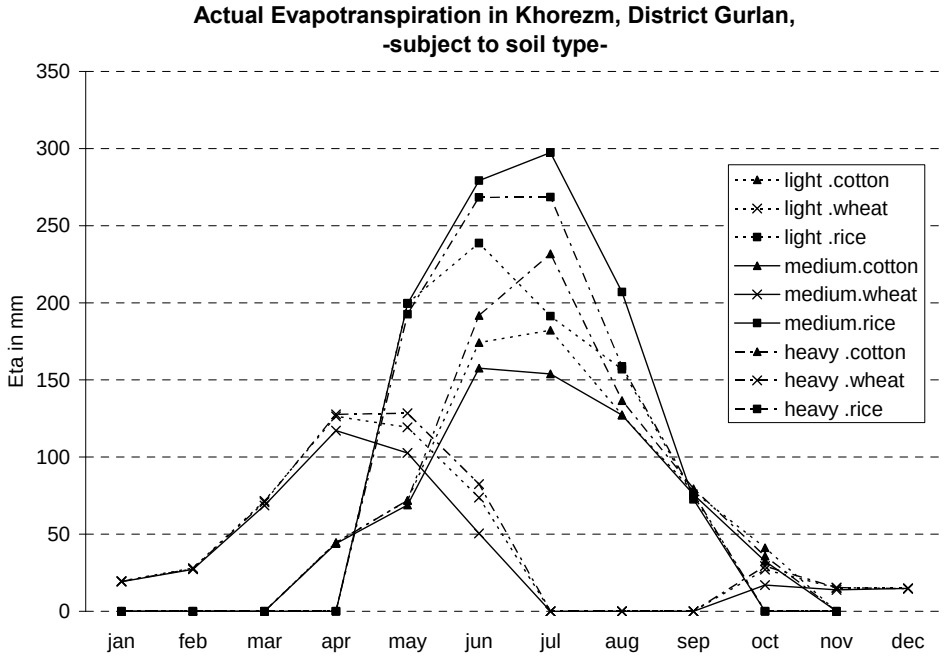


Figure 6-8: Calculated ETa for the district Gurlan (by soil type)



The range of ETa in 2003 in the Khorezm region matches very well those of other studies. CONRAD et al. (2004, 2006) calculated an evapotranspiration for the summer season of 530 to more than 1000 mm, with an average of approx. 600-900 mm. FORKUTSA (2005, 2006) calculated ETa values based on some field observation in Khiva in the range of 160-640 mm (average of 450) within the vegetation period 2003.

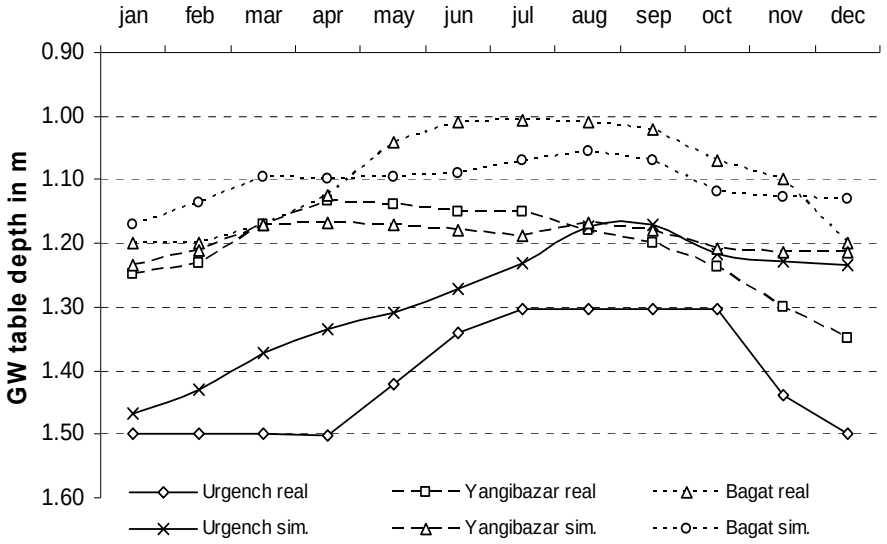
For a first plausibility-based groundwater validation, simulated groundwater values for all districts in the Khorezm region were compared with extrapolated and averaged groundwater data that are available for around 1000 groundwater observation wells distributed over the Khorezm region (IBRAKHIMOV, 2005). Those

groundwater measurements were conducted three times per year in April, July, and October and the values in the remaining months were interpolated. With only three specifications per year it is difficult to adjust groundwater curves, but a simple interpolation method was chosen as the most appropriate approach here.

Real data were also crosschecked with monthly groundwater measurements on an experimental farm in the Khorezm region (TISCHBEIN, 2006). The characteristics of the groundwater curves are comparable. As can be seen in Figure 6-9, simulated groundwater levels over months match well with the quasi real groundwater values. Here the use of a simple groundwater tank model provided by BEAR (1977) and implemented by CAI (1999) seems to be an effective instrument to emulate groundwater balances involving pumping and extraction, percolation and discharge processes.

Groundwater in the Khorezm region is in general relatively shallow (Figure 6-9). Due to leaching in February to April and intensive irrigation during the summer months, the groundwater table can rise towards the ground surface. Such a shallow groundwater status is desired by farmers and to some extent is consciously manipulated (water afflux in canals, blockage of drainage) since subsurface water can be used by the crops, and functions as a "storage" mechanism during periods of water shortages.

Figure 6-9: Groundwater simulation and validation



Source: "Real groundwater data": MAWR (2003/2005).

After the calculation and validation of hydrologic and agronomic parameters and relative crop yields (based on actual evapotranspiration)[5], it is now possible to determine economic parameters such as gross margins for main agricultural crops per district, value of water, marginal value, gross revenue and costs of crop production (Table 6-1).

[5] For additional validation of parameters like deep percolation, soil moisture, drainage, crop water consumption see SCHIEDER (2008, forthcoming).

Table 6-1: Some economic indicators for the Khorezm region in 2003 resulting from the model

		Khasarasp	Khanka	Urgench	Yangibazar	Gurlan	Bagat	Yangiarik	Khiva	Khushkupir	Shavat	Khorezm total
Gross margin, in M US $	with water price	6.76	6.33	5.069	2.068	7.227	3.007	4.35	3.156	0.161	2.888	41.016
	without water price	8.007	7.626	6.479	3.167	8.846	4.089	5.287	4.179	1.634	4.181	53.495
Gross margin, US$/ha		285	237	211	100	276	149	275	164	6	108	178
Cropped area in 1000ha		23.7	26.7	24.1	20.6	26.2	20.2	15.8	19.2	27.3	26.7	230.5
Revenue in M US $		16.31	15.64	14.29	9.93	18.26	10.42	10.58	9.87	9.46	12.07	126.82
Variable planting costs, M US$		8.30	8.01	7.81	6.76	9.41	6.33	5.30	5.69	7.82	7.89	73.33
water costs, M US$		1.24	1.26	1.38	1.05	1.58	1.10	0.98	1.02	1.54	1.33	12.46
total water applied, M m3		411.8	418.5	458.5	350.9	526.6	366.1	326.6	338.6	513.5	443.6	4154.7
Value of water US $/m3	with water price	0.016	0.015	0.011	0.006	0.014	0.008	0.013	0.009	0.0003	0.007	0.010
	without water price	0.019	0.018	0.014	0.009	0.017	0.011	0.016	0.012	0.003	0.009	0.013

Determination of Gross Margins (GM), Water Costs (WC) and Water Application (WA) for single crops/crop field level and for all districts is calculated by:

$$GM\_c_{dt,c} = \mathrm{Re}v\_c_{dt,c} - WC\_c_{dt,c} - \sum_{s} Area_{dt,s,c} * Otc_{dt,c} \quad (1)$$

$$GM\_all_{dt} = \sum_{c} GM\_c_{dt,c} \quad (2)$$

$$WC\_c_{dt,c} = SW\_c_{dt,c} * Sct_{dt} + PW\_c_{dt,c} * Gct_{dt} \quad (3)$$

$$WC\_all_{dt} = SW\_all_{dt} * Sct_{dt} + PW\_all_{dt} * Gct_{dt} \quad (4)$$

$$SW\_c_{dt,c} = \sum_{m}\sum_{s} WCP_{dt,s,c,m} / eff\_dstr * (1 + leach) \quad (5)$$

$$SW\_all_{dt} = \sum_{m} WS\_dt_{dt,m} \quad (6)$$

The items involved in these equations are defined in the following:

GM_c, GM_all	Gross margins for crops and districts	*SW_c, SW_all*	Surface water applied to crops and districts
Rev_c, Rev_all	Revenue for crops and districts	*PW_c, PW_all*	Pumped water applied to crops and districts
WC_c, WC_all	Water costs for crops and districts	*dt,c,s*	District, crop, soil
WV_c, WV_all	Value of water for crops and districts	*Area*	Cropped area
Otc	Other variable planting costs	*Sct*	Surface water price (Costs)
Gct	Groundwater pumping costs	*WCP*	Surface water applied to fields
Eff_dstr	Distribution efficiency	*Leach*	Leaching fraction of water application
WS_dt	Gross water supply to districts		

Gross Margins act as an indicator of profitability of crops as well as of districts (Equation 1-6), the proportion of leaching is included, as leaching is one important factor in crop growing processes and soil preparation and must be reflected within economical analyses. In 2003, the reference year of the calculations, the leaching fraction was relatively high, due in large part to favorable climatic conditions, and leaching – which normally begins in March – was initiated in January and February. Around 20 % of the total water supply was leached within the first months of the year.[6]

In Table 6-2, a differentiation between gross margins with and without a water price is demonstrated. For the calculation of water costs for districts and for single crops, total gross surface water and pumped water applied to fields and their costs are included. An overall surface water cost of 0.003 US$ per cubic meter

[6] In this preliminary assessment, salinity was not included. Irrigation and groundwater salinity is likely to reduce gross margins as it affects crop growth.

and pumping cost of 0.005 US$ per cubic meter are assumed. As can be seen, those water pricing items have a relatively large influence of approximately 23 %, compared to the situation without water costs on gross margins.

Another interesting point is the distribution of gross margins over single crops. As shown in Table 6-2, mainly cotton and alfalfa have a negative value. This means that even without introduction of water pricing, the costs for those crops exceed revenues. For alfalfa, this can be explained by the fact that alfalfa is mainly used within the farms and not for selling. For cotton, the state order in cotton production and the controlled lower selling prices resulted in relatively low gross margins. It must be noted that depending on the farmer's cotton growing orders, pesticides, machinery and seed will be provided and do not reflect real marked prices. Despite significant favorable crop growing prices in 2003 it would in general not have been worthwhile for farmers to grow cotton mainly because of lower selling prices (when compared with world market prices). But the fact that the government commands and buys a certain quantity of cotton at guaranteed prices while at the same time providing subsidized inputs (MÜLLER, 2007, chapter 10 in this volume; RUDENKO and LAMERS, 2007) represents an enormous incentive for farmers to consider cotton production as a "safe" option that somehow – not necessarily in monetary terms – compensates for the lower prices.

In contrast, high prices are being paid for rice and vegetables, but they also consume much more irrigation water. The share of these two crops in terms of total area seems to be controlled mostly by administrative orders. It remains to be studied how the present cropping pattern would be affected by water prices? Water values per crop will be discussed below and can be useful in decision-making.

Table 6-2: Gross margin per crop in M US$, without water pricing

	Cotton	Wheat	Rice	Other grain	Alfalfa	Vegetable	Fruit	Potato
Khasarasp	-0.222	0.571	6.651	0.018	-0.166	1.119	0.028	0.008
Khanka	0.004	0.59	4.929	0.025	-0.186	1.959	0.068	0.237
Urgench	-0.538	0.755	5.061	0.059	-0.149	1.044	0.214	0.032
Yangibazar	-0.638	0.434	3.07	0.011	-0.152	0.455	-0.108	0.096
Gurlan	-1.344	0.375	8.54	0.072	-0.265	1.122	0.184	0.163
Bagat	-0.321	0.605	3.087	0.022	-0.234	0.796	0.042	0.094
Yangiarik	-0.204	0.356	3.748	0.035	-0.116	1.248	0.076	0.145
Khiva	0.053	0.27	1.065	0.012	-0.091	2.517	0.075	0.278
Kushkupir	-1.06	0.623	1.765	0.041	-0.386	0.553	0.011	0.087
Shavat	-0.433	0.541	2.202	0.027	-0.193	1.23	0.321	0.486
Khorezm total	-4.703	5.12	40.118	0.322	-1.938	12.043	0.911	1.626

Revenues are determined by produced yields and obtained market prices:

$$\mathrm{Re}v\_c_{dt,c} = \sum_{soil} yld_{dt,c} * Area_{dt,s,c} * Cpp_{dt,c} \qquad \mathrm{Re}v\_all_{dt} = \sum_{c} \mathrm{Re}v\_c_{dt,c} \tag{7}$$

with:

yld Yields

Cpp Crop selling prices

Table 6-3: Revenues per crop and district, in M US$:

	Cotton	Wheat	Rice	Other grain	Alfalfa	Vegetable	Fruit	Potato
Khasarasp	3.84	1.63	8.93	0.04	0.09	1.45	0.30	0.05
Khanka	4.05	1.90	6.44	0.06	0.10	2.40	0.27	0.44
Urgench	3.05	2.02	6.71	0.13	0.06	1.54	0.56	0.24
Yangibazar	3.32	1.41	3.97	0.03	0.16	0.64	0.20	0.21
Gurlan	3.30	1.17	11.06	0.15	0.13	1.53	0.55	0.38
Bagat	3.10	1.76	3.99	0.04	0.07	1.02	0.26	0.17
Yangiarik	2.27	1.10	4.90	0.08	0.14	1.52	0.26	0.32
Khiva	3.02	1.25	1.42	0.04	0.09	3.26	0.27	0.52
Kushkupir	3.37	1.92	2.38	0.11	0.14	0.95	0.30	0.30
Shavat	3.91	2.00	2.97	0.08	0.20	1.57	0.65	0.70
Khorezm total	3.32	1.61	5.28	0.07	0.12	1.59	0.36	0.33

As can be seen in Table 6-3, the highest revenues can be obtained for rice and cotton, this is mainly because of the large cropped areas for cotton (>45 %), and due to the high selling prices of around 450 US$/ton for rice. With respect to gross margins, alfalfa and maize, sorghum, barley, and beet have relatively small revenues and total production of these crops is used internally.

Finally, the economic value of water is calculated with respect to water application to crop fields and water withdrawals to districts (Table 6-1, Table 6-4). Depending on this water value, decisions on cropping patterns and areas, water allocation and applications to crops can be implemented. The economic value of water is established as the relationship between gross margins to total water costs with respect to single crops and to districts.

$$WV\_c_{dt,c} = GM\_c_{dt,c} / TW\_c_{dt,c} \tag{8}$$

$$WV\_all_{dt} = GM\_all_{dt} / TW\_all_{dt} \tag{9}$$

with:

TW_c, TW_all Total Water applied to Crops and Districts

Table 6-4: Water value per crop and district, in M US$ m^{-3}, without water pricing

	Cotton	Wheat	Rice	Other grain	Alfalfa	Vegeta-ble	Fruit	Potato
Khasarasp	-0.001	0.011	0.079	0.008	-0.004	0.075	0.002	0.006
Khanka	0.00002	0.007	0.090	0.011	-0.003	0.095	0.007	0.032
Urgench	-0.003	0.009	0.054	0.007	-0.003	0.035	0.009	0.003
Yangibazar	-0.003	0.008	0.084	0.012	-0.003	0.031	-0.004	0.018
Gurlan	-0.006	0.009	0.058	0.011	-0.004	0.038	0.007	0.012
Bagat	-0.001	0.017	0.114	0.010	-0.006	0.053	0.003	0.020
Yangiarik	-0.001	0.015	0.078	0.008	-0.004	0.088	0.006	0.020
Khiva	0.0004	0.005	0.050	0.004	-0.002	0.042	0.005	0.020
Kushkupir	-0.005	0.008	0.051	0.013	-0.004	0.023	0.001	0.011
Shavat	-0.003	0.008	0.045	0.006	-0.003	0.050	0.012	0.046
Khorezm total, avg	-0.002	0.010	0.070	0.009	-0.004	0.053	0.005	0.019

As shown in Table 6-4, the economic value of water for rice and for vegetables is relatively high compared to that of other crops. Particularly for rice, this result is surprising as one would expect a lower value mainly due to the higher water utilization rate for rice. Revenues for rice are much higher than for other crops, so it is worthwhile for farmers to grow rice.

5 OPTIMIZATION

After introducing this "positive model" – the validation of main parameters and of economic and hydrologic de-facto analyses – the normative optimization model can be executed, which is presently under way (SCHIEDER, 2008 forthcoming). The economic analyses that are or will be conducted address the following questions:

- What is the economic value of water for different crops and demand sites and how does it change over time under different water supply situations?
- What influences will infrastructural investment have on profits and costs, as well as on water use efficiency?
- How will the irrigated area change under various hydrological conditions and how does it affect gross margins?
- How will the change of output prices influence cultivation, cropping area or crop type, and how sensitive will the cropping area and crop prices react to the modification of cotton or wheat prices?

- What will happen to water users, profit, demand, area and value of water if water prices are introduced?
- Is it possible to raise a tax on excessive salt discharge and what are the consequences on profits and incomes, as well as salt quantity?

6 CONCLUSIONS

This paper presents a system modeling approach to analyze efficient water allocation and sustainable water resource management at a regional scale for the the Khorezm region in Uzbekistan. The main advantage of the model is its capability to integrate several aspects of the regional agricultural water use system, including socio-economic, hydrologic, and ecological aspects in a consistent system, and to account for the interdisciplinary nature of water resource problems within the context of an irrigation-dominated agricultural region. With this model it will be possible to analyze, for example, the effects of institutional directives and economical incentives on ecology and hydrology, and, vice versa, the impacts of hydrological situations on the economy.

Preliminary results and tests from the "positive model" outlined above demonstrate a running, robust model that provides plausible results. The model will be expanded to include salinity simulation and leaching mechanisms, sensitivity analyses of model parameters, and more extensive economic and hydrologic analyses. The model has been constructed in a way to allow further extension from a regional scale to a river basin scale or further focusing on a local scale such as farms for more detailed analysis. The model also can serve as one part of a decision support system to be developed for agriculture and water management in Uzbekistan.

ACKNOWLEDGEMENTS

This study was funded by the German Ministry for Education and Research (BMBF; project number 0339970A).

REFERENCES

BEAR, J. (1977): Hydraulics of groundwater, New York.

BROOKE, A., KENDRICK, D., MEERAUS, A., RAMAN, R. (1998): GAMS. A users guide, Oxford.

CAI, X. (1999): A modeling framework for sustainable water resources management, University of Austin [Dissertation].

CAI, X., MCKINNEY, D. C., ROSEGRANT, M. W. (2003a): Sustainability analysis for irrigation water management in the Aral Sea region, *Agricultural Systems, 76(3)*, pp. 1043-1066.

CAI, X., MCKINNEY, D. C., LASDON, L. (2003b): An integrated hydrologic-agronomic-economic model for river basin management, *Journal of Water Resources Planning and Management, 129 (1)*, pp. 4-17.

CENTRAL ASIA REGIONAL WATER INFORMATION BASE [CAREWIB] PROJECT: Information portal for water and environmental issues in Central Asia, <http://www.cawater-info.net/index_e.htm>.

CONRAD, C. (2006): Fernerkundungsbasierte Modellierung und hydrologische Messungen zur Analyse und Bewertung der landwirtschaftlichen Wassernutzung in der Region Khorezm (Usbekistan), University of Würzburg [Dissertation].

CONRAD, C., RÜCKER, G. R., SCHWEITZER, C., DECH, S., HAFEEZ, M. (2004): Modeling seasonal actual evapotranspiration with remote sensing and GIS in Khorezm region, Uzbekistan, in: OWE, M., D'URSO, G., GOUWELEEUW, B. T., JOCHUM, A. M. (eds.): Remote sensing for agriculture, ecosystems, and hydrology VI, Proceedings of SPIE, 5568, pp. 214-224, 11th SPIE International Symposium on Remote Sensing, Mas Palomas, Gran Canaria, 14-16 September 2004.

DEPARTMENT OF AGRICULTURE AND WATER RESOURCES IN KHOREZM REGION [OBLWOCHOS] (2004): Final information on realization of water using plan during period of 2001-2004 in Rayons of Khorezm region, Urgench.

DEPARTMENT OF IRRIGATION AND DRAINAGE SYSTEM [UPRADIK] (2001): Technical report for year 2000, Urgench.

DEPARTMENT OF IRRIGATION AND DRAINAGE SYSTEM [UPRADIK] (2004): Technical report for year 2001-2004, Urgench.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS [FAO] (1997): AQUASTAT country profile: Uzbekistan, <http://www.fao.org/ag/agl/aglw/aquastat/countries/uzbekistan/index.stm>.

FORKUTSA, I. (2005): Personal communication, 17 August, 2005.

FORKUTSA, I. (2006): Modeling water and salt dynamics under irrigated cotton with shallow groundwater in the Khorezm region of Uzbekistan, University of Bonn [Dissertation].

GIESE, E. (1998): Die ökologische Krise des Aralsees und der Aralseeregion, in: GIESE, E., BAHRO, G., BETKE, D. (eds.): Umweltzerstörungen in Trockengebieten Zentralasiens (West- und Ost-Turkestan), Ursachen, Auswirkungen, Maßnahmen, Stuttgart.

IBRAKHIMOV, M. (2005): Spatial and temporal dynamics of groundwater table and salinity in Khorezm (Aral Sea Basin), Uzbekistan, *ZEF Ecology and Development Series 23*, Bonn.

KHOREZM DEPARTMENT OF LAND AND WATER RESOURCES OF MINISTRY OF AGRICULTURE AND WATER RESOURCES [OBLSELVODKHOS] (2002): Data on norms, limits and usage of irrigation water from 1997 to 2001, Urgench.

LUBIN, N. (2004): Uzbekistan. A country study: Uzbekistan, in: CURTIS, G. E. (ed.): Kazakstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan: Country studies, Washington, D. C.

MCKINNEY, D. C., CAI, X., ROSEGRANT, M., CLAUDIA, C. C. A. SCOTT (1999): Integrated Basin-Scale Water Resources Management Modeling: Review and Future Directions, *SWIM paper 6,* Colombo.

MINISTRY OF AGRICULTURE AND WATER RESOURCES OF UZBEKISTAN [MAWR] (2002): Hydro-eological melioration expedition (Khorezm) of the MAWR, April 1990-Oct 2001, Tashkent.

MINISTRY OF AGRICULTURE AND WATER RESOURCES OF UZBEKISTAN [MAWR] (2005): Hydro-geological melioration expedition (Khorezm) of the MAWR, April 2003-Oct 2004, Tashkent.

MÜLLER, M. (2006): A general equilibrium approach to modelling water and land use reforms in Uzbekistan, University of Bonn [Dissertation].

RUDENKO, I., LAMERS, J. P.A . (2006): The comparative advantages of the present and future payment structure for agricultural producers in Uzbekistan, *Central Asian Journal of Management, Economics and Social Research, 5(1-2)*, pp. 106-125.

SCHIEDER, T. (2008 – forthcoming): Analysis of water use and allocation for the Khorezm region in Uzbekistan using an integrated economic-hydrologic model, University of Bonn [Dissertation].

SOVIET UNION SCIENTIFIC-RESEARCH INSTITUTE OF COTTON PRODUCTION [SOYUZNIHI] (1992): Melioration and irrigation of crops in cotton rotation, Tashkent [in Russian].

TISCHBEIN, B. (2006): Personal communication, 14 June, 2006.

UNESCO (2000): Water related vision for the Aral Sea basin for the year 2025, Fontenoy.

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE [UNECE] (2001): Environmental performance review of Uzbekistan, New York/Geneva.

Continuity and change: Land and water use reforms in rural Uzbekistan,
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 7, pp. 129-141.

CHAPTER 7

PROBLEMS AND PERSPECTIVES OF WATER USER ASSOCIATIONS IN UZBEKISTAN

DARYA HIRSCH[*]

ABSTRACT

From the first days of their independence in 1990, the countries of Central Asia began to reform land use and agriculture. In the Republic of Uzbekistan, as a result of establishment of relatively small farms (from 1 to 100 ha) replacing the former *shirkats* (who were the original follow-up structures to the *kolkhozes* and *sovkhozes*), thousands of individual water users appeared. However, this was not adequately accounted for in the reform processes e.g.: The responsibility for the technical maintenance of on-farm irrigation and drainage systems was not allocated. To provide for this, the first water user associations (WUAs) were established in 2000, and since 2003, a new wave of reforms since 2003 resulted in the complete coverage of the country with WUAs in 2006. This study looks at the functioning of WUAs, their mechanisms of management and conflict resolution. It concludes that WUAs have an important role to fulfill in water distribution in Uzbekistan, but that their functioning is hampered by lack of payments, unclear mandates, and lack of training. Donor-assisted implementation of pilot WUAs, in contrast, showed a better performance and acceptance rate, possibly due to a better emphasis on capacity building.

Keywords: Land reform, water reform, agricultural policies.

[*] Formely: Darya Zavgorodnyaya, University of Osnabrueck, Institute of Environmental Systems Research, Barbarastraße 12, 49069 Osnabrück, Germany, phone: +49/(0)541-969-3342, fax: +49/(0)541-969-2368. Email: dzavgoro@usf.uni-osnabrueck.de.

АССОЦИАЦИЙ ВОДОПОЛЬЗОВАТЕЛЕЙ В УЗБЕКИСТАНЕ: ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ

ДАРЬЯ ХИРШ[*]

АННОТАЦИЯ

С первых дней обретения независимости (1991), страны Центральной Азии начали реформирование использования земельных ресурсов в сельском хозяйстве. В результате создания относительно небольших по площади (1 до 100 га) фермерских хозяйств (взамен бывших колхозов и совхозов), в регионе появились тысячи водопользователей. Но подотчетность не была адекватно организованна для процессов реформ, например, не была распределена ответственность за поддержание технического состояния межфермерских ирригационных и дренажных каналов. Для решения этой проблемы, в Узбекистане, в 2000 году, возникли первые ассоциации водопользователей (АВП), а с 2003 года в республике была начата реформа в водном (ирригационном) секторе и результатом ее явилось полное внедрение АВП по всей республике в 2006 году. Данное исследование изучает работу АВП, ее механизм управления и решения конфликтов. Заключение показывает,что АВП имеют важную роль в выполнении распределении водных ресурсов в Узбекистане, но работа АВП затруднена невыплатой взносов со стороны членов АВП, неясного мандата управления (распределение власти), и нехваткой тренингов. Внедрение пилотных АВП, поддержанных иностранными донорами, показало лучшую работу и более высокий уровень принятия АВП членами, что возможно связано с более тщательным упором на усиление мощностей посредством тренингов и интенсивной работой с персоналом и участниками АВП.

Ключевые слова: Земельная реформа, водная реформа, аграрная политика.

---

[*] Дарья Хирш (Завгородняя), Институт по Исследованию Систем Окружающей Среды, Оснабрюкский Университет, Оснабрюк, Германия, тел: +49/(0)541-969-3342, факс: +49/(0)541-969-2368. Эл. почта: dzavgoro@usf.uni-osnabrueck.de.

1 INTRODUCTION

The economic reforms of the agricultural sector in the Republic of Uzbekistan started in 1992 and continue still today. These reforms are carried out in an "evolutionary" way: Whereas most countries of Central Asia plunged head-on into some form of market economy, the government of Uzbekistan pursued an "Uzbek way" with strong government control of agricultural production (POMFRET and ANDERSON, 2002). Reforms mainly address the organizational aspects of the agricultural enterprises' activities and less the economic aspects such as liberalization of agricultural production, and establishment of markets for agricultural inputs and products. Today, there are different types of agricultural enterprises, in particular collective farms (*shirkats*, now formally extinct), family farms and *dehqons*.

The water sector was not taken into account in the so-called first stage of reforms. This was corrected in the second stage of the reforms that started in 2003. In March of this year, the decisive decree of the President of Uzbekistan was passed "On the most important extension directions of reforms in agriculture" (24 March, 2003) was passed (UZBEKISTAN, 2003a). As a result, an essential resolution of the Cabinet of Ministers of the Republic of Uzbekistan (N 320) dated 21 July, 2003, was issued: "The improvement of water management organization" (UZBEKISTAN, 2003b). These decrees also solicited the establishment of WUAs in the Republic.

The first WUAs in Uzbekistan were established in 2000 in the form of pilot projects, with support from international donor organizations. The government supported the establishment of WUAs in some of the unprofitable collective farms. The first WUAs did not have a secure legal basis and their establishment was legitimated by Cabinet decrees and regulations. The legitimacy of this process was often disputed. Standardized by-laws and other necessary documents such as contracts of water supply were provided by the government. The leaders of WUAs and their technical staff were elected under the supervision of the governmental water management organizations (*OblSelVodKhoz* and *RaySelVodKhoz*).

Whereas the first of these WUAs were established based on the hydrographical principle, i.e. new boundaries were cut to provide for water allocation according to hydrographic micro-basins, later the process was sped up by establishing WUAs that corresponded to the former territories of the *shirkats*.

At the time of this study (2004), there were three WUAs with two or three years experience in Khorezm. All others had been founded only in 2003. Limited economic data such as business plans and reports do not yet allow for a profound investigation of the performance of WUAs. Therefore this study focused on the perception of water users, officials and international donors as a way of assessing the WUA's performance. The study analyzes how WUAs – as a now central element of the reform package in Uzbekistan – are designed and implemented; how do

they function; and how are they perceived by farmers, the government and international donors.

Specific research questions were:

1. How do water users perceive the WUAs? How do users perceive themselves as members of WUAs? What does the membership consist of?
2. What are the characteristics of presently (in 2005) functioning WUAs? What is the importance of leadership and hierarchy? What is important for water users in WUAs in terms of equality[1] and stability? What is unique in the behavioural pattern of Uzbek water users in relation to functions of WUA (e.g. conflict resolution mechanisms etc.)?

The following section of this paper describes the methodology used within this study. Section 3 gives an overview of the results and discussion, and sections 4 and 5 summarize the perspectives of WUAs in the Republic of Uzbekistan. This paper focuses specifically on Khorezm, a region in Northwestern Uzbekistan.

2 METHODOLOGY

Khorezm is a region of the Republic of Uzbekistan, and is located in the irrigated lowlands of the Amu Darya River, which is the major tributary to the Aral Sea. It covers 680,000 ha, of which 270,000 ha are irrigated, and has a population of 1.3 million people of which roughly 70 % are rural. The Khorezm region serves as a model region in which many of the more general problems regarding the establishment of WUAs in Uzbekistan are exemplified, where available, country-wide data were additionally used.

This study is based on qualitative methods; semi-structured interviews were conducted in the Khorezm region with officials and users of WUAs and stakeholders of irrigation management. Triangulation supported the findings where possible. Preliminary results from a standardized questionnaire indicated a need to focus the analysis on the WUA's chairman's role, the importance of user fees, and "indigenous" conflict resolution mechanisms.

Four established WUAs in the Khorezm (See Table 7-1) and four pilot projects supported by international donors in Syr Darya district and Fergana Valley (see Table 7-2) were selected for the research. The water users in the WUAs have a wide variety of primary agricultural training. Their professions range from teachers and medical doctors to agricultural specialists.

---

[1] In Uzbek usage, equity means water distribution based on the irrigation rate of each crop, whereas stability denotes reliable irrigation water supply (from interview with V. Sokolov).

A standardized questionnaire proved to be an appropriate instrument to record the *fermers*' unbiased opinions about WUAs. The questionnaire takes into account factors important for the functioning of WUAs as mentioned by AGRAWAL (2001), OSTROM (1990), MEINZEN-DICK (1999), and BRUNS (1999).

The questionnaire was created and based on so-called attitude questions which address how water users perceive their WUA. The questionnaire was organized in groups of thematically linked questions. So, for instance, if the main question was *"Why do you pay user fees?"*, additional aspects were covered in order to gain complex information about the actors' perceptions, such as their opinion on statements like *"The WUA is our main organization. It is necessary to maintain it with our own means and my user fee is an opportunity to contribute to the common business*!*"*; *"I can take water from the canal and do the cleaning of the canal independently"*; *"I would like to pay the WUA fee, but I don't have the money"* (Figure 7-1). Concerning the role of the WUA chairman for water users, questions revolved around water rotation, conflict mediators and conflict resolution.

Table 7-1: Characteristics of the WUAs investigated in the Khorezm region

No.	Rayon	Names of WUAs	Members	Served area, ha	Number of respondents
1	Khiva	"Mirob"	90	1426	20
2	Yangibazar	"Buston"	239	5043	25
3	Yangibazar	"Eski Daryalik"	93	2822	21
4	Kushkupir	"Shikhyab"	148	1841	23

The theoretical basis for the questions was partially built on WUA design principles developed by OSTROM (1990). Besides Ostrom's design principles, factors such as adaptation of a WUA to local conditions and evolution over time (BRUNS and MEINZEN-DICK, 1998; BRUNS, 1999; HUPPERT and WALKER, 1989, OSTROM, 1990; AGRAWAL, 2001), the degree of the WUA's autonomy, rights, and governance authority to manage irrigation (BRUNS, 1999; MEINZEN-DICK, 1999; OSTROM, 1990), specification of roles and accountability of leaders and employees (MEINZEN-DICK, 1999), financing from irrigation fees and mobilization of money, reliable water delivery and transfer services (BRUNS, 1999), transfer of responsibility to the farmers (BRUNS, 1999; MEINZEN-DICK, 1999), recognition from government and external legitimacy for farmers' activities (MEINZEN-DICK, 1999; OSTROM, 1990, OSTROM, 1992), were identified in the literature as essential for irrigation management.

Answers to the questionnaire were coded; summarized in spreadsheets and analysed with the statistics software package SPSS. In addition the answers were triangularized (cross-checked) with the help of other techniques of qualitative research such as group discussion, role-playing games, mapping, etc. For this, additional

resources were used, e.g., answers to questions concerning the water user meetings, supporting information would include the minutes of the meetings. Data at the national level were obtained from the four different pilot WUAs organized by the three international donors IWMI, ADB and USAid (see Table 7-2).

The present paper is based on a first assessment of the data collected in 2003 and 2004. Readers interested in the full analysis set are referred to ZAVGORODNYAYA (2006).

Table 7-2: Characteristics of the WUA pilot projects investigated in other districts

Region	International donor	Project title	Names of WUAs
Fergana Valley, Kuva Rayon	IWMI (International Water Management Institute	Integrated water resources management (IWRM)	"Akbarabad"
Fergana Valley, Ezovon Rayon	USAid (United States Agency for International Development)	Central Asian Natural Resources Management Program (NRMP)	"Ak Altin"
Syr Darya *Oblast*, Ak Altin Rayon	ADB (Asian Development Bank)	Ak Altin Agricultural Development Project	"Vodiylik Suvchi", "Suv Agro"
Syr Darya *Oblast*, Mirzaabad Rayon	USAid	Central Asian Natural Resources Management Program (NRMP)	"Kushkulak"

3 RESULTS AND DISCUSSION

Irrigation water is distributed in a rotational fashion among the farmers depending on the same channel. How this water is allocated throws light on the handling of water distribution and potential for conflict in the region. A top-down approach is predominant but, depending on the region, autonomous problem resolution is as likely: The water users were most often informed by the WUA chairman about their turn to take water for irrigation (this was answered by over 80 % of the respondents in three investigated regions of Uzbekistan); however, in Khorezm and Syrdarya farmers often seem to come to an agreement directly with other farmers (Table 7-3).[2]

[2] The question in the questionnaire was as follows: How do you know that it is your turn to receive water from the canal? with the following possible answers: (a) The sequence is discussed at the general meetings; (b) The WUA chairman informs me; (c) The farmer who receives water before me informs me; (d) At random; (e) I come to an agreement with other farmers. For the answers, degrees from 'fully agreed' to 'disagreed' were given (five-step scale). Table 1-3 lists only answers, which were ranked as most important. The percentages added up according to the scale. The table shows only percentages to "fully agreed" degree.

Table 7-3: Water allocation mechanisms (%)

Regions	"WUA chairman informs me about water rotation"	"I come to an agreement with other farmers"	"The farmer who receives water before me informs me"	"Water is distributed at random"
Khorezm 2003 (N=89)	79	75	51	29
Khorezm 2004 (N=40)	33	0	18	0
Ferghana 2004 (N=21)	100	5	0	0
Syrdarya 2004 (N=20)	80	85	35	25

There was a strong difference in responses in the Khorezm region between the years 2003 and 2004, principally regarding the answers on "agreement" and "random distribution", but the reasons are unclear.

Table 7-4: Conflict mediators in a WUA (%)

Regions	WUA Chairman	Mirobs	WUA Council	WUA General Assembly
Khorezm 2003 (N=89)	77	60	21	55
Khorezm 2004 (N=40)	85	45	18	5
Fergana 2004 (N=21)	67	52	64	39
Syrdarya 2004 (N=20)	65	40	40	50

The WUA often acts as a conflict mediator in the three investigated regions (more than 60 % of respondents) (Table 7-4)[3]. Hydrotechnical personnel (Mirobs) and the WUA General Assembly can also act as conflict mediators. WUA councils have lower importance in conflict resolution. These answers did not change over time (Khorezm 2003 and 2004).

Regarding conflict resolution mechanisms of the more specific – and possibly more problematic – situation of untimely or unauthorized water withdrawal by a competing water user, the role of a WUA chairman (Table 7-5)[4] was less important

[3] The question in the questionnaire was: Who resolves the conflicts and disputes in your association: (a) Commission for the resolution of disputes; (b) WUA Council; (c) WUA chairman; (d) WUA General Meeting; (e) Other respected WUA members; (f) *Mirabs* (Hydrotechnical personnel). For the answers, degrees from "fully corresponds to reality" to "does not correspond to reality" were given (five-step scale).

[4] The possible statements in the questionnaire were: If anyone takes water without permission and out of turn… - (a) …it happens, I'll forgive the first time; (b) …it happens, I'll talk to that man; (c) …I'll start a conflict; (d) …I'll also take water out of turn; (e) …I'll

(on average over 40 % of respondents in all three investigated regions). Again, either an autonomous conflict resolution approach was sought by directly contacting the infringer (over 69 % in Khorezm and Fergana, and 55 % in Syr Darya), or a relative indifference was shown either through "forgiveness" (51 to 80 %) or "waiting for their own turn" (more than 60 % in Khorezm and Fergana, 38 % in Syr Darya).

Table 7-5: Conflict resolution mechanisms (%)

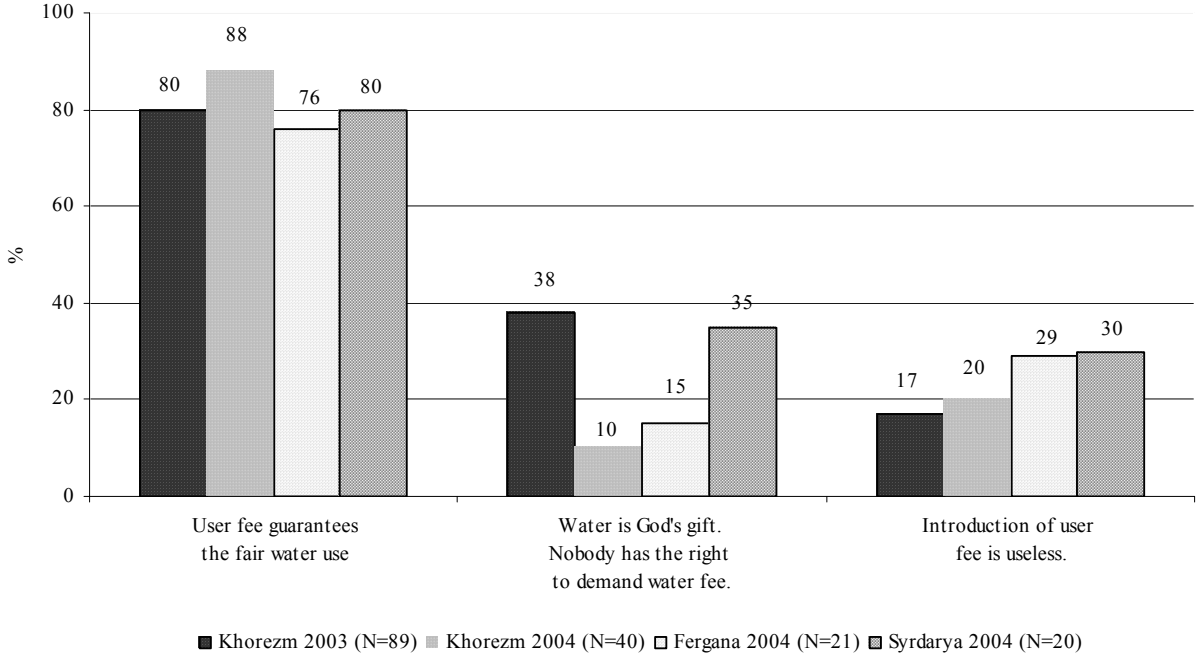
	I will talk to that man	I will "forgive" for the first time	I will talk to chairman	I will wait for my own turn
Khorezm 2003 (N=89)	66	51	44	72
Khorezm 2004 (N=40)	88	73	63	73
Fergana 2004 (N=21)	67	72	67	38
Syr Darya 2004 (N=20)	55	80	55	65

To introduce the topic of user fees for WUA members, it was mentioned by the interviewer that user fees are a mechanism for equality and fairness of irrigation water distribution (see Figure 7-1).[5] Farmers from all three regions agreed with that statement. However, about one third of the water users both in the Khorezm region (in 2003: 38 %) and in the Syr Darya region (35 %) believed that water is God's gift and nobody has a right to demand user fees. In contrast, only 15 % of the Fergana farmers, and – in 2004 – 10 % of the Khorezmian farmers agreed with this statement. The change of the opinion of Khorezmian farmers from 2003 to 2004 is explained by the fact that awareness rising was carried out among WUA members.

ignore that man; (f) …I'll talk to the chairman; (g) …I'll appeal to the community committee (mahallya); (h) … I'll wait for my own turn. For the answers, degrees from "absolutely approved" to "disapproved" were given (five-step scale).

[5] The question was: Are you willing to pay user fees to the WUA? Possible answers: (a) User fees guarantee the fair water use as the one who takes a lot of water pays accordingly more; (b) Water is God's gift. Nobody has the right to demand water fees; (c) Introduction of user fees is useless. At first water will be received only by those who are situated upstream or who have a lot of money. For the answers, degrees from "absolutely sure of it" to "unsure" were given (five-step scale).

Figure 7-1: Perceptions on importance of the user fee paid to the WUA



Another question regarded the user fees for WUA members. The respondents from all three regions of Uzbekistan exhibited a strong ownership feeling towards the WUAs they belonged to (Figure 7-2)[6]. At the same time, over 50 % of respondents in the Khorezm region (consistently over the two years) and Syr Darya pointed out that they understand the importance of the payments to a WUA, but they are not in command of their own money (this refers to a specificity of the Uzbek banking system in which government bodies exert strong control on bank withdrawals). Nevertheless, 48 per cent of the farmers in Syr Darya stated that they can take water from the irrigation canal and clean the canal independently, without a WUA, but less than 22 % of the respondents in Khorezm and Fergana agreed with this statement.

Non-payments or untimely payments of water users to WUAs remain one of the largest obstacles for the functioning of WUAs. WUA administration personnel in several occasions complained not to have received their salary for several months in a row. Farmers which own more than than 10 ha of land have to grow strategically important crops such as cotton and wheat, the yields of which are delivered to state-owned ginneries. The farmers in all areas suffer from untimely

6 The question and answers in the questionnaire were: Do you feel the necessity for paying user fees? – (a) The WUA is our farmer-run organization. It is necessary to maintain it within our own means. And my user fee is an opportunity to contribute to common business! (b) I can take water from the canal and do the cleaning of the canal independently; (c) I would like to, but I don't have money. For the answers, degrees from "fully agreed" to "disagreed" were given (five-step scale).

payments for the delivered cotton. If payments do arrive, however, they are made directly to the bank accounts and withdrawals from these accounts are under strict control.

In addition, the absence of funds in WUAs constrains their opportunity to buy new machinery or repair exisiting omes; this in turn reduces their ability to provide services to their members. The generally low level of equipment availability may be seen from the following figures: On average, a WUA has 0.29 excavators, 0.28 bulldozers, 0.1 tractors and 0.25 car transport (BOCHARIN, 2004: 31). A WUA on average has about 100 members.

Most WUAs in Uzbekistan[7] rely on pump irrigation (instead of gravimetric water flow). On average, each WUA has 3 pumping facilities, every one of which serves approximately 7740 ha of irrigated land (BOCHARIN, 2004: 31). Where pump irrigation prevails, as in the Khorezm region, the payments for fuel or electricity are considered a priority, and the payments are transferred from the farmers' bank accounts without the farmers' previous knowledge.

BOCHARIN (2004) stresses: "The lowest payment for WUA service was observed in Kashkadarya (15 % of actual expenses), Syrdarya (10 % of actual expenses) and Tashkent (7 % of actual expenses) Regions. In Andijan, Bukhara and Navoy the payments for WUA services and works have been increased. In 2003 in Andijan it was increased by 61 %, in Bukhara 41 % and in Navoy – 40 % of actual expenses of the WUA" (BOCHARIN, 2004: 31). On average, in 2003, 22 % of the actual expenses were paid.

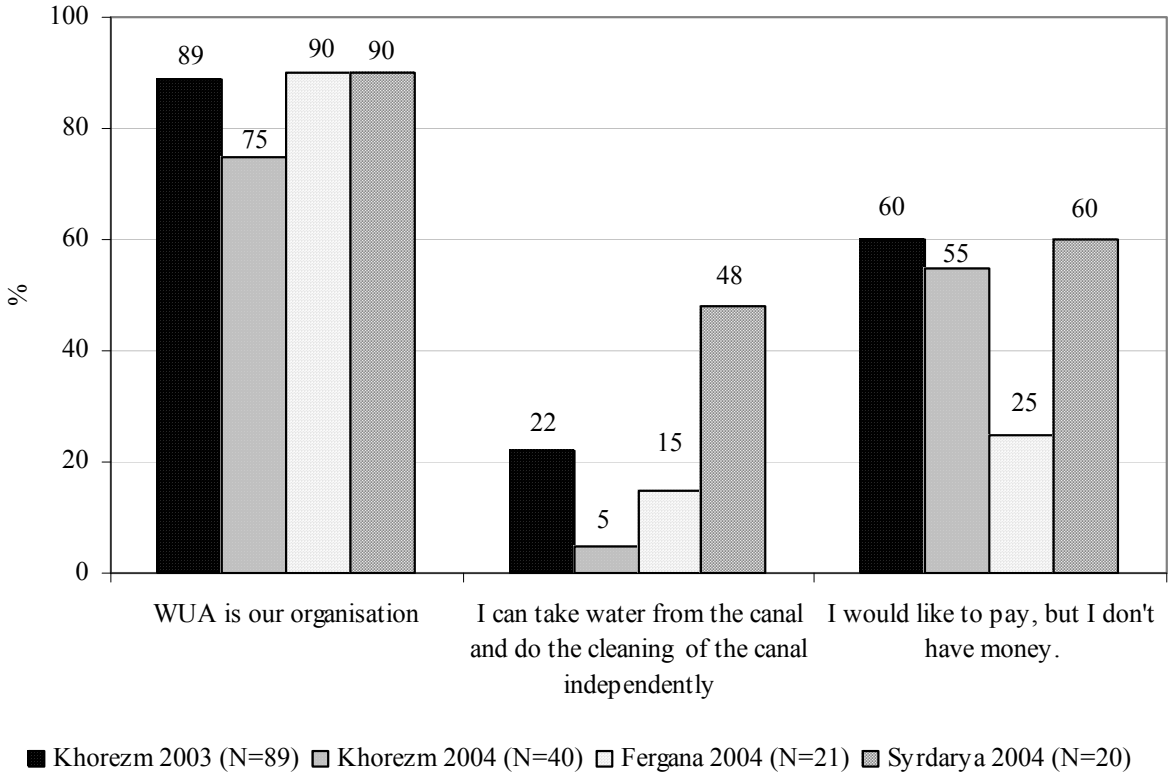
According to BOCHARIN (2004) "on average the actual cost per unit of WUA amounted to 1000 *soums*/ha[8] (prices for 2003), but costs differ widely between regions. For example, in the Samarkand and Khorezm regions the average actual cost per unit were, respectively, 3570 and 3910 *soums*/ha, whereas in Syrdarya and Navoy, these costs were 256 and 454 *soums*/ha, respectively".

---

[7] The total number of WUAs in the Republic of Uzbekistan amounts to 894 (December, 2005).

[8] In 2003, 975 Uzbek *soums* corresponded to 1 US Dollars.

Figure 7-2: Necessity of the user fees for the WUA members



4 CONCLUSIONS

The WUAs in the Khorezm region provide services such as water allocation, including the cleaning of canals or maintenance of pumps and other equipment. Respondents in all three Uzbek regions perceived the WUA Chairman as an important actor for the overall execution of tasks. Likewise, Water Masters are equally involved in conflict mediation and/or resolution. Less important for conflict mediation in the respondents' opinion were the WUA Councils and general assemblies. Also, autonomous approaches to problem resolution are as likely as mediated conflict resolution, e.g. farmers just "forgive" or patiently "wait for their turn." In gravity-irrigated regions the importance of a WUA increases, as seen in Fergana and Syr Darya. In areas with pump irrigation, the temptation to use the water without considering other water users is higher.

The water users in Fergana and Syrdarya seemed to be more convinced than those in the Khorezm region that paying user fees is beneficial. This is consistent with the higher level of capacity building work that was provided by the internationally supported pilot projects in Fergana and Syrdarya. Nevertheless, it seems difficult to overcome the legacy of the Soviet system and the expectations that inputs for agricultural production will be given free of charge, or the more Islamic notion that water is a public good.

This points to the need to increase capacity building among farmers, a process in which international donors could play an important role via training, awareness raising and by setting up infrastructure such as rural business advisory centers. The members of pilot WUAs are more conscious of agro-technical activities than farmers in the Khorezm region. The training should aim, for example, at basic hydrometric, economic and legal knowledge, and should become permanent: For example, farmers' schools could be established.

5 PERSPECTIVES FOR WUAS IN THE UZBEK CONTEXT

The following recommendations may help increasing the effectiveness of the operation and management of WUAs in Uzbekistan:

- Further careful liberalization of production and sale markets of agricultural products in order to stabilize the financial situation of water users;
- Full implementation of the law the Republic of Uzbekistan "On integration of land users into water user associations" in order to give real powers to WUAs;
- Capacity building regarding goals and objectives of integrated water resource management among farmers;
- Organization of permanent training centers of technical and legal education of WUA members.[9]

ACKNOWLEDGEMENTS

This study was funded by the German Ministry for Education and Research (BMBF; project number 0339970A).

REFERENCES

AGRAWAL, A. (2001): Common property institutions and sustainable governance of resources, *World Development, 29*, pp. 1649-1672.

BOCHARIN, A. (2004): Upravlenie vodno-zemel'nymi resursami Respubliki Uzbekistan, Tashkent.

BRUNS, B. (1999): Irrigation reformation in Indonesia: A concept paper, in: ABERNETHY, C. L., HEIM, F. (eds.): Irrigators' organizations: Government actions towards effective irrigators' organizations with special reference to Lao PDR and Vietnam, Zentralstelle für Ernährung and Landwirtschaft (ZEL), Feldafing/Zschortau, pp. 81-101.

[9] This point was also stressed by BOCHARIN (2004) and ADB experts (2005).

BRUNS, B., MEINZEN-DICK, R. (1998): Negotiating water rights in contexts of legal pluralism: Priorities for research and action, Prepared for presentation at the "Crossing Boundaries" Conference of the International Association for the Study of Common Property, June 10-14, 1998, Vancouver.

HUPPERT, W., WALKER, H.-H. (1989): Management of irrigation systems: Guiding principles, Eschborn.

INTERNATIONAL WATER MANAGEMENT INSTITUTE [IWMI], ASIAN DEVELOPMENT BANK [ADB], WORLD BANK [WB] (2005): WUA formation and development (*unpublished work*).

MEINZEN-DICK, R. (1999): The need for irrigators' organizations, in: ABERNETHY, C. L., HEIM, F. (eds.): Irrigators' organizations: Government actions towards effective irrigators' organizations with special reference to Lao PDR and Vietnam, Feldafing/Zschortau, pp. 12-25.

OSTROM, E. (1990): Governing the commons: The evolution of institutions for collective action, Cambridge.

OSTROM, E. (1992): Crafting institutions for self-governing irrigation systems, Oakland.

POMFRET, R., ANDERSON, K. H. (2002): Gradual economic reform and well-being in Uzbekistan, in: LU, A., MONTES, M. F. (eds.): Poverty, Income and distribution and well-being in Asia during the transition, Hampshire & New York.

UZBEKISTAN (2003a): O važnejšich napravlenijach uglublenija reform v sel'skom chozjajstve, *Presidential Decree 3226*, *5,* pp. 25 March, 2003.

UZBEKISTAN (2003b): O soveršenstvovanii organisazii upravlenija vodnym chozjajstvom, *Regulation No. 320,* from 21 July 2003.

ZAVGORODNYAYA, D. (2007): Water users association in the Republic of Uzbekistan: Theory and practice, Bonn.

SECTION 4

POLICIES, TECHNOLOGY ADOPTION, AND AGRICULTURAL MARKETS

Continuity and change: Land and water use reforms in rural Uzbekistan
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 8, pp. 145-164.

CHAPTER 8

BARRIERS TO TECHNOLOGICAL CHANGE AND AGRARIAN REFORM IN KHOREZM, UZBEKISTAN

CALEB WALL[*]

ABSTRACT

There are a number of serious challenges to technology adoption and agrarian reform in rural Uzbekistan. These must be acknowledged, and mitigation strategies devised, for sustainable development strategies to be implemented. Some of the barriers result from government policies that stifle innovation and risk taking, whereas the preconceptions of farmers and decision-makers require working with leading farmers. The constraints on farm decision-making autonomy present a number of barriers to technology change and large scale adoption of new technologies and agrarian reform will be premised on continuing reforms in land tenure, cropping decisions and farm management. Whilst the current political climate does not allow for effective changes to remove these barriers, the gradual reform process and the reform of state farms into leasehold units hold real potential. However, without the reform of the existing barriers to technology change, current reforms will achieve very little.

Keywords: Technology adoption, good governance, rural reform.

[*] Junior Research Fellow, Center for Development Research, University of Bonn, Germany. Email: Caleb.Wall@gmail.com.

ПРЕПЯТСТВИЯ К ТЕХНОЛОГИЧЕСКИМ ИЗМЕНИЯМ И АГРАНЫМ РЕФОМАМ В ХОРЕМСКОЙ ОБЛАСТИ УЗБЕКИСТАНА

КАЛЕБ УОЛЛ[*]

АННОТАЦИЯ

Существует ряд серьезных проблем на пути к применению новых технологий и осуществлению аграрных реформ в Узбекистане. Для того, чтобы внедрить стратегии устойчивого развития, необходимо признать этот факт и разработать меры по уменьшению таких проблем. Некоторые препятствия возникают вследствие политических решений, которые сдерживают принятие инноваций и рисков. Принимая во внимание предубеждения фермеров и лиц, принимающих решения, появляется необходимость работать непоередственно с передовыми фермерами. Препятствия к независимому принятию решений на уровне отдельного хозяйства представляют в свою очередь ряд барьеров к технологическим изменениям и широкомасштабному внедрению новых технологий, а реформы в сельском хозяйстве будут основываться на продолжающемся реформировании землевладения, схем посева и управления фермерским хозяйством. Постепенный процесс реформирования и преобразования государственных хозяйств в арендуемые единицы представляет несомненный потенциал, даже если в данной обстановке не произойдут серьезные изменения для преодоления существующих преград. Таким образом, без преодоления существующих барьеров на пути к технологическим изменениям текущими преобразованиями можно достигнуть очень малого.

Ключевые слова: Усвоение технологий, Разумное Управление, сельскохозяйственная реформа.

[*] Младший научный сотрудник, Центр по Развитию Исследований, Боннский Университет, Германия. Эл. почта: Caleb.Wall@gmail.com.

1 INTRODUCTION

This paper reports on action research[1] conducted during the two main harvest periods in the Khorezm region, Uzbekistan in 2003. The main aim of this research was to assess the barriers to technological change and agrarian reform in rural Khorezm, Uzbekistan; more specifically, the economic and social challenges that militate against rural development. These were hypothesised to consist of both a legal and an economic system that conspires against progressive agricultural policies such as the introduction of multiple cropping. It was further hypothesised that the challenges could be partially explained as a defence by certain elites, seeking to maintain certain practices, which supported their own interests. As the environmental and economic situation in Uzbekistan continues to decline there is a growing need for rural reform[2]. It is vital that any international development interventions that are taken are cognisant of the unique challenges and legal framework of rural Uzbekistan. Likewise, the opinion of farmers towards these barriers is of similar importance, as agrarian reform can only be effective when implemented in concert with the rural population. Reforms to date have generally been imposed without considering the perceptions of farmers, and whilst rural reform has been prominent on the government's agenda, this has often been at the expense of rural livelihoods. This research aimed to adopt an ethnographic approach, viewing the challenges to agrarian change from the perspective of the rural farmers, as well as from an international development perspective.

A total of 207 farmers were interviewed across the period, many more than once. Selection was primarily through snowball sampling – utilising existing project contacts in regions and then progressing to further interviews through introductions. Interviews were primarily conducted within four regions of Khorezm chosen for their sociological representativeness, including access to water as a key factor. Most interviews were semi-structured interviews and adopted a broadly

---

[1] That is research that is focused on what is actually occurring in a given setting, using observational and interview tools to attempt a better understanding of real events as they occur.

[2] That the ecological situation in Uzbekistan is in decline is undisputed (POMFRET and ANDERSON, 2002, p. 190), however official statistics suggest that Uzbekistan's economy is growing. This premise is problematic, given the unreliability of official figures on which economic growth is based (an unpublished US State Department report states that "The <Uzbek> government claims that GDP rose 4.1% in 2003; however the US Government does not think it was greater than 0.3%", cited in MURRAY, 2004: 2-3).
Equally problematic for the assembly of reliable data is the dominance of the Black/unofficial market in Uzbekistan and lack of effort to document this (BARTLETT, 2000). However, even if we accept the official figures of economic growth, this does not account for the massive population growth (2.3% p.a.) and low average age (23.9 years) which could see Uzbekistan's population double in the next 30 years (UNDP, 2001), suggesting that GDP per capita is set to fall drastically. So whilst the official picture is of economic growth in the post-Soviet period the reality on the ground suggests economic decline in real terms.

ethnographic approach (c.f. REINHARZ, 1992: 18). This included extensive use of focus groups and whole household meetings. Group based research was also conducted, especially in the use of H-Forms, Decision trees and priority ladders (for a discussion of these methods, see WALL and LAMERS, 2004). The gender representation was much better in the group based work, achieving 39 % female participation (ibid). However the challenges of working in the Khorezm region restricted female participation to 21 % for one-on-one interviews.

By focusing on the perceptions of farmers towards technology change, a range of opinions were elicited in an attempt to understand the barriers that exist to technological adoption. Primary amongst these problems is a lack of farm decision making autonomy; which incorporates real limitations on the security of land tenure, politicised cropping decision making and centralised farm management. It is argued in this paper that because cropping decisions are centralised and political, rather than devolved and practical, that farm management and cropping decisions are distinct areas for analysis. This paper argues furthermore for the need for reform of the cropping decision system, this refers to the process through which cropping decisions are made, rather than the actual cropping decisions made.

Secondly the tendency for incentives to favour negative or flawed decision making is a key constraint. This is especially the case in terms of establishing efficient water management that accounts for the entire economic benefit of different crops, not just the formulaic attainment of state goals in an unquestioning and uncritical manner[3] (WEGERICH, 2002: 9-11). There are also disincentives for innovation at the farm and bureaucratic levels and these pose constraints to technology change and agrarian reform. These disincentives include a punitive system for non-fulfilment of the state plan coupled with few sources of profit for excessive performance. This research also exposed a high degree of preconceptions held by farmers and decision makers, many of which are contrary to established scientific best practice. These preconceptions are exacerbated by an economic system that restricts farmer options – placing more decision making authority with centralised bureaucracy, which also suffers from uninformed opinions. Finally, the potential for change within the political and economic system is discussed in light of the numerous barriers to technology change and agrarian reform.

---

[3] MÜLLER (Chapter 10 in this volume) makes an interesting case that, contrary to many other papers (SPOOR, WORLD BANK etc.) that the Uzbek state does not profit *economically* from cotton production. At a macro level this may be correct, there are differing views and I do not wish to claim competence in deciding this. Yet one must acknowledge that at a meso and micro-economic level, state actors (if not the state) profit from cotton through corruption and other informal practices. Given that this compensation is seen as part of the 'payment' that state actors (eg *hokims*) receive, it would be naïve to claim that the state is a disinterested party.

2 FARM DECISION MAKING AUTONOMY

I will demonstrate below that farm decision making autonomy is severely restricted in Uzbekistan. This lack of autonomy poses a real constraint to the transfer of new agricultural technologies. Farmers are unable, for a variety of reasons, to make informed (and un-feted) decisions about technology use and farming methods. This is especially pertinent in terms of; secure land tenure, cropping decisions, and farm management.

2.1 Secure land tenure

Post-Independence, Uzbekistan has made halting moves away from Soviet style *kolkhoz* (collective) farms, shifting most farms into *shirkats*, a form of "joint stock company" whereby former collective farm employees (*kolkhozniks*) became share-holders in a new farm. However, the real impact of these reforms has been slight, with few management changes and where "most *shirkats* are the same *kolkhozes* and *sovkhozes* (state farms) in smaller scale (ILKHAMOV, 1998: 545). However, these *shirkats* were always seen as "a temporary step between the 'stage of the *kolkhoz'* and the final 'stage of the Private Farms'" (TREVISANI, 2006). This stage of private farming was first introduced in 1998 in the "Farm Law" for Uzbekistan, which was updated in 2004. This law allows for the creation of "leasehold" farms, which are nominally "private" farms of 10 ha. or more, which enjoy a fifty year lease. Within the Khorezm region the pilot region of Yangibazar was first "privatised" (i.e. converted into leasehold farms) in 2003, however leasehold farms first appeared in Uzbekistan in 1992 (POMFRET, 2000: 271), since then this policy has subsequently been introduced across almost all of Khorezm in February 2005.

Under the system of leasehold farms all land is officially owned by the state, but it can be leased for negotiable periods by farmers for a set fee or land tax. The actual official rent is relatively low; however the imposition of a state order for cotton and wheat provides much of the state income from this land. The relatively low land tax is also inflated by an array of unofficial "taxes" or bribes necessary to access and maintain control of the leasehold land. State officials need to be bribed to ensure that the land which is privatised is high quality, and it is then necessary to "negotiate" the state plan each year – this also comes at a financial cost in the form of bribery, favours and corruption. From this expenditure the farmers gain the right to their land, as specified under the legislation:

> "Farms specialising in plant cultivation products shall be allowed areas with minimal size of at least 10 hectares for the purpose of grain and cotton growing, and of at least 1 hectare for the purpose of gardening, wine and vegetable growing, as well as cultivation of other specimens. On provision of land areas, farms take on the obligation to provide the yield of agricultural crops (three-years average) in the amount of no less than the cadastre assessment of the land. Given obligation is supported in the land-lease agreement." (Land Law, 2004: Article 5.)

We see here that the legislation is clearly aimed at establishing "private" farms as sources of cotton and wheat (KARIMOV, 2003). Under the typical arrangement given in the legislation, and more or less followed in practice, only 10 % of farm land is available for cultures other than cotton and wheat. There is every indication in existing legislation (KARIMOV, 2003; GoU, Law on Farm, 2004) that the state plan system will continue and that the expansion of land tenure is more that of usufruct right, subject to a state order specifying "proper use". So, whilst the lease period can be as long as fifty years, after three years the farmer's performance is reviewed by the *hokim's* (regional governor's) office. Follow-up research in 2005 identified that land tenure issues certainly exist, with some farmers having their land taken away from them under the pretext of improper use – in some cases this re-nationalisation of land was found in my research to be, at least in part, politically motivated. Indeed, the legislation does allow for immediate disenfranchisement of land for improper use or for the failure to fulfil the state plan. The new land law of Uzbekistan (2002) specifies that farms must "provide for supply of agricultural production on government requests in compliance with signed agreements of contracting within limits of envisaged volumes" (article 17) and that "violation of land legislation, including cases of utilisation of land area for the purposes other than farming, including sowing agricultural crops, not specified in the contracting agreement" (article 32) will lead to the liquidation, without mention of compensation, of the farm. Thus whilst there is legal land tenure, this must be read with the caveat that land can be taken away from the farmer at any time, through the decision of a *hokim* (local mayor) or other senior official. In Yangiarik in 2004 there were apparently twenty one cases of farm liquidation from approximately 1000 leasehold farms, accounting for approximately 2 % of all leasehold farms. So whilst the formal legal institutions provide clear rules and standards, the informal institutions – or "the rules of the game" – determine a great deal of what actually occurs in rural Khorezm. Thus the net impact of these reforms has been slight, with land tenure rights remaining insecure. So, whilst the move towards so called "privatisation" is occurring, and has been rapidly expanding in 2005 – after this research was conducted, there is reason to suspect that the broadening of land tenure is too limited in scope or security to be realistically labelled as "private" land. Whilst the discourse used by the government, and adopted by farmers, is one of "privatisation" – it is wrong to assume that this carries with it western legal notions of usufruct rights with title enshrined in legislation and protected by the courts. In Uzbekistan, "private" land is neither secure nor land on which the owner can decide what to plant. Farmers still retain a limited degree of security in their right to land and a high degree of uncertainty that their leases will not be cancelled. Aside from the issue that usufruct rights in Uzbekistan are severely limited, to perhaps 10-20 % of actual land holdings, an issue discussed below. A closer analysis of the land law (de jure) as well as anecdotal evidence from early-2005 (de facto) suggests that whilst farmers may

hold a legal right to land – this right is insecure and very conditional. Most recently (2005) almost all of the Khorezm region has been "privatised" yet the cotton growing season has not been freed at all from the state plan. Similarly, in Yangibazar (where privatisation begins in the Khorezm region) there are increasing accounts of land seizure – with unconfirmed interviews suggesting that approximately 2 % of land was de-privatised in 2004. True or not, these reports further undermine the security of land tenure, at least in the minds of farmers, who are forced to rely upon rumour rather than reported fact, in their determination on their own security of land tenure.

In view of this limited security of land tenure, it is worthwhile to analyse the likely impact that these new reforms will have on the barriers to technology change in Uzbekistan. Evidence for this comes from 2003 in the form of H-Form analysis[4], comparing leasehold farmers in Yanghibazar with *shirkat* (joint-stock shareholding companies) farmers in other regions. This research identified that those farmers who enjoy no land tenure have little incentive to invest in their land, especially to implement sustainable land use practices. This is because they do not have a security of "ownership" of the land, and an "ownership" of the environmental problems faced. With short-term or insecure land tenure the rational decision for farmers is to conduct extractive farm practices that emphasise short-term profit gains over long-term ecological sustainability.

This theoretical view is reinforced by differences in opinions between farmers interviewed at Yanghibazar and Khonka *hokimyats*. Yanghibazar was imposed within a national pilot program to lead the way in the Khorezm region by "privatising" all *shirkat* farms, whereas Khonka was not selected and was slow to liberalise. In each instance (across a total of 58 direct interviews and 5 focus groups) farmers from Yanghibazar indicated greater concern than their colleagues from Khonka about soil degradation, salinisation and organic matter loss. This is surprising given that the devolution from *shirkats* to private farms is not yet finished. It is possible that this concern is due to privatisation, or that the salinisation and hence, the decline in profitability of *shirkats* was the reason for the privatisation. Similar differences of opinion were evidenced within the Yangiarik *hokimyat*, where some farms have been privatised whilst others remain *shirkats* or *kolkhozes*. We see in the below Table 8-1, showing results from the priority ladder method that soil quality, water quality and financial resources are all *more* important for those farmers on privatised land (for further discussion see WALL and LAMERS, 2004).

---

[4] For a detailed discussion of the methods used in this research, refer to WALL, C. and LAMERS, J. P. A. (2004).

Table 8-1: Prioritiy ladder of farmers in Khonka, Yangiarik and Yangibazar

Priority	**Yanghibazar (private)**	**Yanghibazar (private)**	**Yangiarik (private)**	**Yangiarik (*shirkat*)**	**Khonka (*shirkat*)**	**Khonka (*shirkat*)**
Fertiliser availability	7	9	9	9	2	9
Price of vegetables at bazaar	11	13	14	14	9	14
Quality of wheat produced	10	12	12	11	12	11
Quality of cotton produced	9	11	11	12	13	13
Availability of herbicides/pesticides		10	10	10	6	10
Agricultural engineering	6	8	7	5	5	8
Seed quality		7	1	3	11	7
Supply of machinery and technology	4	6	5	2	7	2
Availability of diesel for tractors	8	5	6	7	10	3
Financial resources	1	4	4	6	8	1
Soil quality	2	1	3	1	1	6
Water quality	3	3	2	8	4	5
Water/irrigation timing	5	2	8	4	3	4

It was interesting to note that within the Yangiarik rayon there was a marked difference of views on sustainability and investment between private farmers and *shirkat* workers. In most instances those farmers who had a degree of land tenure indicated an increased willingness to implement sustainable land use practices, and many were making greater use of natural fertilisers such as cow manure. However, as the land rights of farmers remain restricted, the incentive to invest in the land through sustainable land use may remain low. So, whilst leasehold farmers may have a greater interest in ecological sustainability than *shirkat* employees, this will be limited by the degree of security they have over their land tenure. This phenomenon is closely linked with the low degree of autonomy that leasehold farmers have over cropping decisions, an issue discussed below.

2.2 Cropping decisions

Cropping decisions in the Khorezm region remain heavily centralised. Farmers are given very little decision power over crop choices in a system of State Plans for the production of mandated quantities of cotton and wheat, which are classified as "strategic crops". The ecological and environmental impacts of this monoculture and the accompanying excessive irrigation are severe, including declining living standards, high morbidity rates and severe gynaecological ailments in the Karakalpak and Khorezm regions, which are nearest to the Aral Sea (POMFRET and

ANDERSON, 2002: 90). The Government of Uzbekistan retains an official policy of encouraging cotton and wheat production on a large scale, which in turn are compulsorily acquired at sub-market rates (WORLD BANK, 1999; SPOOR, 1999). In practice every Rayon, and in turn every *shirkat* and now every leasehold must produce certain quantities of cotton and wheat, according to a plan for both quantity of produce as well as amount of land under cultivation of each crop. One hundred percent of the cotton crop is purchased at 60-65 % of world market value and then sold abroad by the central government for foreign exchange revenue (WORLD BANK, 1999)[5]. However this figure varies greatly, depending on how you measure world market price (farmers are paid for un-ginned cotton, for which there is no market[6]). Approximately fifty percent of the wheat crop is also purchased below market rates, ostensibly to ensure domestic food security. In approximately 80 % of respondent's farms, cotton and wheat rotations continue without any fallow or alternate crops being utilised, with vegetables being cropped on separate land or as a third crop in between the harvest of winter wheat and the planting of winter-wheat. Or, inter-row cropped (illegally) between the cotton. In some regions of Uzbekistan, especially in the Khorezm region, local varieties of rice are favoured by farmers both for their usefulness in the staple food plov as well as because of historically high market prices. The production costs are however somewhat distorted as water (essential for paddy rice cultivation) is essentially free in Uzbekistan, thus subsidising rice production. Whilst four participants noted that the 2003-2004 drop in market price of rice was possibly due to market over-supply of rice, over fifty other respondents did not mention the issue of over production. In any case, in 2004 rice production was officially banned in the Khorezm region, however it continued to a large extent. In some farms, such as in Yangiarik – there has been a marked increase in the production of rice. This is concomitant with raised ground water levels, a factor that farmers interviewed were aware – yet unconcerned – about. Despite the attempts at land reform, the national economy and especially the state budget both continue to rely heavily upon agriculture and, in particular, cotton production. "Agriculture accounts for 30 per cent of GDP, 60 per cent of foreign exchange receipts and about 40 per cent of employment" (KANDIYOTI, 2002: 8). Cotton continues to constitute a large proportion of government revenue through the compulsory acquisition of the "strategic crop" from farms at sub-market rates. There is little evidence to date of any interest by the state in a reform of the state plan system. Rather, there is significant evidence to suggest that land reform is more a means of improving

---

[5] Some observers note that officially only 30% of cotton is part of the state plan. What this ignores is the factual monopoly by which in practice all cotton is sold to the state. Thus it is accurate to talk about 100% of the cotton going to the state, as this is what occurs in practice.

[6] However this argument misses the point that farmers only sell un-ginned cotton precisely because the government is a monopoly purchaser of cotton – thus preventing the development of competitive cotton ginning industry.

the efficiency of the existing state plan system, rather than as an entrée to greater systemic reform of agriculture in Uzbekistan. Of course we are at the very beginning of the privatisation regime and it may well be that further liberalisation occurs. If so, this will mark a move away from the central command economy – however if all the other structures of central planning and control remain in place, it is difficult to classify the land reforms as anything other than a re-organisation.

To balance this negative view, leasehold farmers have a greater degree of autonomy in terms of planting outside of the state plan system. Once a farmer has planting their state quota (by land area), they are able to exercise a high degree of autonomy over their remaining land. This may range from as little as 10 % discretionary lands for most farmers who are involved in the rice & wheat complex. Some farms, especially those with established fruit groves or land only suitable for rice production, may have a much higher percentage of discretional land. This discretion is somewhat illusory, as it is often the case that no other crop can be grown on the land. The discretionary land is used firstly for producing domestic consumption needs, followed by market influenced cropping decisions. At Yanghibazar, which has fully devolved all *shirkat* farms to leasehold farms, there is a high level of farmer initiative. This includes growing grapes, tomatoes, and evidence of small investment in post-harvest processing facilities by a growing number of individuals. The most common form of post-harvest processing is small scale wheat and rice milling – suggesting that for aspects of the economy outside of the state plan, there is a potential for private industry to manage processing. The optimistic view of land tenure is supported by World Bank survey data cited by VAN DUSEN et al. (2003) which measured the average number of crops across different farm types. Here it was shown that *shirkats* had an average of 1.24 crops, compared to 3.28 for *shirkat* household plots and an impressive 3.62 for leasehold farms. Thus it is vital to acknowledge that the case for optimism is nuanced. We would be wrong to disregard the significant achievements of the state centred command economy since 1992 (or equally of the Soviet experiment). For instance KOTZ (2002) argues that the *shirkat* system was very effective in achieving wheat self-sufficiency in the post-1991 period:

> "Uzbekistan's agricultural sector had been operating under central planning since the 1930s, and it did not have a significant sector of independent farmers who knew how to grow a variety of crops. The government used its control over the large collective farms to issue directives to shift a part of production from cotton and other crops to grain. Agricultural experts were deployed to provide the know-how required to make this crop shift. This succeeded in rapidly increasing grain production. Given the institutional reality of agriculture in Uzbekistan, it seems unlikely that such a rapid shift could have been undertaken through market methods. (KOTZ, 2002)"

Whilst we may question the economic wisdom of aiming for wheat self-sufficiency, given that neighbouring Kazakhstan can produce rain-fed wheat and

lower economic and financial costs, we must acknowledge that the policy was very successful.

More negatively, POMFRET (2000) credits this lack of attempt at systemic reform of the state order system with the gradual economic decline of agriculture in Uzbekistan. In a compelling comparison between China's very successful land reform project and Uzbekistan's continuing collapse, POMFRET (2000) points out that the key difference is the maintenance of state plans for output, which were abandoned in China but which have, if anything, been strengthened in Uzbekistan. So whilst the introduction of leasehold property in China is broadly hailed as a successful move towards market based production in the rural economy (whilst remaining within the "Communist" ideology of no private property) this has not been the case in Uzbekistan. TREVISANI (2006) makes a similar judgement in the specific case of the Khorezm region where "agriculture is going, more than through a veritable liberalization, through a process of reorganisation". In the absence of reform of the state plan system that land reform becomes a somewhat vacuous concept. Farmers retain only an insecure tenure over their land, which can be removed for a failure to fulfil the state plan. Likewise, it is illusory to discuss usufruct rights when at least eighty percent of use is externally mandated, both in terms of crop as well as methods, a third issue discussed below.

2.3 Farm management

In terms of farm management it is clear both from literature sources (KANDIYTOTI, 2002; ILKHAMOV, 2002) and my research (WALL and LAMERS, 2004; WALL, 2004), that *shirkat* managers and leasehold farmers do not have autonomy over cropping and machinery use decisions in the Khorezm region. Rather a complex set of socio-political networks and rules exist, influencing farm management decisions. Primary amongst these is the State Plan system of strategic crops. This issue is discussed at length above. This reinforces the lack of autonomous farm management in the Khorezm region. State strategic crops dominate the agricultural system, accounting for over 60-80 % of typical farm land use. Farmers have little ability to adopt fallow strategies or to opt for more sustainable systems of crop rotation. This is partly because the state plan system also legislates exact farming methods. Land levelling, the depth of ploughing, regimes of fertiliser application and harvesting times of cotton and wheat are all part of the state plan. This occurs through the state agronomists and *hokimyat* (Mayor's office) officials who still – even in Yanghibazar, after privatisation – travel around their regions ensuring that land is being "planted" properly, ostensibly to ensure fulfilment of the plan. Some activities, such as inter-row planting of wheat or melons in the cotton, are officially banned (yet occur none the less).

Partly government control is also regulated through control of agricultural inputs, especially; fertiliser, seeds, water and mechanical traction. Concomitant with this is

the veritable shortage of agricultural inputs, especially mechanical traction and consumables. Farmers rely on the state monopolies for fertilisers and seeds and have only a limited selection of private machinery providers. Farmers must apply agricultural inputs as and when they are available, for the fear that they may not be available at another time. Whilst officially farmers may request inputs at any time (within the centrally established system of norms), in reality monopoly suppliers deliver fertiliser and other inputs at times convenient to the supplier, with little regard for demand. Forty three participants commented that they apply their inputs and use machinery at a time that is largely outside of their direct control. So, whilst a degree of autonomy may exist in theory and legislation, this is curtailed by practical constraints. Fertilisers can only be applied when they have arrived, leaving tacit decision making authority in the hands of the agro-industrial complex. This takes the form of a cohesive state and para-statal system which controls almost all legal agricultural inputs. This same apparatus also exercises considerable coercive power over farmers. Given that this complex remains heavily monopolistic, there is no mechanism through which farmers can choose better quality or service in their input providers.

Important farming decisions, such as when to plant wheat and when to begin harvesting cotton, remain centralised decisions. There is an official period during which strategic crops must be planted and subsequently harvested. It is difficult to ascertain the legal implications of not following such rules; however they are almost universally obeyed. There appears to be a significant amount of legislation in this regard, but it is impossible to find a definitive guide to such regulations. What appears to happen is that directives are issued in the form of decrees by the *hokim* for Khorezm, which are then promulgated on a regional basis and implemented, by Regional *hokims* and state farm managers. The execution of decrees is open to interpretations, and various *hokims* appear to implement these decrees in varying manners. Both *shirkats* and leasehold farmers appear to be equally subject to the imposed regulations from the central political infrastructure. As the privatisation project advances it will be worthwhile reviewing the extent to which leasehold farms gain greater or lesser freedom from the state plan. Experience to date suggests that no greater freedom from the state plan will be gained.

There is of course the argument that the state plan system and the associated monopolies on all inputs, produces strong results. This is of course true. Cotton production remains high and funds a large proportion of the state budget. Likewise the case of national self-sufficiency in wheat is a good example of how the state plan achieves its aims. The problem is what these aims are. Clearly the state plan is aimed at gaining the greatest possible profit (for the state) from agriculture – with little regard for rural livelihoods or the development of the rural economy. If we take these (as well as ecological sustainability) as our aims then we see that the state plan continues to fail. However, in terms of producing an extractable surplus for the state, it is very effective indeed.

3 NEGATIVE INCENTIVES

There are a range of negative incentives for efficient land and water use, as well as for innovation, at work in the rural economy of the Khorezm region. That is to say that farmers are rewarded for actions that are disadvantageous to either their own interests, or to larger environmental and economic considerations. There are disincentives for innovation, which poses a serious constraint to technology change.

Innovation at the local level is a necessary part of effective technology transfer and agrarian change (RICHARDS, 1985). Instead in Uzbekistan there are a range of disincentives, especially for *shirkat* managers and leasehold farmers, for the innovation of agricultural methods. For example, seeds for strategic crops are provided cheaply or free of charge by the Government, even though they have a high fungible value (wheat for flour, cotton for edible oil). Improved sowing methods and the use of better quality seed could reduce seed inputs significantly, but there is no real incentive to do so. Conversely adopting a farming method not promulgated by higher authorities invites rebuke and punishment for *shirkat* and *kolkhoz* managers, as well as endangering the land tenure of new leasehold farmers – who can have their land seized if they "mismanage" it. This risk is not balanced by the possibly of reward if the innovation is successful. So whilst failing to meet the cotton plan would mean a leasehold farmer losing their land, the profit from exceeding the state plan is quite low (POMFRET, 2000). Such a situation favours risk aversion and provides a disincentive to innovation and a real barrier to technology transfer. This has created the mentality within *shirkat* and *kolkhoz* management whereby officials would have to take significant risks were they to adopt new technologies, without any hope of tangible gain if the innovation works. Likewise, whilst leasehold farmers may be interested in new technologies – if they take a risk in trying a new technology and this fails, they may lose their land. Thus, they have no incentive to deviate from accepted central wisdom, and face punishment ranging from dismissal for failing to meet central plans.

A limited margin for experimentation exists for poor farmers in the Khorezm region. This is to say that most farmers are relatively poor, and cannot risk a poor crop in the pursuit of higher yields – this is because of both a credit constraint and due to the risk of falling below the income threshold required to continue farming. Likewise, many farmers are so close to the poverty level that they cannot afford to undergo short-term reductions in profitability in order to achieve long-term economic benefits and sustainability. This is made worse by a regulatory regime that provides negative incentives for risk-taking, and positive incentives for the formulaic fulfilment of centrally devised plans. In such a situation it is difficult to access and target leading farmers to act as agents of technological trials and extension. This will pose a real barrier to the downstream implementation of any technologies.

At the larger scale, research institutes are excessively specialised and face considerable political interference. Cotton and wheat research institutes focus on their narrow production area, with no research on alternative crops or on researching the ecological cost of these dominant cultures. Promotion within these institutes does not come to those who question cotton and wheat growing, or who propose paradigm shifts in agriculture. These same negative incentives exist for those working within governmental research institutes in Tashkent and at Universities in the provinces. There is no central research funding for independent research that might question the wisdom of the state plan, thus preventing innovation.

Given the legal and administrative constraints that exist – it is difficult to implement agrarian reform and technology change. Because cotton and wheat production is so important to the government, any research or activity that could potentially threaten these crops is restricted. For example, an international project promoting potato growing in the Khorezm region has come under a range of sanctions designed to make their extension services ineffective. Whilst international projects face a range of bureaucratic and administrative constraints, even on their research plots, local universities have almost no ability to conduct independent research. Central funding and career advancement relies more on producing legitimating myths than hard scientific evidence for those academics and researchers. There exists at all levels and in all disciplines a lack of academic freedom within Uzbekistan. This poses a real constraint to research and technology change in Uzbekistan, a factor often over-looked in international development projects.

So to at the farm level, innovative methods by farmers carry high risks with little prospect of reward combined with the fact that the majority of farmers lack the capital (fiscal or political) to conduct trials of new methods or technologies. Together, these issues militate against the indigenous development of new farming systems. Increasingly, the uptake of new technologies in Uzbekistan will be premised on the creation of effective incentive systems. Further privatisation of land tenure and reforms in cropping decisions will allow greater incentives for leasehold farmers, who exhibit higher levels of commitment to innovation. This devolution must occur along with the liberalisation of fertiliser and tractor supplies, a reduction in the state order, as well as a move away from centrally promulgated farming methods. Also, there needs to be a strengthening of the protection of land tenure for leasehold farmers in order to establish the right mix of positive incentives for experimentation.

4 FARMER AND DECISION MAKER PRECONCEPTIONS

Farmer and decision maker preconceptions about "correct" agricultural practices are very strong in Khorezm. A poor quality of agricultural education for decision makers, historically low levels of farm decision making autonomy, as well a history

of collective ownership, have come together to form strong preconceptions. This is especially the case in terms of tillage practices and water use management.

It was evident from a range of discussions with *hokims*, university staff, *shirkat* managers and farm workers, that there is a strong belief in periodic tillage of the soil. This was confirmed in 2005 with a review of Soviet era archives, where mechanisation and extensive ploughing were presented as "victories" of Soviet agriculture. Over twenty farm managers and agronomists were interviewed, and every one of them expressed a belief in tillage practices, as well as being somewhat scornful of no-tillage. Whenever it was suggested that ploughing could be replaced with permanent or semi-permanent bed planting, almost all of the forty five farmers interviewed dismissed this idea as ridiculous. Similarly, suggestions that water could be conserved through the use of alternative irrigation methods, was met by strong opposition "You cannot use less water and get the same yield…it is impossible". These preconceptions are only two of many traditionally held opinions about farming best practice. Many would appear to be contrary to significant scientific enquiry and published literature. This is typical of "poor economic, social and environmental performance" of agriculture in the economy, as a result of the bureaucratised structure (ADAMS et. al., 1997: 707). Thus, farmer education must precede any attempts at technology transfer and extension. This will be made more difficult given the legacy of formulaic and centralised educa tional methods introduced in Soviet times and continued to the present. The Soviet method of research and technology transfer was always closely imbricated with ideology and politics and attempted to eliminate traditional forms of expertise and knowledge through "modernisation" campaigns (KREMENTSOV, 1997: 24). The Soviet system of reform, both within and outside of agriculture, was characterised by secrecy and "political correctness" (JORAVSKY, 1970: 8-10). There is little evidence of a development from "top-down" technology transfer towards more participatory methods. There is a real need for the government and official donors to move away from this technology transfer paradigm towards a more farmer focused participatory approach.

5 SETTLEMENT ACCOUNTING

The system of banking and national accounts is based on "settlement accounting". This system uses government owned banks as middle-men or intermediaries for almost all (legal) financial transactions between farmers and inputs suppliers, as well as regulating taxation on profit and assets. All official transactions must be actioned through one of several government banks, with the individual seldom seeing their physical money. Nor is there any evidence of competition between these banks. In the case of cotton, farmers are paid for their cotton harvest direct to their bank account, from which they can transfer money to fertiliser or technology

suppliers, they can also borrow from this account to pay for inputs against their future cotton harvest. The balance remaining in their settlement account at the end of the year is then deemed to be their profit for the year, which is taxed accordingly. It is almost impossible for individuals to access their cash deposits with bank managers refusing to (or simply being unable to) provide cash payments (POMFRET, 2000). This has created a substantial black market for both goods and financial services. Likewise, non-state providers of machinery or other inputs cannot receive payments through the settlement account system, making the private access of machinery and inputs outside of the economic ability of most farmers who rely upon credit to buy their inputs. The settlement accounting system has an impact on private technology providers, fertiliser supplies and on cropping decisions.

> "The state-controlled banking system often acts as a monitor. By law purchases of seeds, fertilizer, machinery, fuel, and other inputs must be through bank transfer, and revenue from agricultural sales must be deposited in a bank and can only be used for approved purposes. Depositors' right of withdrawal in cash is circumscribed by centrally determined limits and local practice. The banks do not serve their depositors, but serve the state in checking that funds are used appropriately. There is no confidentiality or security. Indeed, bank account information is routinely supplied to local officials seeking information about a farmer's activities, and taxes may be deducted directly from bank accounts." (POMFRET, 2000: 273).

Private contractors of tractors and other mechanical technologies must be paid in cash, as they are not eligible to receive deposits to their settlement account. Only Machine Tractor Parks (state run) and *kolkhozes* can rent out equipment and receive a settlement account transfer. This stifles private enterprise, and creates periodic shortages of technology for leasehold farmers, who in many cases do not have the cash required to hire a private contractor. *Kolkhozes* and Machine Tractor Parks were found in my research sample to be inefficient and tended to favour *shirkat* farms over leasehold farmers. Interviews with various leaseholders identified that the settlement account system is a much greater hindrance to poor farmers. Only seven of the thirty poor leasehold farmers interviewed were able to afford private machinery rental. In contrast none of the twelve richer leasehold farmers noted any problems with technology access, thus suggesting that settlement accounting is a greater burden on those without access to liquid capital (usually US Dollars). From my research it is the majority of farmers who lack this capital and access to machinery.

Fertiliser and seed supplies remain a state monopoly and there has been no real move towards introducing effective competition. Even if it did occur, any privatisation would be ineffectual without a prior reform of the settlement account system. It is difficult to envisage private investment in the agricultural input industry, without any real possibility to a contestable market. This is because those areas that have been privatised in the past (such as cotton gins in the early-mid 1990s) faced a range of punitive state policies designed to stifle rather than encourage competition. Strong elite interests are well served by the status quo in the input

sector and one cannot imagine this preferential system ending simply. The lack of access to technology despite privatisation suggests that the settlement account system will pose a real constraint to technology transfer. Even the recent "privatisation" of land is unlikely to change this situation, as most inputs supplies still flow through the same *shirkat* structures as before, especially in the case of machinery and seed supplies (TREVISANI, 2006).

> "In fact, not only do leaseholders receive negligible in-kind payments, but they also claim that the *shirkat* provides them with inadequate inputs and services and then penalizes them for not meeting their production targets. This is a cause for great bitterness, aggravated by a context of growing polarization in access to land" (KANDIYOTI, 2002: 29).

Cropping decisions are also influenced by the settlement account system. Farmers voice a preference for growing rice, as the surplus can be sold for cash at the market. As mentioned earlier, rice production is somewhat distorted as, unlike cotton and wheat, it is outside of the state plan and thus not subject to compulsory acquisition. This is why it is more profitable than, *potentially* higher earning strategic crops, as access to cash is guaranteed whereas bank deposits are not. This system of settlement accounting thus creates a distortion of cropping decisions, which poses a barrier to rural reform.

6 POTENTIAL FOR CHANGE

The political structure of the Khorezm region and Uzbekistan has yet to demonstrate that there is a potential for positive change in the rural political economy. The changes to date, most notably land "privatisation" have been on the scale of re-organisation rather than reform (TREVISANI, 2006). The privatisation of Yanghibazar and the recent expansion of this programme for the rest of the Khorezm region can be seen as encouraging signs. However, this "privatisation" policy needs to be balanced against the evidence to date of the impact of these reforms. This evidence suggests that whilst land tenure may have changed to some extent, the usufruct rights normally associated with land tenure have not altered from the Soviet period of collective farming and the state plan. We also need to remember that there has been a high incidence of corruption that has characterised land reform thus far (KANDIYOTI, 2002). Privileged elites have capitalised on the privatisation scheme, amassing significant land holdings (TREVISANI, 2006). These large land holdings do little to encourage the transition to positive incentive systems for farmers and certainly marginalise many farmers.

The political and economic elites of Khorezm, and indeed the Government of Uzbekistan, continue to rely on the rural economy as a source of funds and power. At a micro level state actors do profit from cotton, at a macro level state power is enforced through the cotton system – regardless of whether the state

profits economically or not – it is not a disinterested power. The vested interest of many high placed political officials in the agro-industrial complex suggests that any reforms may not deliver real benefits (WALL, 2006). For example the privatisation of the fertiliser industry may leave factories in the control of political and economic elites. This makes a move away from monopoly supply unlikely, as existing elites will maintain their monopolies either in a de facto or de jure manner. Likewise the central government has strongly resisted any reform of the financial sector, if anything strengthening the rural banks and the settlement accounting system. So long as the key aspects of the farming system do not reform, the changes from shirkats to leaseholds will have little impact on the rural landscape and economy of Uzbekistan.

If the manifold challenges of: Farm decision making autonomy, negative incentives, preconceptions and a perverse settlement accounting system are to be addressed the systemic issue of corruption must also be addressed. It is less clear if there is the political will, or flexibility within the system, to allow these changes to occur. Without the reform of the political system it is possible that changes in the rural economy will run contrary to their aims. As argued throughout this paper, there are multiple barriers to technology change and agrarian reform. These barriers must be removed in a holistic manner in order to affect substantive rural reform.

ACKNOWLEDGEMENTS

The author acknowledges the invaluable assistance of Peter Mollinga, John Lamers, Christopher Martius and the staff of the ZEF/UNESCO project in the Khorezm region. Equally valuable was the contribution of various farmers and decision makers within the Khorezm region, who provided their time and hospitality, in aid of this research. The German Ministry for Education and Research (BMBF; project number 0339970A) and the Ministry for Schools, Science and Research of the State of Northrhine-Westfalia funded this study.

REFERENCES

ADAMS, W. M., WATSON, E. E., MUTISO, S. K. (1997): Water, rules and gender: Water rights in an indigenous irrigation system, Marakwet, Kenya, *Development and Change, 28 (4),* pp. 707-730.

BARTLETT, D. A. (2000): Economic recentralization in Uzbekistan, *Post-Soviet Geography and Economics, 42 (2),* pp. 105-121.

ILKHAMOV, A. (1998): S*hirkats*, *dehqon* farmers and others: Farm restructuring in Uzbekistan, *Central Asian Survey, 17 (4),* pp. 539-560.

JORAVSKY, D. (1970): The Lysenko Affair, Boston.

KANDIYOTI, D. (2002): Agrarian reform, gender and land rights in Uzbekistan, *Social Policy and Development Programme Paper 11*, Geneva, <http://www.unrisd.org/UNRISD/website/document.nsf/ab82a6805797760f80256b4f005da1ab/c2919ac1cd7b5379c1256cca00369d07/$FILE/kandiyot.pdf>.

KOTZ, D. (2002): Sources and features of the "Uzbek growth puzzle" UNDP Uzbekistan Poverty Report, <www.undp.org/poverty/docs-propoor/uzbekistan-report/>.

KREMENTSOV, N. (1997): Stalinist science, Princeton.

MURRAY, C. (2004): Public lecture "The trouble with Uzbekistan" – By Craig Murray, British Ambassador to the Republic of Uzbekistan, 2002-04, Chatham House, Monday 8 November 2004.

POMFRET, R. (2000): Agrarian reform in Uzbekistan: Why has the Chinese model failed to deliver?, *Economic Development & Cultural Change*, *Vol. 48, Issue 2,* pp. 269-282.

POMFRET, R., ANDERSON, K. (2002): Gradual economic reform and well-being in Uzbekistan, in: LU, A., MONTES, M. F. (eds.): Poverty, income and distribution and well-being in Asia during the transition, Hampshire/New York.

RICHARDS, P. (1985): Indigenous agricultural revolution: Ecology and food production in West Africa, London.

SPECHLER, M. C. (2000): Uzbekistan: The silk road to nowhere?, *Contemporary Economic Policy, 18 (3),* pp. 295-303.

SPOOR, M. (1999): Agrarian transition in former Soviet Central Asia: A comparative study of Kazakhstan, Kyrgyzstan and Uzbekistan, *Institute of Social Studies Working Paper 298*, The Hague, <http://adlib.iss.nl/adlib/uploads/wp/wp298.pdf>.

TREVISANI, T. (2008 – forthcoming). Changing patterns of land control in Uzbekistan: Agricultural policies, dynamics of power and social conflict in and after the *kolkhozes* of Khorezm, FU Berlin [Dissertation].

UNITED NATIONS DEVELOPMENT PROGRAM [UNDP] (2001): United Nations Human Development Report, Uzbekistan.

VAN DUSEN, E., LEE, M., DENNIS, E., ILYASOV, J., TRESHKIN, S. (2003): The conservation of agricultural bio-diversity in Uzbekistan: The impacts of the land reform process, Paper Presented to the CAPRI workshop, September 29, 2003, Rome.

WALL, C. (2006): Knowledge management in rural Uzbekistan: Peasant, project and post-socialist perspectives in Khorezm, University of Bonn [Dissertation].

WALL, C., LAMERS, J. P. A. (2004): Farmer priority setting: Issues and research needs for Khorezm, Uzbekistan, *ZEF Working Papers for Sustainable Development in Central Asia No. 3*, <http://www.khorezm.uni-bonn.de/downloads/WPs/ZEF-UZ-WP03-Wall.pdf>.

WEGERICH, K. (2002): Natural drought or human made water scarcity in Uzbekistan? *Central Asia and the Caucasus, 2 (14),* pp. 154-162.

WORLD BANK (1999): Uzbekistan: Social and structural policy review, *Report 19626*, Washington, D. C.

LAWS AND DECREES

LAND LAW OF UZBEKISTAN (2004): Law on agriculture in the Republic of Uzbekistan (English translation), Law passed by the Parliament of Uzbekistan

Law of the Republic of Uzbekistan on Farmer Enterprises, No 602-I, 30 April 1998, last amended 2004.

Decree of the President of the Republic of Uzbekistan on the Plan for Development of Farmer Enterprises in the years of 2004-2006, 27 October 2003.

Continuity and change: Land and water use reforms in rural Uzbekistan
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 9, pp. 165-182.

CHAPTER 9

ANALYSIS OF AGRICULTURAL MARKETS IN KHOREZM, UZBEKISTAN

IHTIYOR BOBOJONOV[*] AND JOHN P. A. LAMERS[**]

ABSTRACT

This study addresses the three primary types of commodities produced and traded in the Khorezm region of Uzbekistan. The data used in the following analysis was collected over a 23 month period, between 2003 and 2004 on the Urgench and Khiva markets for ten commodities. This report aims to shed light on the role of agricultural markets during the transition period from a command to a market economy. The season and harvest period had a very strong influence on the established price of vegetables and fruits both in the different market types and locations. Except for rice and meat, prices of the other agricultural products depended strongly on their import from administrative regions inside Uzbekistan. Price differences of all commodities between markets were caused in the first place by transport costs. Due to the relatively low transport costs between regions, the price margins and hence the profit margins for traders were low. The analysis of the commodity flow chains revealed that aside from cotton, all other commodities were produced primarily for domestic consumption. Only rice and meat were exported to other regions of Uzbekistan. It is argued that the Khorezm region has presently a comparative advantage to other regions in Uzbekistan for rice production and animal husbandry.

Keywords: Market economy, agricultural markets, transition period, marketing channels, prices.

[*] Junior Researcher, Center for Development Research, Bonn, Germany. Email: ihtiyor@zef.uzpak.uz.

[**] ZEF/UNESCO Khorezm Project Coordinator. Email: j.lamers@zef.uzpak.uz.

Анализ сельскохозяйственных рынков в Хорезмской Области, в северо-западной части Узбекистана

Ихтиёр Бобожонов[*] и Джон П. А. Ламерс[**]

Аннотация

В статье рассматриваются три разных рынка сельскохозяйственных культур в Хорезмской области, на северо-западе Средней Азии. Основные данные, собранные в течение 23 месяцев на рынках городов Ургенча и Хивы по десяти различным продуктам, показывают роль рынков сельскохозяйственных культур в переходный период. Сезонный и урожайный периоды оказали сильное влияние на установление цен на фрукты и овощи как на рынках различных типов, так и в зависимости от месторасположения. Кроме риса, цены на сельскохозяйственные продукты зависят от количества произведенной сельхозпродукции в других областях. Различия цен между рынками можно объяснить, во первых, стоимостью транспортировки, а низкие цены транспортировки между областями влияют на снижение разницы между ценами и прыбили. Анализ цепи потока продуктов показал, что все продукты, кроме хлопка, были произведены, в первую очередь, для внутреннего потребления. А в другие области Узбекистана экспортировались только рис и мясо. Предполагается, что в настоящее время Хорезмская область в сравнении с другими областями Узбекистана обладает преимуществом в производстве риса и животноводстве.

Ключевые слова: Рыночная экономика, Сельскохозяйственные рынки, Переходный период, цепь потока продуктов, цены.

[*] Младший научный сотрудник, Центр по Исследованию Развития (ZEF), Боннский Университет, Бонн, Германия. Эл. почта: ihtiyor@zef.uzpak.uz.

[**] Координатор проекта ЦЭФ/Юнеско в Ургенче. Эл. почта: jlamers@zef.uzpak.uz.

1 INTRODUCTION

When Uzbekistan became a sovereign country in 1991, it possessed a specialized agrarian sector. The arid continental climate favors open-field production of annual, warm-season crops such as cotton. Before independence in 1991, Uzbekistan supplied raw cotton, cotton fiber and early harvested vegetables to other Soviet republics (OLIMJANOV and MAMARASULOV, 2006). Imports from other Soviet republics covered Uzbekistan's demand for cereals (particular wheat), potatoes and sugar. Crop cultivation in Uzbekistan occurred on large, specialized state and collective farms, heavily mechanized and with subsidized fertilizers, seeds and pesticides. Marketing activities and the supply of agricultural input were centrally organized outside the farm during the FSU[1] period (ALI et al., 2003). After independence, the vegetable and fruit production sector collapsed (OLIMJANOV and MAMARASULOV, 2006) and the imports of sugar and potatoes decreased significantly (MURADOV, 2002).

Following independence, the government of Uzbekistan (GoU) opted for a gradual transition from the command-state to the envisaged market economy, intending thus to cushion the severe impacts of the collapse of the FSU as experienced in neighboring countries (SPOOR, 2003). This was substantiated in maintaining, for example, the governmental targets for cotton and wheat and a strong control of major marketing activities of these strategic crops (MURADOV, 2002). Although the strategic crops cotton and winter wheat covered on average 61 % of the arable land during the last 14 years (OBSTAT, 2005), farmers are free to cultivate other products on the remaining land and to sell these commodities.

During the FSU epoch, agricultural commodity prices were centrally fixed and producers did not depend on a market demand, which does not mean that during the SU-era marketing and trade did not occur. The so-called "state-shops" sold commodities produced by the country or region itself, whereas consumer co-operatives sold commodities coming from abroad. At markets (*bazars*), people could sell commodities from their own (kitchen) gardens or obtained from their share of state farms.

Although the introduction of economic reforms by Gorbachev in 1985 sparked entrepreneurship and the development of private enterprise in the FSU, until 1991 these activities were still restricted in Uzbekistan. After independence, several reforms were introduced but the abolishment of the system of fixed prices and the adoption of a free market environment where commodity prices are to be established turned out to be a severe obstacle for producers due to their lack of knowledge and experience in a market-oriented production set-up (MATYAQUBOV, 2004). The marketing experience gained during the FSU period was insufficient

[1] Former Soviet Union.

to cope with the disruption of trade, shortages of all agricultural inputs, the limited opportunities for marketing agricultural commodities, and the limited opportunities to earn foreign exchange via agricultural activities, which was engraved by the absence of farmer advisory services to support farmer decision-making (ALI et al., 2003). Currently, many "state shops" still exist, but their functioning is reduced. In contrast, the *bazars* are flourishing and both the type of products and amount of commodities sold has sharply increased since 1991. In the study region Khorezm, the number of markets has increased and the administration of these markets has changed. *KhorazmBazarSavdo*[2], the umbrella organization of all markets, collected fees from sellers and controlled the sale of restricted and prohibited products such as alcohol, cotton oil, guns, and drugs.

Little market research has been conducted in the FSU countries. In a study in neighboring Tajikistan, it was found *"… an increased market orientation improves farmers' efficiency in the use and allocation of agricultural resources…"* (LAMERS and VON OPPEN, 1998). Despite the absence of information on prices for producers and consumers or on supply and demand in Uzbekistan (YUSUPOV, *unknown)*, recent findings showed that farmers obtained higher profits when selling their products directly to consumers (MURADOV, 2002). Farmers are thus in need for market information also as a guide for their decision-making. This study analyzed therefore the various types of markets in the Khorezm region, located at the southern part of the Aral Sea Basin in the lower reaches of the Amu Darya (see chapter 8 for details of the study region), and evaluated the situation and role of the three dominating agricultural markets: *Dehqon* markets, private as well as government trade purchase organizations and processing plants. Finally, the study intended to identify for what commodities the Khorezm region has a comparative advantage.

2 DATA COLLECTION, PROCESSING AND ASSESSING

A combination of methods was needed to collect the necessary information about the different markets and institutions involved in the marketing and to monitor the price dynamics of ten agricultural products in the Khorezm region. Weekly prices of meat, egg, rice, wheat, onion, potato, apple, carrot, tomato and the processed sour cream were collected in Urgench, the capital of Khorezm, and Khiva city markets over a 23 month period between 2003 and 2004. Stratified random sampling was used for the selection of the markets surveyed. Seasonal trends and price variations were analyzed using regression and correlation analyses and *t*-tests, all performed with Excel software. Transaction costs of market access and transport costs were gathered during the same study period.

---

[2] Khorezm Market Trade Association.

Product flow chains of the ten agricultural products were elaborated and analysed to identify the importance and share of key market agents (governmental and private) involved in the marketing of agricultural products. Qualitative and quantitative data were obtained from interviews conducted with sellers and key resource experts such as directors of processing plants and storage facilities involved in agricultural marketing in the Khorezm region. Secondary data on the planted area, yields and farm gate prices of the monitored market commodities were provided by *OblStat*[3], *OblSelVodKhoz*[4], and the regional statistic departments which allowed cross-checking and completing the data sets.

Parameters for market differentiation included the location, products marketed, prices, product origin, duration and opening time, service provision, number of sellers as well as the type of market agents.

3 RESULTS

3.1 Type of agricultural markets

Three types of markets were identified where agricultural products were marketed: *Dehqon* markets, Universal markets, and Mini markets. The Khorezm region had seven main *dehqon* markets. They usually were located one or two kilometers outside the center of the capital city of each of the eleven administrative districts. All locally produced agricultural products, except cotton, were sold at these markets mostly by producers selling their own produce. Clothing and other non-agricultural products were also sold, albeit in much smaller quantities. A livestock section existed as part of the *dehqon* market in most of the seven markets. Households were the main suppliers of animals whereas butchers, farmers as well as traders were the primary consumers of animal goods. Products such as oil cake, husks, and other non-agricultural products were traded by resellers. Prices in general could be bargained. *Dehqon* markets were open one or two days a week.

Eleven Universal markets existed in the Khorezm region, all of them situated in the center of the capital of the administrative district. A wide variety of products were traded at these markets, which enjoyed a relatively developed "service" sector. The section with agricultural products occupied the largest part of the market. Next to farmers, resellers intervened actively at Universal markets, which were open most days of the week. In case Universal and *dehqon* markets were located in close proximity, Universal markets were not operational during periods when

[3] *OblStat* is the local Branch of Uzbekistan's Statistical Office in Khorezm region.
[4] *OblSelVodKhoz* is the Khorezm regional Agriculture and Water Resources Management Office.

dehqon markets were open, due primarily to buyers demonstrating a preference for *dehqon* markets.

Numerous Mini-markets, chiefly trading agricultural products, existed in the Khorezm region and were frequented by 15-20 sellers. In particular, resellers operated on these mini-markets, which explains why prices in these markets were in general 10-15 % higher than in Universal markets. Mini-markets were open every day of the week.

Market transactions also occurred also outside the controlled markets since farmers and *dehqons* sold their products directly from their homesteads to fellow villagers. This home marketing reduced transport expenses for sellers as well as customers.

3.2 Market segmentation by type of sellers in Urgench market

Three types of sellers were identified at the different market types (Table 9-1): (i) Sellers, who sold their own products thus referring to farmers, household and *shirkat* members; (ii) resellers or retailers, who bought products from farmers or wholesalers and traded these; (iii) intermediates and wholesalers. Depending on the commodity and trading place, resellers sold on average 100-200 kilograms of product per day. Butchers were classified as resellers, since they bought animals from special livestock markets, slaughtered them and sold meat in pieces at the market. Special wholesalers traded mostly rice and eggs whilst others traders imported apples from Iran, potatoes from Surkhandarya, onions from Kashkadarya, and tomatoes from Samarkand during both the winter and spring.

Carrot, wheat, rice, egg, sour cream and meat were locally produced only (Table 9-1). Rice and animal husbandry products were never imported into the region, but rather, exported out of the region to other administrative regions in Uzbekistan, which is discussed in more detail in the following sections.

3.3 Commodity flow chains

The following three commodity flow chains demonstrate a contrasting picture (Figures 9-1, 9-3 and 9-5). The commodity flow chain of winter wheat is depicted in Figure 9-1. *KhorazmDonMahsulot*[5] is the association that transported wheat directly from the field of the farmers to the state mills. In case farmers organized their own transport, *KhorazmDonMahsulot* reimbursed the transportation costs. About 70 % of the harvested wheat by private farmers and cooperative farms (*shirkats*) reached consumers via the intervention of government structures. The remaining 30 % was delivered to markets by the producers, mainly wholesalers, or consumed. There where no import and export activities involved in the wheat

[5] Khorezm grain products.

flow chain except that wheat flour was imported from Kazakhstan, since it has a higher baking quality than the wheat produced in the Khorezm region.

After 1991, meat production sharply increased in the Khorezm region (Figure 9-2) also driven by a gradually increased share of exported meat, in particular to other regions of Uzbekistan (Figure 9-3). This was caused by constant lower meat prices in the Khorezm region. For example, in 2004 the meat price at Urgench and Khiva markets in Khorezm averaged 1800 *soum*/kg compared to 2000 *soum*/kg in Tashkent, the capital of Uzbekistan which is located roughly 1000 km from Urgench; or in Navoi, a region located at about 600 km from Urgench. The quantification of export quantities was not possible.

Table 9-1: Number of sellers, type of sellers and product origin in Urgench market, 24.04.04

Product	Total sellers	Number of sellers interviewed	Farmer sellers, %	Reseller, %	Reseller bought from	
					Wholesale (imported or brought),%	Farmer or wholesaler (local),%
Egg	30	7	57.1	42.9	0	100
Apple	89	12	33.3	66.7	62.5	37.5
Meat	53	6	0	100	0	100
Rice	64	7	57.1	42.9	0	100
Wheat	13	4	50.0	50.0	0	100
Onion	147	16	37.5	62.5	60	40
Potato	169	20	30.0	70.0	71.4	28.6
Tomato	75	7	28.6	71.4	40	60
Carrot	109	9	42.9	57.1	0	100
Sour cream	11	4	25.0	75.0	0	100

Figure 9-1: Simplified commodity flow chain of winter wheat in the Khorezm region in 2004

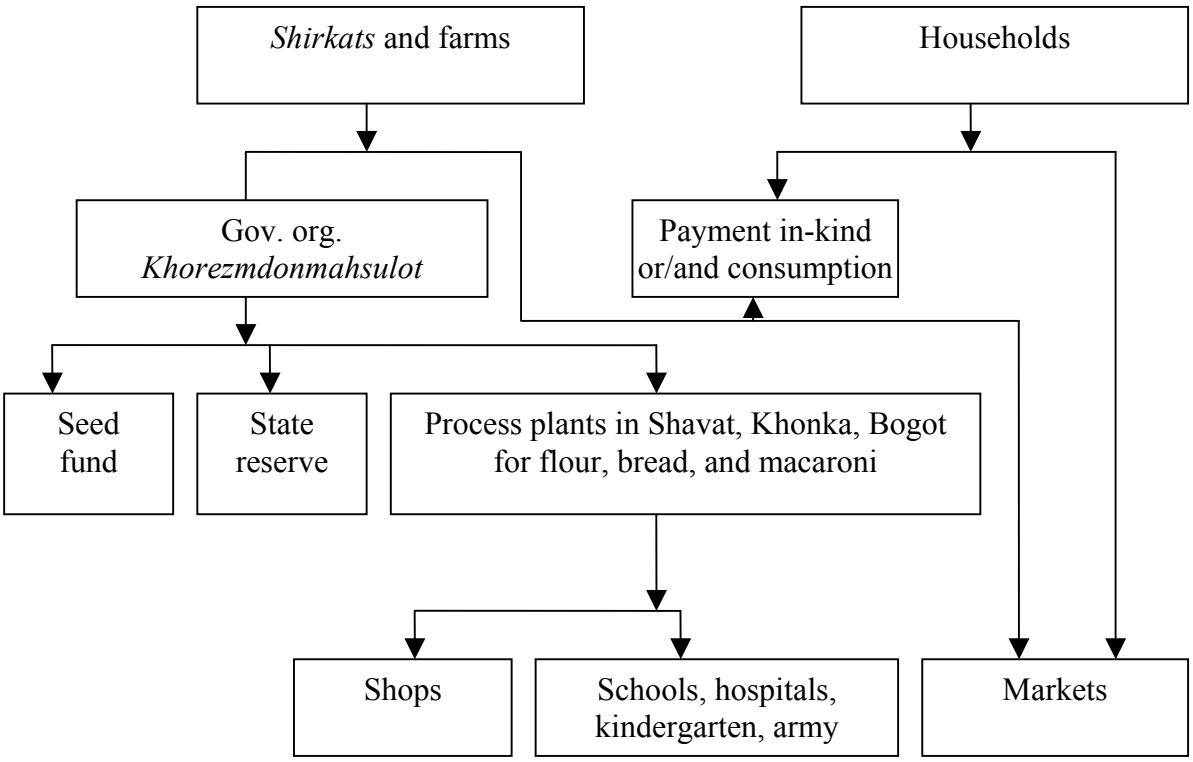
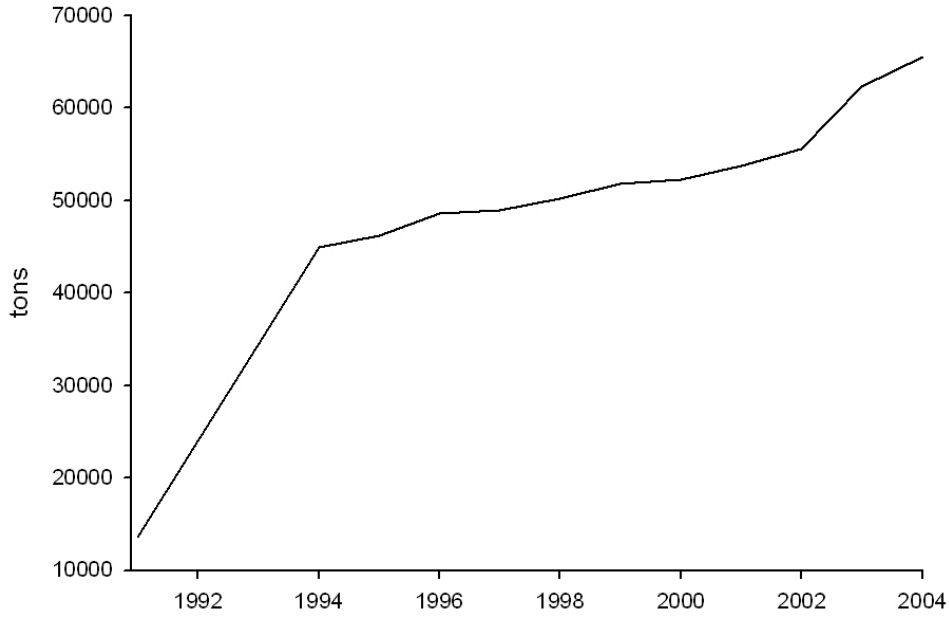


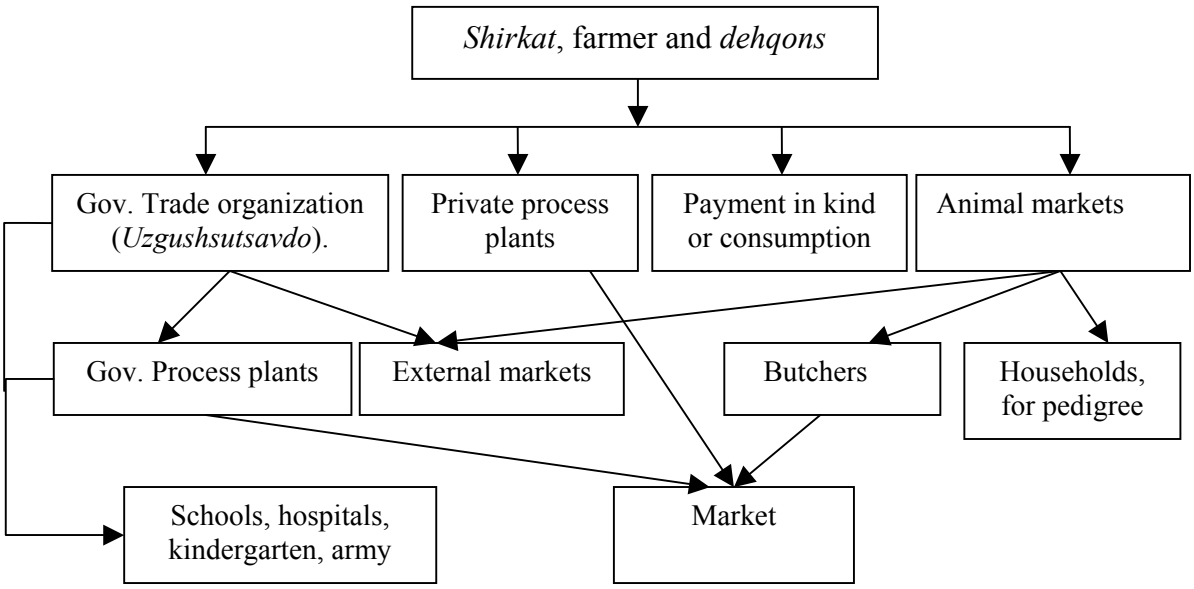
Figure 9-2: Dynamics of meat production (in tons) in the Khorezm region between 1991 and 2004



Source: OBLSTAT, 2005.

Note: Points in the figures are connected for increasing visualization only.

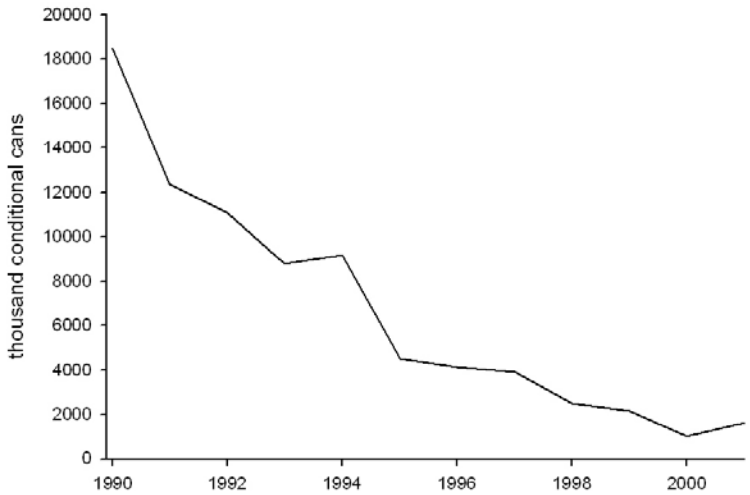
Figure 9-3: Simplified meat flow chain in the Khorezm region, 2004



The vegetable flow chain differed considerably from the wheat flow chain, owing primarily to the absence of a state order for vegetables and deteriorated processing facilities (Figure 9-4). For example, potatoes were marketed as a raw, non-processed commodity (Figure 9-5). The bulk of the potato production originated from private farmers and households and was marketed directly by producers or wholesalers.

Vegetable production and marketing turned out to be extremely seasonal in the Khorezm region (see Section 3.4). The share of vegetable import was considerably higher in winter and spring seasons as it is shown in Table 9-1. Export of these products did not occur.

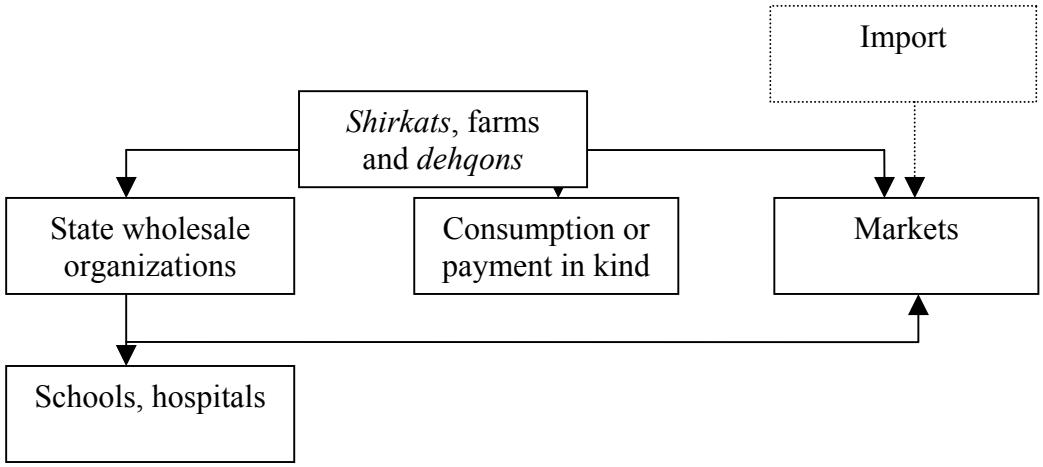
Figure 9-4: Dynamics in the total amount of processed agricultural products by state processing plants in the Khorezm region over the period 1991-2001



Source: OBSELVODKHOZ, 2004.

Note: Points in the figures are connected for increasing visualization only.

Figure 9-5: Simplified potato flow chain in the Khorezm region in 2004



3.4 Price analysis

Price analyses showed that wheat, meat, egg, rice and sour cream prices were 5-10 % higher at the Urgench market as compared to the Khiva market (Figures 9-6 and 9-7). Differences in prices of grains and animal products in Urgench and Khiva markets were low, owing to the low transportation costs of these products. During the wheat harvest period in June-July 2003, the state price averaged 72.8 *soum*/kg[6], in contrast to the average market price of 100 *soum*/kg. Transportation costs to the market varied between 2 and 4 *soum*/kg. Prices for agricultural commodities were lower in the spring of 2004 than 2003.

The total amount of regional rice and potato production influenced the average annual prices as evidenced by the highly, negative correlation (rice r=-0.89; potato r=-0.9) whereas for wheat this correlation was absent (r=0.2). For the other products, the data collected were insufficient for a reliable analysis.

During the study period, only small price fluctuations were monitored for all commodities (Table 9-2), except for tomato, apple and egg (sold per piece). This showed a clear seasonal variation as substantiated in peaking prices during the winter months January, February and March. They were clearly lower during the summer months June, July, August and September.

In several cases price differences were caused by product qualities. Prices of vegetables and fruits were lower in district markets compared to the Urgench market. In the Khiva market, the demand for imported fruits and vegetables of very high quality was, surprisingly, absent.

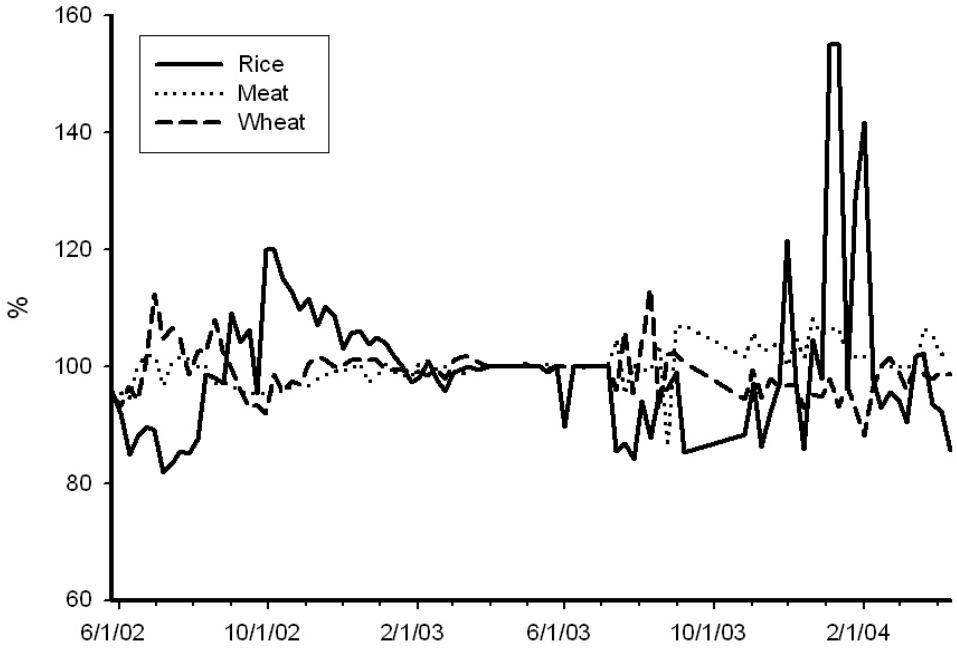
Interviews with resellers revealed that they could hardly influence prices because of the stiff competition, except during winter when only a limited number of resellers

[6] During the study period, one US dollar equivalent on average 1020 Uzbek *soum.*

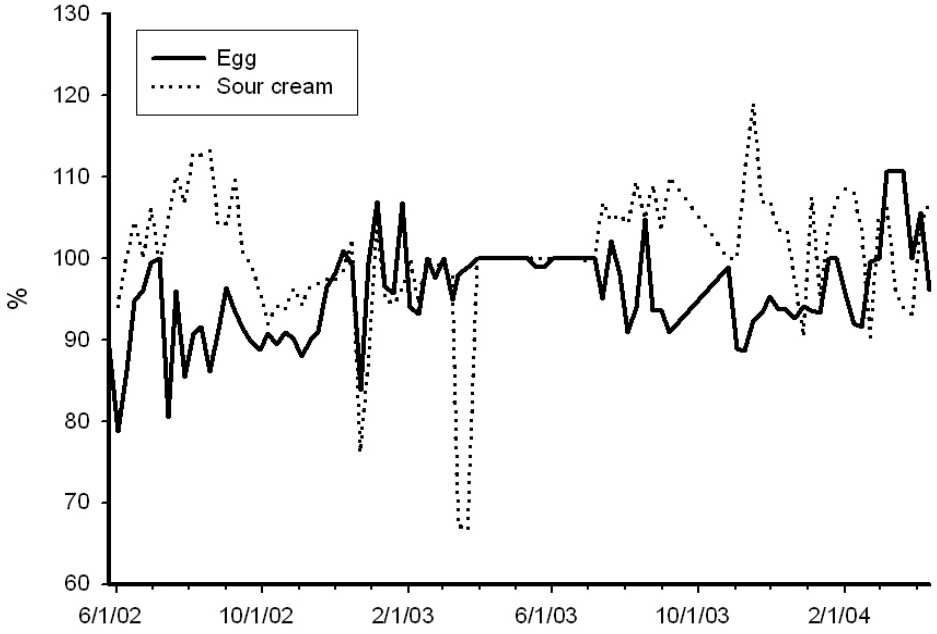
operated at the markets. Price negotiations among resellers worked only for a limited number of products such as tomatoes and cucumbers, which are very rare in winter periods. The percentage which resellers added equaled mostly the costs of the services rendered.

Figure 9-6: Difference[7] in market prices of rice, meat, wheat (a), egg and sour cream (b) at the markets of Khiva and Urgench between 26.05.02-11.04.04

a)



b)

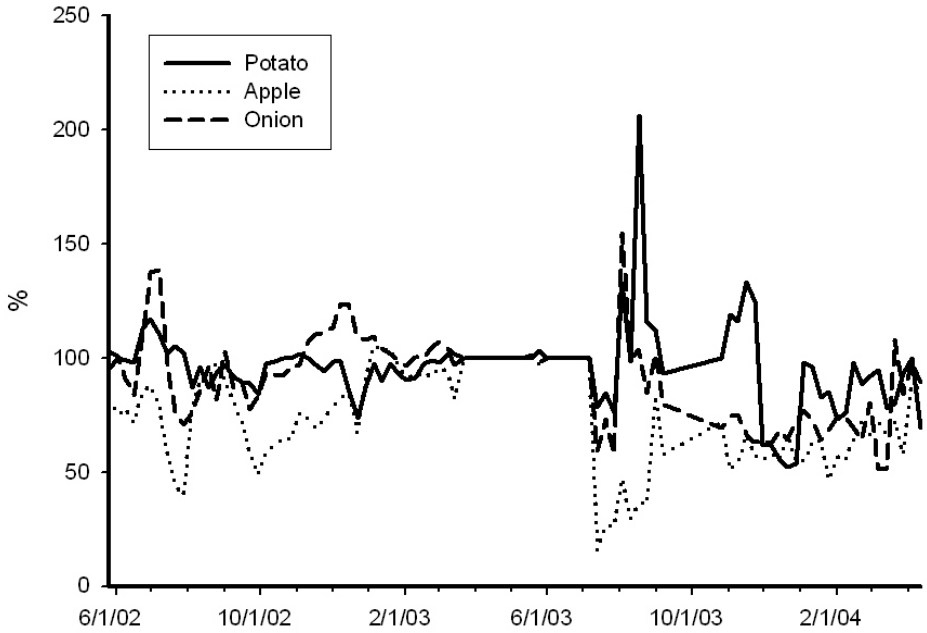


Note: Points in the figures are connected for increasing visualization only.

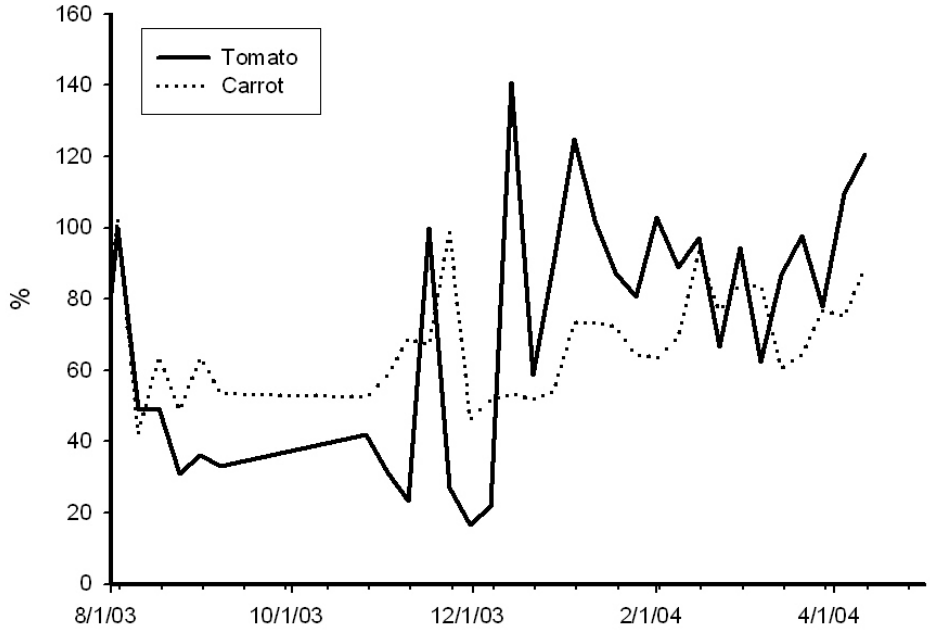
[7] 100% means the same prices, less than 100 mean lower prices in Khiva market and vice-versa.

Figure 9-7: Market prices of potato, apple, onion (a), tomato, carrot (b) at the markets of Khiva and Urgench between 26.05.02-11.04.04

a)



b)



Note: Points in the figures are connected for increasing visualization only.

Table 9-2: Variation in Urgench market prices (in *soum*/kg) during 26.05.02-11.04.04

Commodity	Mean	Standard Error	Minimum	Maximum
	---------- *soum*/kg ----------			
Egg[8]	57	1	42	87
Apple	420	33	124	1833
Meat	1741	13	1533	1989
Onion	117	9	48	501
Potato	167	8	71	450
Rice	466	16	253	808
Wheat	109	1	89	130
Tomato	684	100	78	2150
Carrot	62	3	36	108
Sour cream	1309	18	1094	2213

4 DISCUSSIONS

The annual average market prices of the monitored commodities in the Khorezm region depended primarily on gross production in the region, which was under strict surveillance of the GoU and controlled via water and land allocation. Previous findings also reported that the area sown to coarse grains had shrunk continuously in response to the state order for wheat and had resulted in keen shortages of feed grain (FAO, 2000). In contrast, the price of winter wheat did not follow this trend but remained rather low and stable and thus independent from its production. Winter wheat is the main cereal crop used in Uzbekistan for bread making and hence it is one of the rationed items in Uzbekistan. Prices of rationed items were subject to governmental control (FAO, 2000). After independence, domestic wheat cultivation became a declared policy of the GoU to satisfy domestic needs. In the Khorezm region, the area under wheat increased more than two-fold in less than 15 years: From 36.8 thousand ha in 1990 to 86.0 thousand ha in 2003 (OBLSTAT, 2005). The low and stable wheat prices were due to the intervention of *KhorazmDonMahsulot*. This organization bought wheat at low prices from those farmers producing under a state order agreement. The prices offered by of *KhorazmDonMahsulot* were inflexible and could only compete with the prices of the *dehqon* markets during the harvesting periods, during which prices on those markets dropped.

[8] *Soum*/piece.

The GoU has a monopoly in the operation of wheat mills. These state mills paid farmers according to four quality classes, but Khorezmian wheat is of notoriously inferior quality compared to the spring wheat produced in neighbouring Kazakhstan due to the high salt and mineral contents in the soil which reduces the palatability and quality of the crop (KIENZLER, 2005). In 2004, the average gluten content of Khorezmian wheat did not exceed 23 %, barely reaching the classification of "satisfactory" baking quality wheat. Consequently, state bakeries used to mix the wheat flour with that of higher quality to achieve average baking quality flour. Also, due to outdated machinery used during the harvest, the degree of pollution of the wheat is high and often the cause for a further downgrading of the quality (KIENZLER, 2005). The difference between government and market prices of wheat explained why farmers attempted to escape from state order contracts and tried to produce for "private" markets where quality control is much less severe.

It is recognized that the economic reforms introduced after independence in Uzbekistan did not favour vegetable production and resulted in the collapse of this production and marketing segment (ALI et al., 2003). Hence it is no surprise that vegetable supplies were extremely seasonal, most likely because it was very costly to grow vegetables during the cold winters (ALI et al., 2003). Moreover, trading vegetables and fruits rendered prices unpredictable, independent of the product volume and not clearly subject to supply and demand. As long as the strong governmental control on the price elaboration of such products prevails, the profit margins will remain low and thus also incentives for production increase. This is in particular true for vegetables and fruits, of which 75 % were produced by *dehqons* (OLIMJANOV and MAMARASULOV, 2006). Likewise, the deteriorated and primitive post-harvest handling technologies are not conducive to an increase in sales for vegetable markets and their integration into production lines (ALI et al., 2003).

Price analysis, however, revealed a consistent difference between Khiva and Urgench market prices of vegetables and fruits that could be explained by the transporting costs of these products. In general, this price difference underlined the high demand for these types of products at markets in Urgench, which has approximately 300,000 inhabitants and is the largest urban center in the region. The interest of the Uzbek population for fruits and vegetables is considered a primary reason why this sector has nearly recovered and is approaching levels achieved during the SU era (ALI et al., 2003). Moreover, vegetable production also seems a profitable and secure source of income (BOBOJONOV et al., 2007), but the absence of a reliable price information system limited farmers and traders making better-informed decisions to increase profits further. In case farmers become aware of higher demand and prices for their products, and in particular for those for which they have a comparative advantage, their income is bound to increase. HAU and OPPEN (2002) argued even that better market access can promote a more efficient allocation and use of resources leading to increased productivity. Moreover,

markets offer an outlet also for hitherto subsistence-oriented farmers to sell their own products for much needed cash. The development of markets and enterprises will generate income not only for the individual households but also for the GoU.

The established commodity flow chains did not include an export component, indicating that the commodities monitored were produced mainly for domestic consumption. This is in contrast to the situation during the FSU era, where processed vegetables and fruits, were mostly exported from the Khorezm region by nation-wide overarching monopolistic structures like other regions in Uzbekistan (OLIMJANOV and MAMARASULOV, 2006). Since the processing capacities of Khorezm collapsed after independence (Figure 9-4), Khorezm has no comparative advantage for this production and market segment anymore. In contrast, at present, Khorezmian traders historically competed with traders from other regions due to the low transport costs previously mentioned as a potential hindrance for income generation for farmers (FAPU/TASIC, 1996). The large quantities of imported potatoes and onions from Surhandarya, Kashkadarya and Samarkand regions in Uzbekistan, influenced the prices of potato and onions on the Urgench and Khiva markets. In the regional markets, these commodities were then sold additionally by resellers together with products from their own region. Hence, price establishment in the markets seemed not to have been so much influenced by local conditions but more by conditions outside the market owing to the trade-purchase relations in the region. Especially in rural areas, commodities were sold directly by farmers and *dehqons* at their homestead to mainly neighbors or retailers. An influence on price establishment due to this home-marketing could not be identified, which confirms previous speculations in Uzbekistan (FAPU/TACIS, 1996).

Rice was one out of the two products exported to other regions of Uzbekistan. Due to the overwhelming flat topography, Khorezm has a natural comparative advantage for producing paddy rice on larger areas in case of sufficient water supply. Due to the agro-climatic conditions, rice yields with a quality highly suitable for making the local *plov* dish, are much more possible compared to other regions of Uzbekistan. Consequently, rice production is highly profitable as recently postulated (DJANIBEKOV, 2008 forthcoming) as long as there is no fixed price for water (BOBOJONOV and LAMERS, 2006).

Furthermore, meat turned out to be one of the most exported products to markets outside the study region, but within the territory of Uzbekistan. Livestock producers could not sell meat directly to the consumers, but instead sold animals at special livestock markets. Households greatly engaged in livestock rearing and it was recently confirmed that this represented another chief source of income and consequently was a preferred means to counterbalance the generally high rate of unemployment in the rural areas of the Khorezm region (MÜLLER, 2006). Since

the local meat price in Khorezm was lower than at other national markets, *Uzgushtsutsavdo*[9], another governmental organization, bought meat directly from farmers in the Khorezm region and exported this meat to other regions of Uzbekistan. Although WALL (2006) argued that in particular cattle breeding in the Khorezm region has become defunct after independence, this speculation seems overly conservative because it left out the observations about the high involvement of the rural population in livestock rearing (MÜLLER, 2006) and the steadily increasing meat production (Figure 9-2). Moreover, the high share of exports in the meat flow chain is another indication that the Khorezm region, compared to the other national regions, has, aside from rice production, a comparative advantage of producing meat.

Both rice production and livestock rearing in the Khorezm region are examples that an increased market-orientation can form a sound foundation for improving farmers' efficiency in the use and allocation of agricultural resources as argued previously (HAU and VON OPPEN, 1992). The mobilization of such resources in the Khorezm region has started because of the existing differences in comparative cost advantages. Both the markets and the trade fuelled production generated welfare because Khorezmian farmers and traders responded to improved market access and the associated price signals with specialization first. The trend is ongoing and points at an intensification of these production niches. Furthermore, it can be expected that an increase in exchange and trade not only sparks the specialization in commodities, sectors and regions, but encourages the development of infrastructure and transport as well (HAU and VON OPPEN, 1992). Moreover, increased competition among traders may lower costs for both producers and consumers.

5 CONCLUSIONS

Despite various reforms, the GoU has kept its central grip on the marketing of main agricultural products, such as winter wheat and cotton. For other commodities, market prices were influenced in the first place by the produced quantities, which presently depend on the area allocated by the GoU. The market prices of products other than rice and meat were influenced strongly by the amount and prices of the transported commodities, in particular during winter and spring months. Low transportation costs between the administrative regions cushioned price differences between regionally produced products and those products im ported from other regions. The price differences between markets in the different districts of the Khorezm region equaled transportation expenses.

Farmers mostly produced for regional markets and made their decisions based on regional market prices. Moreover, the current infrastructure and legal environment

[9] Uzbekistan Meat and Milk Trade Association.

were not conducive to promote the export of goods for small-scale farmers. Government prices were very low and a processing sector was hardly developed. Also, the demand for agricultural products in the Khorezm region was very limited and an increase in gross production may cause immediately declines in prices.

Prices for rice and meat were substantially lower in the Khorezm region compared to other administrative regions of Uzbekistan, and a regular export of both commodities has begun. Although at present only rice production and animal husbandry in the Khorezm region have this comparative advantage, the establishment of a market information system may enhance this initial step further and could be of vital importance in improving farmers' knowledge on agricultural marketing and giving them a chance of increasing economic gains. Given the strong linkage between marketing and development, the improvement of markets and marketing is an important developmental tool for countries in transition. Yet to reach this level, the present trade activities need to be developed further to fully exploit the comparative advantages of the Khorezm region, such that all potential benefits of agricultural trade are realized.

REFERENCES

BOBOJONOV, I., LAMERS, J. P. A. (2006): Optimization of crop allocations based on comparative economic advantages for various scenarios in Khorezm province of Uzbekistan, in: Proceedings of transition toward market economy conditions in the water resource management and land melioration sector in Uzbekistan (Section 1 and 2), Ministry of water resources and agriculture of Uzbekistan, University of TIIM, Tashkent, November 16-18, 2005, pp. 70-76.

DJANIBEKOV, N. (2008 – forthcoming): A micro-economic analysis of farm restructuring in the Khorezm region, Uzbekistan, University of Bonn [Dissertation].

FAPU/TACIS (1996): Marketing and price policy in the Republic of Uzbekistan, Tashkent.

FOOD AND ARGRICULTURE ORGANIZATION (2000): Fao/WFP crop and food supply assessment mission to the Karakalpakistan and Khorezm regions of Uzbekistan. <http://www.fao.org/Documents/Show_Cdr.Asp?Url_File=/Docrep/004/X9188e/X9188e00.htm>.

HAU, M. A., VON OPPEN, M. (2002): Market access and agricultural productivity in Doi Inthanon Villages, Paper presented at the International Symposium Sustaining Food Security and Managing Natural Resources in Southeast Asia: Challenges for the 21st Century, 8-11 January, Chiang Mai, Thailand.

KIENZLER, K., LAMERS, J. P. A., IBRAGIMOV, N., VLEK, P. L. G. (2005): Sustainable winter wheat production in the Aral Sea Basin: Quantity, quality and economics of mineral fertilizer utilization, in: Proceedings of the INTAS Aral Sea Basin Water and Food Conference: Managing Water and Food Quality and Security in Central Asia, Almaty, Kazakhstan, September.

LAMERS, J. P. A., VON OPPEN, M. (1998): Basis for an agricultural input and output market strategy to sustain food security in Gorno-Badakhshan, Tajikistan, Report On A Study.

LUMPKIN, T. A., ALI, M., FAROOQ, U. (2005): Vegetable research and development in Central Asia: A guideline for setting priorities under data scarcity, in: Vegetable production in Central Asia: Status and perspectives. Proceeding, Shanhua, Tainan: AVRDC – The World Vegetable Center, pp. 1-23.

MATYAKUBOV, U. (2004): Agro marketing. Textbook for UrSU Students, UrSU, Urgench [in Uzbek].

MÜLLER, M. (2006): A general equilibrium approach to modeling water and land use reforms in Uzbekistan, University of Bonn [Dissertation].

MURODOV, CH. (2002): Internal and export prices for agricultural products, <http://R0.Unctad.Org/Infocomm/Comm_Docs/Docs/Projectp/Docsuzbe/Murodovp.Pdf> [in Russian].

OLIMJANOV, O., MAMARASULOV, K. (2006): Economic and social context of the vegetable system in Uzbekista., in: KUO, C. G., MAVLYANOVA, R. F., KALB, T. J. (eds.): Increasing market-oriented vegetable production in Central Asia and the Caucasus through collaborative research and development, *Avrdc Publication Number 06-679*, pp. 91-95, <http://www.avrdc.org/pdf/Proceedings_CAC.pdf>.

REGIONAL DEPARTMENT OF THE MINISTRY OF MACRO-ECONOMICS AND STATISTICS OF THE REPUBLIC OF UZBEKISTAN IN KHOREZM OBLAST [OBLSTAT] (2005): 14 Years of Independence, Statistical Collection, Urgench.

SPOOR, M. (2003): Intuitional development for growth with equality in Uzbekistan, <http://www.Undp.Org/Poverty/Docs-Propoor/Uzbekistan-Report/Uzbekistan-Contents.htm>.

WALL, C. R. L. (2006): Knowledge management in rural Uzbekistan: Peasant, project and post-socialist systems of agricultural knowledge in Khorezm, University of Bonn [Dissertation].

WEHRHEIM, P., WIESMANN, D. (2003): Food security in transition countries: Conceptual issues and cross-country analyses, *ZEF – Discussion Papers on Development Policy 62,* Bonn.

YUSUPOV, E. D. (n.d.): Yield and diversity in agricultural trade in Uzbekistan. <http://R0.Unctad.Org/Infocomm/Comm_Docs/Docs/Projectp/Docsuzbe/Yusupovp.pdf> [in Russian].

Continuity and change: Land and water use reforms in rural Uzbekistan
PETER WEHRHEIM, ANJA SCHOELLER-SCHLETTER, and CHRISTOPHER MARTIUS (editors 2008), Chapter 10, pp. 183-203.

CHAPTER 10

COTTON, AGRICULTURE, AND THE UZBEK GOVERNMENT

MARC MÜLLER[*]

ABSTRACT

Production of raw cotton and exports of cotton fiber in Uzbekistan are subject to a variety of government regulations. Among the most relevant policies are the administrative setting of production targets, governmental price control, and taxation of exports on the one hand, but also significant subsidization of inputs and debt-write offs for cotton producers and various forms of subsidies for the processing of cotton fibre on the other. Additionally, an assessment of who are "winners" and "losers" under the current cotton market policy regime is hampered by a lack of consistent data. This study aims at quantifying the magnitude of distortions resulting from direct and indirect government interventions. We start with a graphical, partial welfare analysis of the cotton market and then present a quantitative analysis for the years 1993 to 2004. Missing data were estimated by the author. The contribution of this work is that the analysis is carried out for the sequential markets of raw cotton and fibre. In contrast to other analyses which focus on primary cotton production only, this study indicates that the effects of the major cotton policies on the major actors involved are not at all clear. The results raise the questions whether the sector policies are rational, whether they are possibly counter-balanced by macro-economic disturbances (e.g. exchange rate fluctuations) or whether they are simply an attempt to shield as much labour in rural Uzbekistan as possible.

Keywords: Partial welfare analysis, cotton market regulations, Uzbekistan.

---

[*] Until 10/2006, Senior Research Fellow, Center for Development Research, University of Bonn, Germany; Currently European Commission, Joint Research Centre, Sevilla. Email: marc.mueller@JRC.europa.eu.

ХЛОПОК, СЕЛЬСКОЕ ХОЗЯЙСТВО И УЗБЕКСКОЕ ПРАВИТЕЛЬСТВО

МАРК МЮЛЛЕР[*]

АННОТАЦИЯ

Производство хлопка-сырца и экспорт хлопкового волокна регулируются со стороны правительства в Узбекистане. В числе основных методов регулирования значатся, с одной стороны, административное принятие производственных программ, государственный контроль цен и налогообложение на экспорт, а с другой стороны, значительное финансирование затрат и списание долгов производителей хлопка, а также предоставление различных форм субсидий для переработки хлопкового волокна. Кроме того, отсутствие последовательных данных затрудняет определение выигравших и побежденных в условиях действующего на рынке хлопка нормативного режима. Данное исследование направлено на определение размеров искажений, ставшие результатом прямого либо косвенного вмешательства со стороны правительства. Мы начинаем с графического, частичного анализа развития хлопкового рынка и затем представляем количественный анализ на период с 1993 по 2004 гг. Новизна настоящего исследования состоит в том, что анализ осуществляется для взаимосвязанных рынков хлопка-сырца и хлопкового волокна. В отличие от других исследований, сосредоточенных в основном на первичном хлопкопроизводстве, данное исследование показывает, что воздействие главной хлопковой политики на основных участников рынка представляется не совсем ясным. Согласно результатам проведенного исследования возникают следующие вопросы: Является ли курс сельскохозяйственной политики рациональным? Уравнивается ли заданный курс нарушениями макроэкономических процессов (например, неустойчивостью обменного курса)? Либо это всего лишь попытка трудоустройства как можно большего количества сельского населения Узбекистана?

Ключевые слова: Частичный анализ развития, регулирование хлопкового рынка, Узбекистан.

---

[*] До октября 2006 г. Старший Научный Сотрудник, Центр Исследования Развитий, Боннский Университет, Германия; в настоящее время – Европейская Комиссия, Совместный Исследовательский Центр, Севилья. Эл. почта: marc.mueller@JRC.europa.eu.

1 BACKGROUND AND RATIONALE

The policies applied on the Uzbek markets for raw cotton and cotton fiber are frequently addressed and discussed in scientific studies, country analyses and reports from national and international organizations (SPOOR, 2004; BLOCH, 2000; POMFRET, 2003; IMF, 1998; IMF, 2000; WORLDBANK, 1999; GUADAGNI et al., 2005; CER, 2005; RUDENKO, 2006; MÜLLER, 2006). Identification of the actors who gain and the actors who lose under the current regulations and the evaluation of potential policy reforms is hampered by a lack of reliable and consistent data for the time since independence and an opaque system of taxes, subsidies, production targets, and input provisions. Crucial information like input subsidies or domestic fiber prices can usually not be found in publications of national statistical departments, or research institutes (Centre for Efficient Economic Policies (CEEP), Centre for Economic Research CER). Furthermore, analysis from international organizations (IMF, 1998; WORLDBANK, 1999; GUADAGNI et al., 2005) cover only limited periods of time and apply different methods of evaluation, for example, the net-transfers out of the cotton sector. Most studies indicate positive transfers out of agriculture via the cotton sector, but differ significantly concerning the magnitude of the net-transfers.

The aim of this study is to derive a transparent and consistent outline of the policies related to the Uzbek cotton market and the impacts on the actors involved. The general idea is to use all available information, mainly from the studies mentioned above, but also from a variety of other sources, to merge them into a single database, and to derive comparable results. The nature of the problem requires the estimation of missing data points, which is done by applying an estimation method based on the works of BRITZ et al. (2004) in the context of the compilation of a complete and consistent database for the agricultural sector of the European Union. The fact that the used studies do not only differ in terms of methods but also in terms of data-structure, requires that the smallest common denominator of data aggregation is achieved. This process is a comparatively blunt tool, however, the loss of detail is outweighed by the gain of a complete and consistent data set of the Uzbek cotton sector for the period from 1993 to 2004.

Section 2 provides the conceptual framework of the actors involved in the cotton market and gives a qualitative overview on the impacts of the relevant policies on the interlinked partial markets by using a graphical partial welfare analysis. We continue in section 3 with a description of the database, how it was compiled and the way in which data-gaps were filled. The resulting monetary flows within the cotton sector, especially the net-transfers out of agriculture and the potential revenues for the budget of the Uzbek government, are then discussed in section 4. We conclude in section 5 with a summary of results and possible implications for further research on the topic.

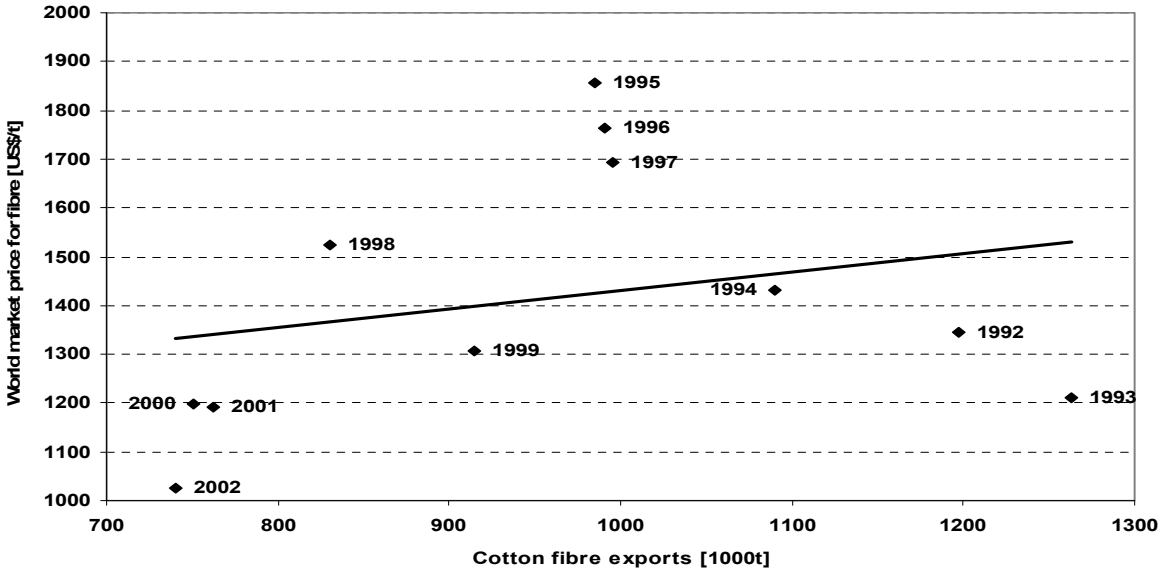
2 PARTIAL WELFARE ANALYSIS OF MARKETS FOR RAW COTTON AND FIBER

Cotton is a strategic crop in Uzbekistan and its production is largely state controlled. It is the dominant crop within the agricultural sector and about 32 % of the total cropped area between 1993 and 2005 in Uzbekistan was used for cotton production (FAOSTAT, 2006). The dominance of this crop is the result of a history of interventions dating back to the Soviet system which continues today, primarily in the form of output quantities determined by the government. Production targets are set at the national level and then broken down to regions (*oblast*), districts (*rayon*) and finally to the actual producers (former *kolkhozes*, new *fermers* and *dehqons*). In theory, 30 % of the target level has to be sold to the responsible state marketing board (*Uzkhlopkopromzbyt*) at state prices which are usually described as being well below the hypothetical world market price (WMP) for raw cotton. The remaining 70 % might then be sold to the same organization at around 20 % higher prices, which are still below the WMP, or to private processing facilities. Due to the fact that the state does not allow any significant private cotton marketing and that the production targets are usually very ambitious, the total produced quantity is in practice sold to governmental institutions (IMF, 2000; WORLDBANK, 1999; KANDIYOTI, 2001). The resulting supply of raw cotton is then processed into fibers and seeds. Fibers are mainly (but decreasingly) exported or used by the domestic textile industry. Seeds are either redirected to the agricultural producers for sowing purposes, or are milled to cotton oil and oil-cake. Cotton oil is an important food product while oil-cake is used as a fodder component in the animal husbandry sector.

This study focuses on the sequential markets for raw cotton and cotton fibers. A simplified graphical analysis of the relevant market regulations is carried out in a first step in order to identify the potential effects on the actors on these markets. The following graphical analysis was conducted under the assumption that changes in quantities for exports do not affect the export price, thus treating Uzbekistan as a price-taking small country on the international cotton fiber market. Such an assumption might appear counter-intuitive given the fact that Uzbekistan is the second largest exporter of cotton fiber after the USA. There is, however, no empirical indication for effects of Uzbek export quantities on the WMP (ROSENBERG, 2001) in recent years (see also Figure 10-1, where a weak positive relation between the world market price in US$ and the export quantity in 1000 tons is shown for the entire decade before 2002). However, the correlation between Uzbek exports and world market prices was clearly negative between 1992 and 1997 when the share of Uzbekistan in the world-exports of cotton fiber remained between 20 % and 18 %. This share dropped to 14 % in 1998 and declined even further to 12 % until 2002, with the apparent consequence that the fiber exports of Uzbekistan had

a much weaker impact – if any – on the world market. Thus, the treatment of the Uzbek cotton sector as a price-taker is justified for the time since 1998.

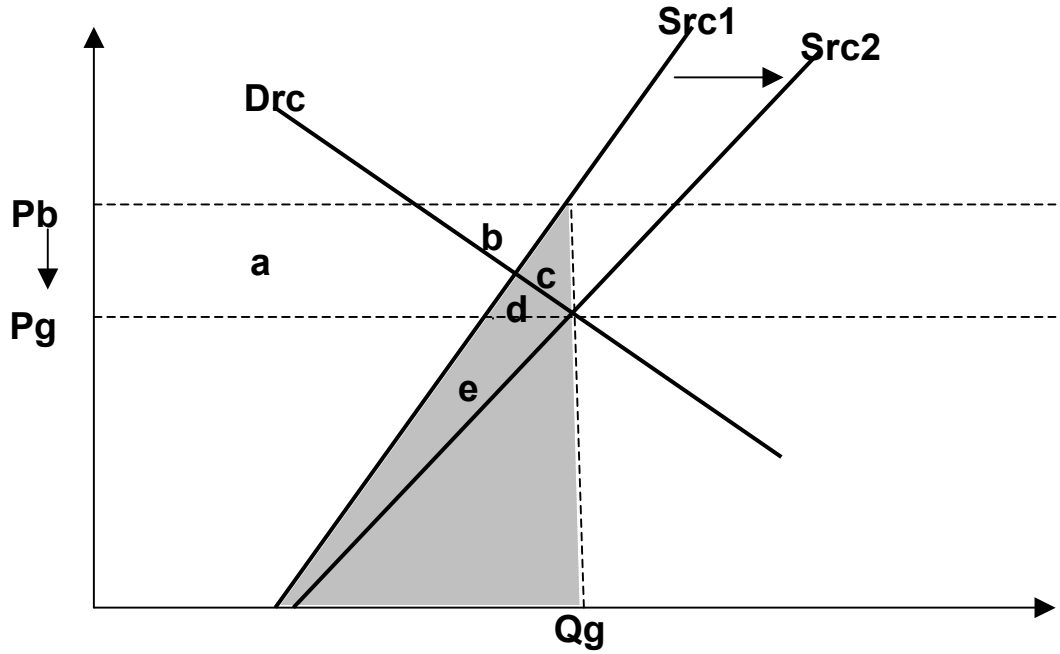
Figure 10-1: Uzbek cotton fiber exports and world-market prices, 1992 to 2002



Source: MÜLLER, 2006.

The partial market for raw cotton is illustrated in Figure 10-2 in a strongly simplified manner: Domestic demand for raw cotton is represented here by the line **Drc** and the initial domestic supply is revealed by the marginal cost curve **Src1**. The domestic market is assumed to be fully competitive and open to the world market in this initial situation, by which the border price **Pb** (i.e. WMP) is determined. If producers are price takers and behave rationally, they will decide to produce an output level of **Qg**. The marginal costs equal the market price (**Pb**) and the total variable costs, represented by the grey shaded area below the marginal cost curve, are more than fully covered by the revenues from selling total output (**Pb** times **Qg**). Producer surplus is the total area above Src1 and below the dotted price line. Because output exceeds domestic demand, raw cotton would be exported, as is the case.

Figure 10-2: Partial market for raw cotton



Source: MÜLLER, 2006

In comparison to this free trade situation the government decides to intervene in the cotton market and to decrease the domestic price administratively to **Pg** at which the domestic demand equals **Qg**. At this price, domestic demand is higher than domestic supply. To ensure the provision of the fiber producers with domestic raw cotton, a minimum production target is set at **Qg** by the government. Due to this system of regulations, the raw cotton sector loses the areas **a** and **b** as producer surplus compared to the initial situation.[1] The total cost of production (the grey shaded area below the marginal cost curve **Src1** until **Qg**) is the same as in the initial situation. **Pg** is below the marginal cost and the producers lose additionally **c** and **d**, representing the production costs that are not covered by the earnings from selling **Qg** at **Pg**. The fiber sector on the other hand gains **a** and **d** as consumer surplus. The total welfare loss by comparing effects on producer and consumer surpluses is the combined area of **-c-d**. In order to mitigate the burden for raw cotton producers, the government implements a system of input subsidizations (e.g. for water and intermediates), thus shifting the marginal cost curve from **Src1** to **Src2**. This compensates for the losses **c** and **d** and adds **e** as surplus to the welfare of producers; the demand side is not affected, but the state loses the combined areas of **c**, **d**, and **e** through the payment of indirect subsidies.

[1] Producer surplus is defined as revenues (price * quantity) minus variable costs (area under the marginal cost curve and to the left of the quantity line. Consumer surplus is defined as the value of the utility consumers receive for which they do not have to pay for. Or, in other words, amount of money by which consumers value a good or service over and above its purchase price.

The net welfare effects of this government intervention are as follows:

Producers of raw cotton:	**-a**	**-b**			**+e**
Fiber producers:	**+a**			**+d**	
State:	**-**		**c**	**-d**	**-e**
Net welfare change:		**-b**	**-c**		

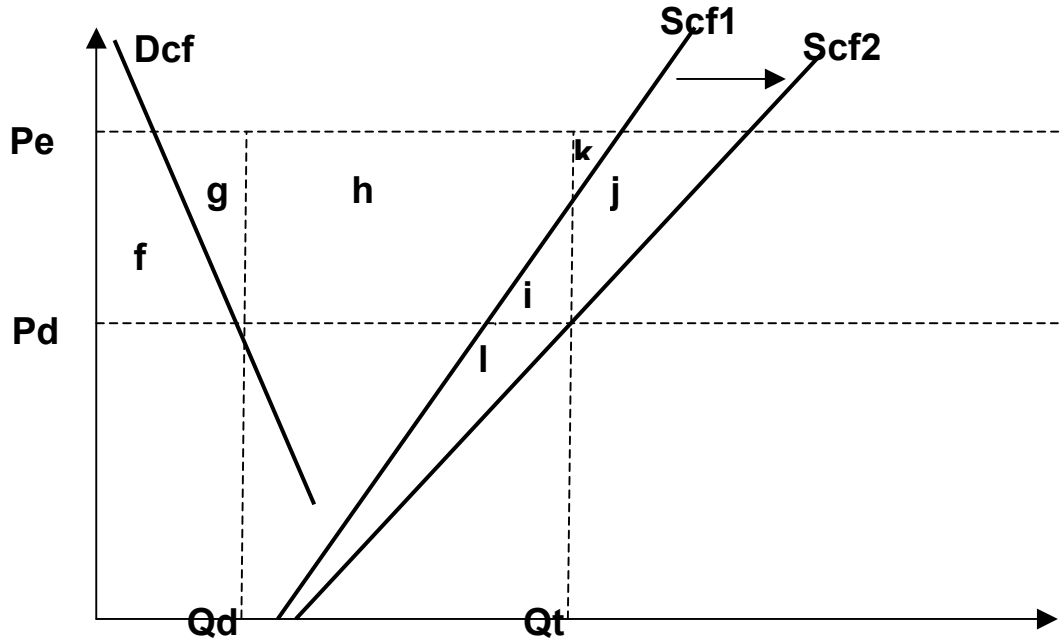
The net economic effect of this intervention is clearly negative. The intervention still may turn out to be rational, however, if the results are combined with the repercussions on the fiber market. This is shown in in the following Figure 10-3. The decreased price for raw cotton shifts the marginal cost curve of fiber producers from **Scf1** to **Scf2**. If producers can realize the export price **Pe** for fiber, which resembles the world market price at the market EXR, they would gain the areas **i**, **j** and **l** as additional surplus. However, because of the exchange rate system, they can realize **Pd** only, which is the WMP at the official EXR and therefore they lose **f**, **g**, **h**, **i**, **j**, and **k**. Domestic demand for cotton fiber benefits from this regulation by having access to fiber at the domestic price **Pd.** Therefore, the consumer surplus increases while by **f** as if compared to a non-distorted foreign exchange market. The government finally gains the areas **h** and **i** through skimming the difference between export value at market and official EXR.

Hence, the net welfare effects on this partial market amount to:

Producers of cotton fiber:	**-f**	**-g**	**-h**		**-k**	**+l**
Domestic fiber processors	**+f**					
State:			**+h**	**+i**		
Net welfare effect:		**-g**		**+i**	**-k**	**+l**

In contrast to the market for raw cotton, the net welfare changes have no clear direction because of the positive (**i**, **l**) and negative (**g**, **k**) terms. However, ROSENBERG (2001) shows a clear net welfare loss on the centralized export markets, but not for the cotton sector alone and only when taking the exchange rate regime into account.

Figure 10-3: Partial market for cotton fiber



Source: MÜLLER, 2006.

Likewise, the impact on the governmental budget has no clear direction as the gains **h** and **i** (in the market for fiber) are partly or totally offset by the expenditures for **c**, **d**, and **e** (in the market for raw cotton). The net effect of the cotton market regulations on the governmental budget are of particular relevance, not only for this study, but also for the interpretation of the aims of these policies. If the government of Uzbekistan systematically realizes losses, money is not transferred out of the cotton sector and hence, can not be used to finance investments to develop domestic industries. In this case the underlying objectives of government intervention in this market would not be met and one would need to ask how such a seemingly irrational policy could be explained. The quantification of this item is therefore one aim of this study.

3 DATABASE

The partial market analysis in the previous section gave an outline of the data needed to identify the policy interventions in the sequential markets for cotton, particularly the effects on the governmental budget and on the surplus of producers of raw cotton and fiber. To begin, a brief description of readily available time series for the observed period from 1993 to 2004 is provided below. The method used to recover missing data points is then the topic of the following sub-section.

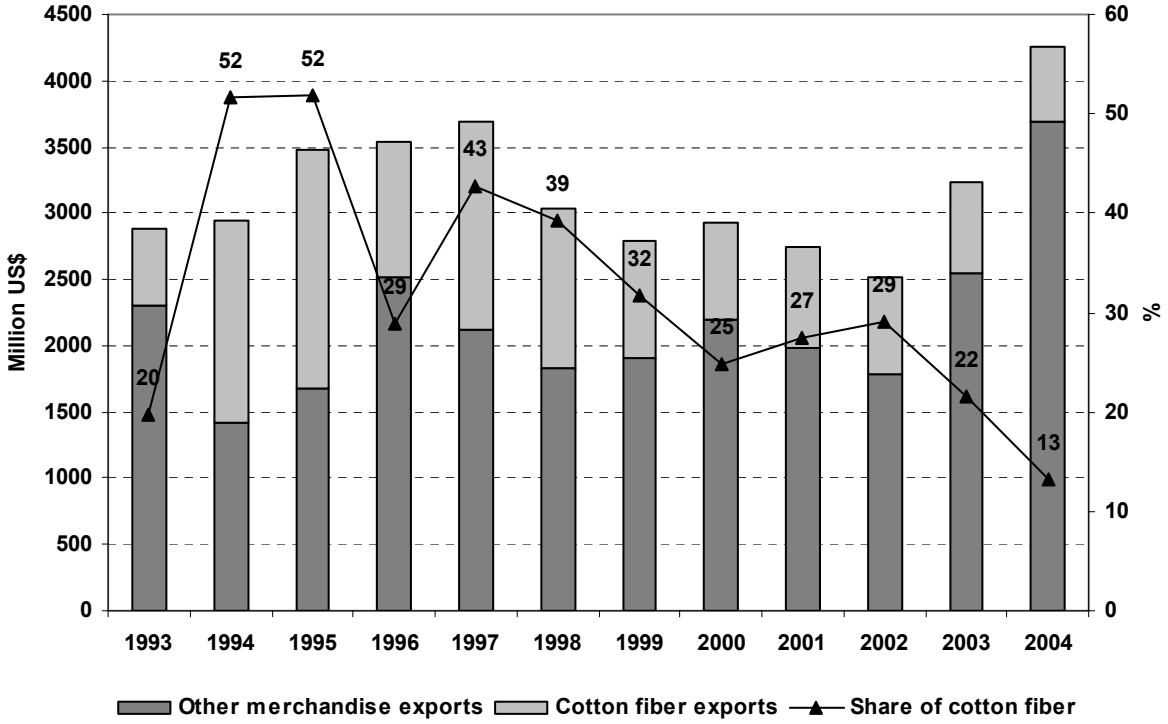
3.1 Available data

Statistics on total harvested area and output of raw cotton as well as on production and export of cotton fiber were obtained from FAOSTAT (2006). We used the Uzbek border price for lint and average world market prices from the same source by dividing total export value over total export quantity, thereby deriving the unit value price. Total merchandise exports in US$, total gross domestic product at factor cost and market prices (GDPf, GDPm), and gross agricultural product (GAO) in current and previous-year prices were taken from ADB (2006). The latter series was used to compute the GDP deflator which again served as an indicator for the development of domestic prices. Total governmental revenues until 1999 were provided by IMF (2000), from 2000 to 2004 by CEEP (various issues). While official exchange rates (annual averages, not last quarter averages as are frequently used) could also be taken from ADB (2006); the market exchange rates for the observation period had to be compiled from multiple sources, including CER (2005) and CEEP (multiple years).

The datasets listed above were used without further processing and revealed already some relevant insights. With regard to the dynamics of total merchandise exports and fiber exports as depicted in Figure 10-4, it can be seen that fiber exports lost continuously their weight in total export earnings down to a level of merely 13 % in 2004. But it was certainly a major source of foreign exchange earnings during the 1990's, with the exception of 1996 when bad harvests did not allow for extensive exports. The low fiber exports indicated for 1993 might be explained with altered trade arrangements in the aftermath of the independence, but it should be mentioned that other sources provide substantially larger figures.

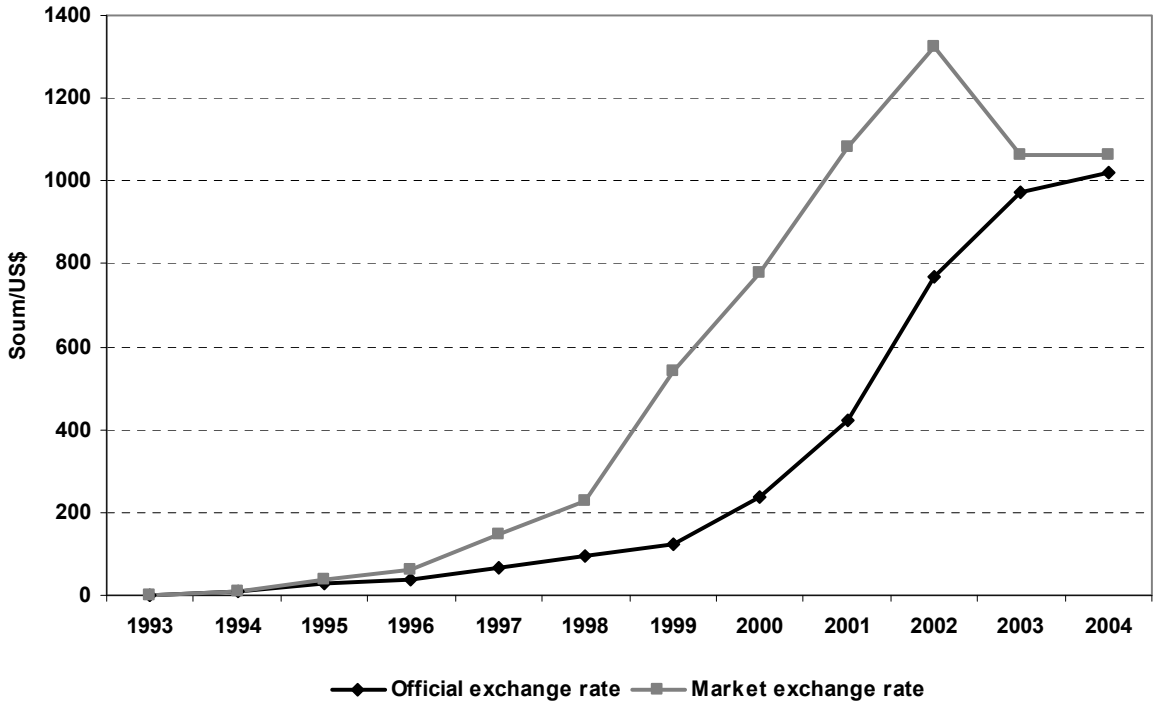
The declining share of cotton since 2002 is not due to significant changes in the absolute export quantity of cotton fiber, but rather due to an increasing total export value. This development coincides with the dynamics of the exchange rates (Figure 10-5). The gap between market exchange rate and official exchange rate, which had been widened until 1999, began to narrow. The narrowing began firstly due to steadily increasing official rates and after 2002 due to declining market exchange rates. By 2004, both rates had almost converged. Consequently, the frequently discussed implicit taxations through the multiple exchange rate system and the resulting welfare losses (ROSENBERG, 2001; IMF, 2000) are apparently abolished, if this trend were to continue. When comparing Figures 3.1 and 3.2, it appears that the end of the overvaluation of the *soum* had caused an immediate response on the export markets.

Figure 10-4: Merchandise exports of Uzbekistan, 1993 to 2004, in million US$



Sources: FAOSTAT, 2006; ADB, 2006.

Figure 10-5: Exchange rates, 1993 to 2004, in current *soum* per US$



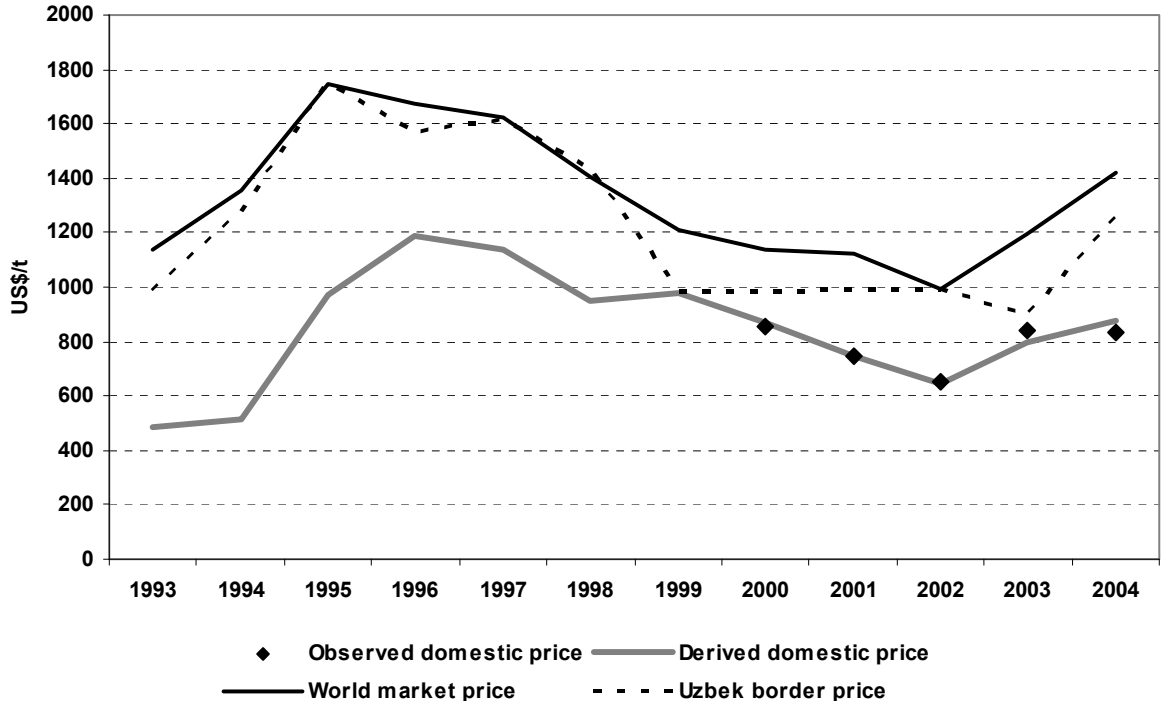
Sources: CEEP, multiple years; CER, 2005; ADB, 2006.

3.2 Compiled data

While the datasets described in the previous section could be used immediately, some others required further processing. The most important information on domestic prices for raw cotton from 2000 onwards could be taken from GUADAGNI et al. (2005), but the only single source for the years before was CER (2005), which provided the values from 1992 to 2000 in constant prices of 1992. We used the relative deviations from 2000 and the first observation point from GUADAGNI et al. (2005) in order to obtain the prices in constant *soum* of 2000. The transformation into current *soum* was then done by using the GDP deflator computed from ADB (2006).

Domestic prices for cotton fiber were also only available from GUADAGNI et al. (2005), but a comparison with the prices for raw cotton indicated that they are on average 4.0 times as high (with a coefficient of variation of 4 %). I used this factor and the compiled set of raw cotton prices to compute the fiber prices. The differences between domestic, border, and average world market prices are depicted in Figure 10-6.

Figure 10-6: Cotton fiber prices, 1993 to 2004, in US$ per ton



Sources: FAOSTAT, 2006; GUADAGNI et al., 2005; author's calculations.

Note: Domestic prices in US$/t were calculated with the official EXR. The gap between world market and domestic prices would be higher when using the market EXR.

Domestic, state controlled fiber price and average world market prices appear to follow the same pattern, which is particularly remarkable as these two series originate from entirely different sources. It appears that the Uzbek government administrates the prices according to world market developments and consequently pursues a rational approach. However, the average world market price does not apply for Uzbek exports, but rather the border price, which tends to be lower and follow a different pattern. In fact the border price between 1999 and 2002 remained stable at around 1000 US$/t, regardless of the declines of world market and domestic prices, which could be the result of trade intervention. However, the data shown here are not sufficient to derive insights into the administrative processes behind the setting of domestic prices and into the trade regulations that influence the border price.

3.3 Filling the gaps

The most crucial information about production cost for raw cotton, processing cost, and input subsidies could not be obtained for the full length of the time period of interest. Again, GUADAGNI et al. (2005) provide the needed data for 2000 to 2004, but earlier years are missing to a larger or lesser extent. Input subsidies between 1995 and 1997 were taken from the IMF (1998), but only as a total for wheat and cotton. The subsidies were derived for cotton by using the ratio between cotton and wheat areas as provided by FAOSTAT (2006). Concerning the variable cost, it was necessary to rely on publications by the International Cotton Advisory Committee (ICAC, CHAUDHRY, 2005 and 1997), which provided averages for several regions, including Asia as a whole. GUADAGNI et al. (2005) split the total variable cost per hectare of raw cotton into labour and other costs.[2] Together with average wages as provided by OBLSTAT (2002a) and CEEP (2002), and norm values for labor input per hectare (OBLSTAT, 2002b), it was possible to compute an average labor demand of 0.58 labor force units per hectare (LF ha^{-1}). This figure is based on the assumption of 260 working days per year (52*5) and 8 hours per working day. The wage rate and the average labor input were then used to calculate labor cost per ha; other cost components and processing costs were still missing.

Based on the work of BRITZ et al. (2004) on the compilation of a complete and consistent (COCO) database for the European Union, a similar, yet simplified, method was applied for the compilation of the database used here. The COCO estimation (see also BRITZ (ed.), 2005) is basically a two-step approach. In a first step, polynomial trends are estimated for the observed values. Trend estimates and the standard error of the regressions are then used in a second step to estimate the missing values under a set of consistency constraints. The detailed approach used here is described below:

---

[2] Labour costs are usually not treated as variable, but since picking costs have the highest share in total labor cost, and because pickers are mainly hired seasonal workers, it was decided labor would be treated as a variable input in the model.

1. Step: Estimation of trends

The starting point was the estimation of a trend value for all incomplete cost data by minimizing the squared deviations between estimated ($\mathbf{C}^{\wedge}$) and observed data ($\mathbf{C}$) for all years **t** and all series **i** in (1), which includes wages, labor cost per hectare, other variable costs, subsidies per hectare and finally processing costs, including marketing and procurement costs. The estimate $\mathbf{C}^{\wedge}$ is in contrast to BRITZ et al. (2004) not expressed as a polynomial trend but here as a quadratic function of the GDP deflator (ADB, 2006) **D** in (2) with α, β, and γ as parameters to be estimated. The decision to use **D** instead of time was made to correct for the inflation of the Uzbek *soum* in the observed period.

$$\min_{\alpha_i,\beta_i,\gamma_i} \sum_{t,i} \left[C^{\wedge}_{t,i} - C_{t,i} \right]^2 \tag{1}$$

s.t.

$$\alpha_i + \beta_i \cdot D_t + \gamma_i \cdot D_t^2 = C^{\wedge}_{t,i} \tag{2}$$

The standard error of the regression **SD** is then computed for each series **i**.

2. Step: Constrained estimation

The next step was also based on the minimization of squared deviations between observed and fitted values ($\mathbf{C}^{*}$), but this time with a different objective function. The first term in equation (3) assures that fitted values are equal to observed ones, but allows for a deviation if the imposed constraints would be violated. The second term ensures that the residuals e between trend line and either observed (if existing) or fitted values (if no observation exists) are minimized in (4). The residuals are weighted with **SD** to put an additional penalty on deviations from the trend line for those series which had a good fit already in step 1.

$$\min_{\alpha_i,\beta_i,\gamma_i} \sum_{t,i \; if \; C_{t,i}} \left[\left(C^{*}_{t,i} - C_{t,i} \right) / C_{t,i} \right]^2 + \sum_{t,i} \left[e_{t,i} / SD_i \right]^2 \tag{3}$$

s.t.

$$\alpha_i + \beta_i \cdot D_t + \gamma_i \cdot D_t^2 + e_{t,i} = \begin{cases} C_{t,i} \; if \; C_{t,i} \\ C^{*}_{t,i} \; if \; not \; C_{t,i} \end{cases} \tag{4}$$

The constraints as expressed in (5) impose that the estimated cost components $\mathbf{C}^{*}$ divided by the different exchange rates $\mathbf{P_r}$ (market and official exchanger rate) is within a "reasonable" range. This reasonable range is either based on information about cost in other countries from the ICAC ($\mathbf{X^{lo}}$ for lower bound and $\mathbf{X^{up}}$ for upper bound) or, if such information was not available as in the case of subsidies, on the standard deviation of the sample data.

$$X^{lo}_{r,t,i} \le X^{*}_{r,t,i} \le X^{up}_{r,t,i} \text{ with } X^{*}_{r,t,i} = C^{*}_{t,i} / P_{r,t} \tag{5}$$

To ensure that the ratio between fitted labor cost per hectare ($\mathbf{C^*_{,LABC'}}$) and wage per labor force unit ($\mathbf{C^*_{,WAGE'}}$) is close to the assumed labor demand per hectare (0.58 LF/ha), we included (6) in the model, in which $\mathbf{L^{lo}}$ and $\mathbf{L^{up}}$ were chosen in a range of +/- ten percent around the prior information of 0.58 LF/ha.

$$L_t^{lo} \le L_t^* \le L_t^{up} \text{ with } L_t^* = C_{t,'LABC'}^* / C_{t,'WAGE'}^* \quad (6)$$

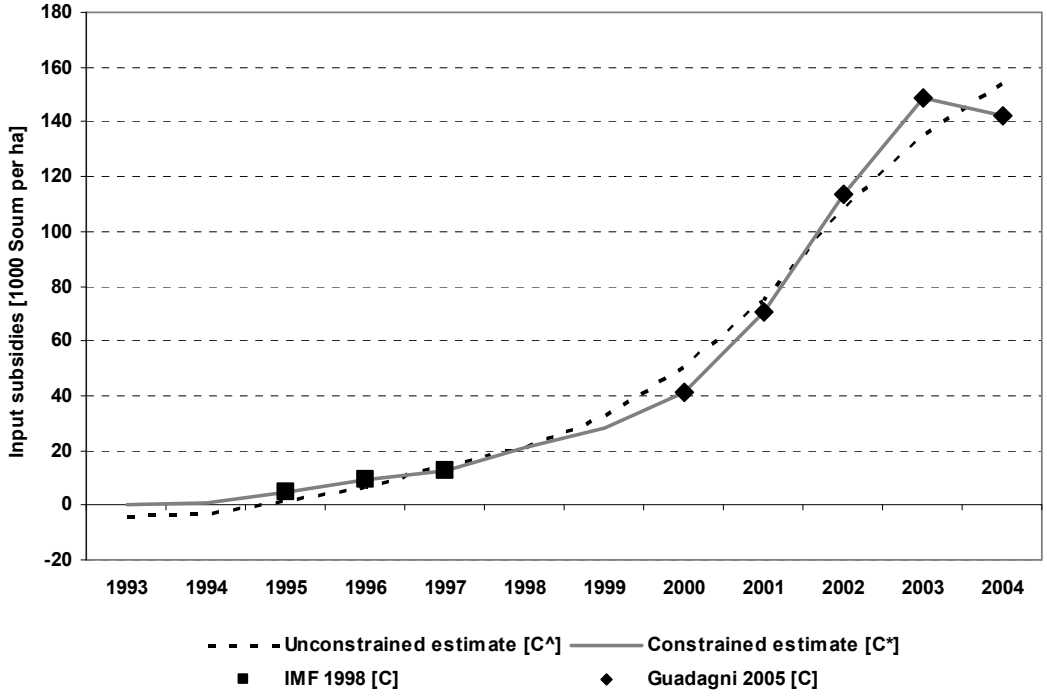
The model including equations (1) to (6) was estimated in the General Algebraic Modeling System (GAMS) and put to work as a non-linear optimization problem (NLP).

3.4 Estimated series

The unconstrained estimate obtained from equations (1) and (2) displays negative values and deviations from the observations, while the fitted values match the observations and do not show any other implausible behaviors. However, only four missing values had to be recovered for the observed period which made this estimation comparatively reliable.

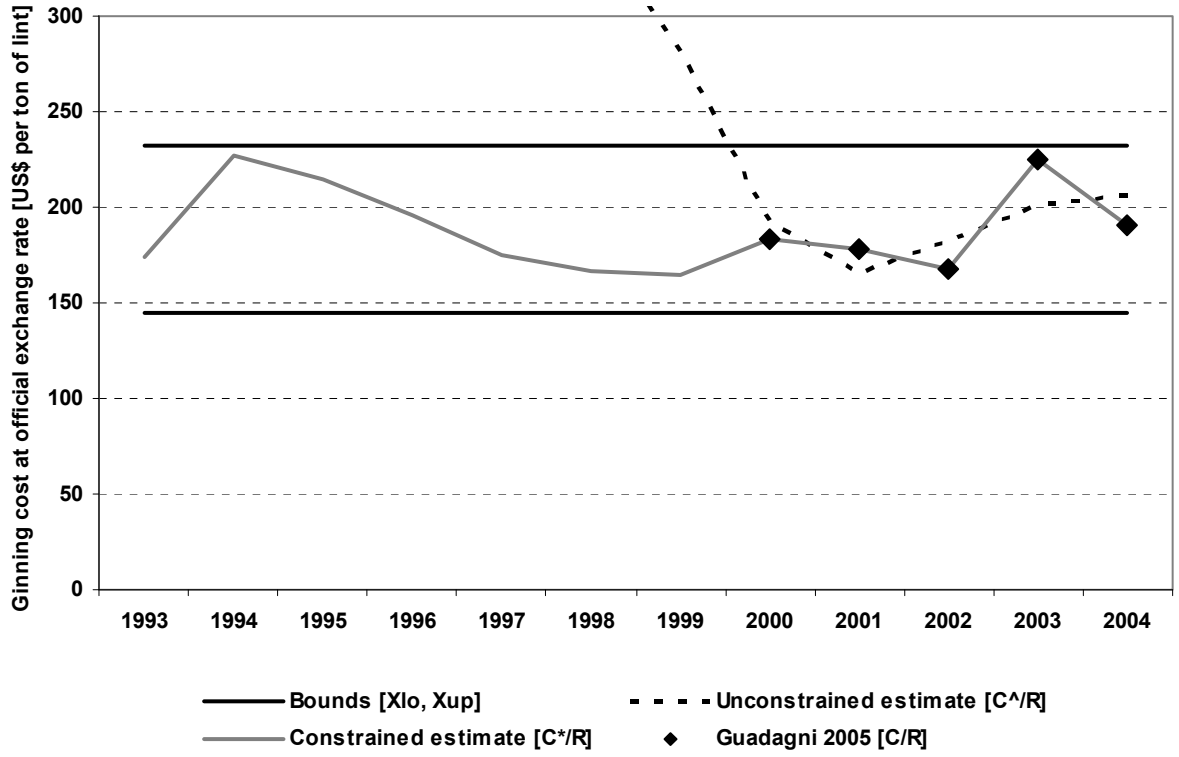
The picture is different for processing costs, for which only five observations at the end of the period were available (Figure 10-7). In this case, it was necessary to rely on the information from ICAC about international costs for cotton processing. The unconstrained estimate clearly violates the prior information that restricts the processing cost to a narrow range around 200 US$/t. The fitted values on the other hand are well within the required range without actually running against the bounds.

Figure 10-7: Estimated and recorded subsides, 1993 to 2004, in current *soum* per hectare



Sources: IMF, 1998; GUADAGNI et al., 2005; author's calculations.

Figure 10-8: Estimated and recorded processing cost, 1993 to 2004, US$ per ton of fiber

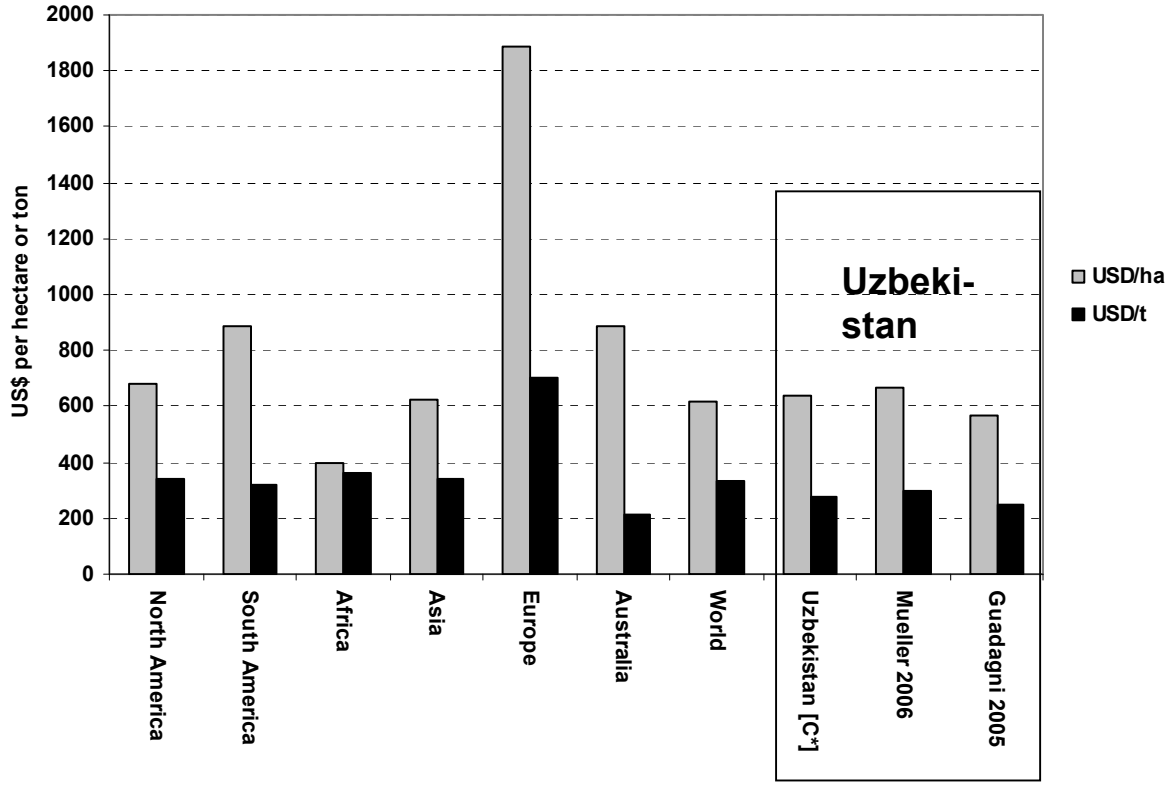


Sources: GUADAGNI et al., 2005; author's calculations.

The estimated average production cost for raw cotton can be seen in Figure 10-8. When comparing the average estimate $\mathbf{C}^*$ with the values provided by GUADAGNI et al. (2005) (**C**) and results based on MÜLLER (2006)[3], one can find that all three values, either expressed per hectare or per ton, cluster around 624 US$/ha or 276 US$/t, with a coefficient of variation of 8 % in both cases. These results are also consistent with the figures provided by CHAUDHRY (2005) as average variable production cost per hectare in Uzbekistan agree with the Asian and global averages, while the cost per ton of raw cotton appear to be lower in Uzbekistan, with only Australia having lower variable cost per ton.

[3] MÜLLER (2006) provides a social accounting matrix (SAM) for Uzbekistan in 2001 with a disaggregated cotton sector. The SAM entries were used to compute the displayed figures.

Figure 10-9: Estimated and recorded raw cotton production cost, Country averages, US$ per ton and hectare



Sources: CHAUDHRI, 2005; MÜLLER, 2006; GUADAGNI et al., 2005; author's calculations.
Note: Values for Uzbekistan were calculated with the official exchange rate.

4 QUANTIFICATION OF NET TRANSFERS FROM THE COTTON SECTOR

Having filled the gaps in the database as outlined in the previous section, it is now possible to calculate some indicators for net revenues and expenditures associated with production and marketing of cotton in Uzbekistan. The data allow deriving the gross margins of the producing and processing activities in this sector. For the gross margins of raw cotton production, Subsidies and variable costs per hectare are considered, incluing acreage and produced quantities and the administrative price for raw cotton. The processing industry realizes a gross margin depending on the prices for lint and raw cotton, as well as on ginning cost and processed quantities. The results are displayed in Figure 10-10 as percentage of GDP at factor cost as obtained from ADB (2006).

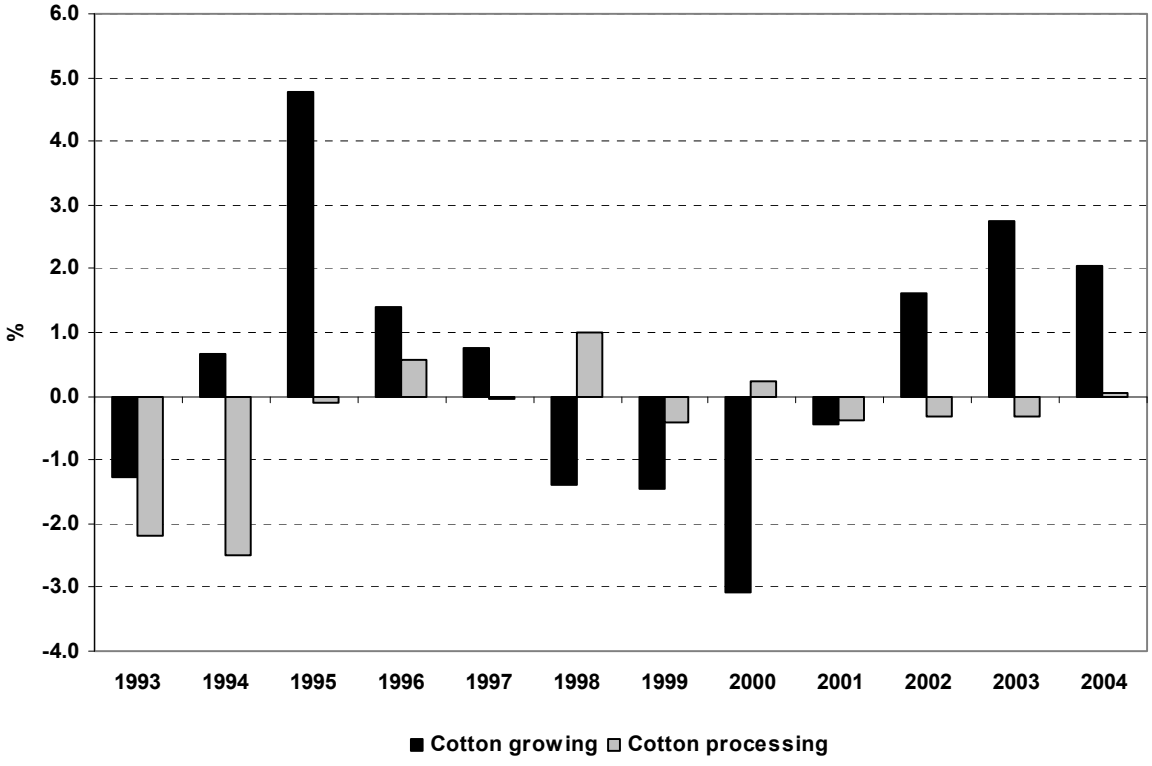
It appears that the gross margin of cotton farmers (black columns) is negative in five and positive in seven years. The negative values for 2000 and 2001 are likely to be caused by the water scarcity in those years (MÜLLER, 2006; FAO/WFP, 2002). Although it seems that the input subsidies can not always compensate the production cost, farmers nevertheless do not systematically realise negative gross margins from raw cotton production. This does not mean that cotton is a favorable crop

to produce for farmers, but it is neither a secure source of revenues for the government of Uzbekistan.

The gross margins for the processors of raw cotton show a clearer tendency with eight years in which negative values were realized. From this point of view, it seems that the processors carry the main burden of the cotton market regulations rather than the farmers. This finding is supported by the results of RUDENKO (2006), who found a similar pattern based on a detailed value-added-chain analysis for the cotton sector in the Uzbek region of Khorezm. However, it should be mentioned that the picture conveyed here is incomplete as neither subsidies for the ginneries nor gross margins from the sales of cottonseed is included. However, if one includes subsidies for this stage of the cotton chain, it is then necessary to adjust the net revenues of the government as well, so that the net transfer is not changed.

One item not included in the calculations above was the debt write-offs for farmers; data are only available for 2000 and 2004 from GUADAGNI et al. (2005), and the significant fluctuation in the data for these two observations did not allow a reasonabe estimation of the values in other years as was possible with production costs. It was, therefore, necessary to rely on a visual examination of farmer's gross margins from raw cotton and the debt-write offs (Figure 10-10). It appears that the debt write-offs coincide with the gross margins as they are comparatively high in and after years were farmers realized negative gross margins, and zero otherwise.

Figure 10-10: Gross margins of cotton growing and processing, 1993 to 2004, in percent of GDPf

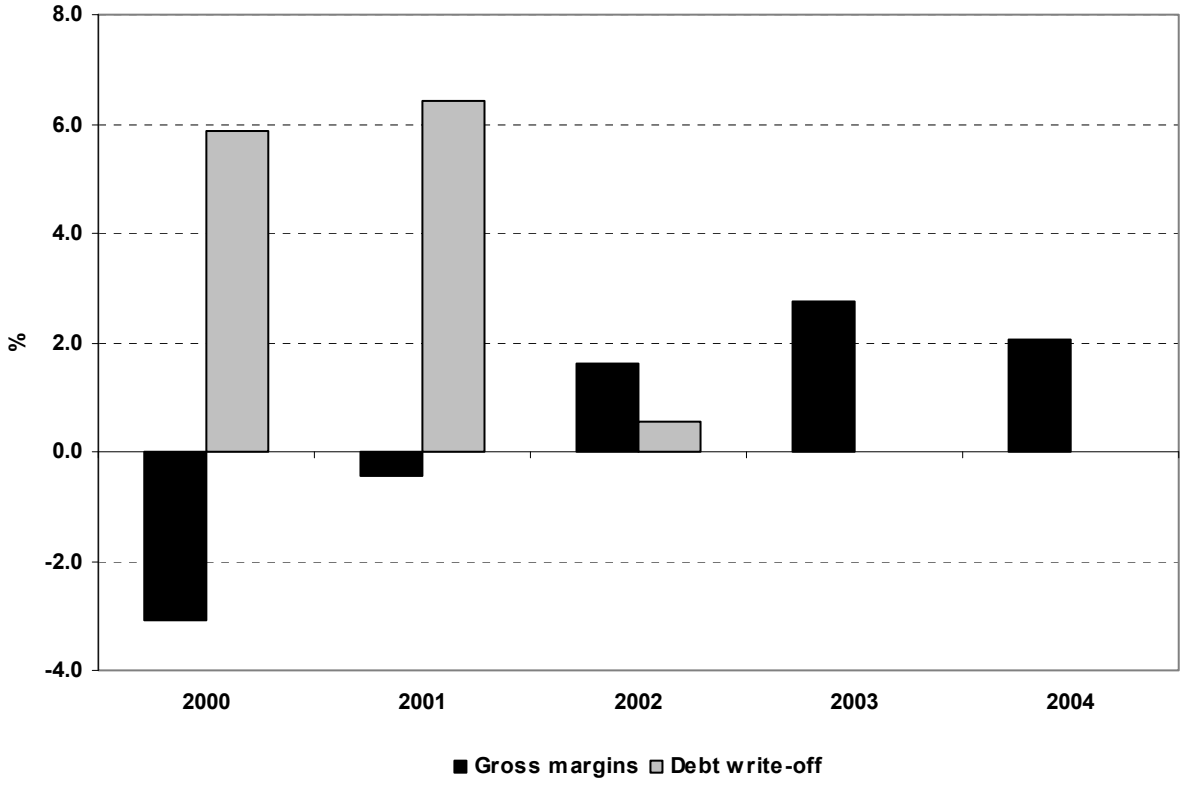


Source: Author's calculations.

It can be concluded that the government compensates the farmers for their losses, however, the extent of this compensation remains unknown. The relation observed in Figure 10-10 does not support the hypothesis that the government of Uzbekistan transfers significant amounts of money out of agriculture as the combined effects of input subsidies and debt write-offs outweigh the indirect taxation via price control.

The last step along the cotton chain is the export of cotton fiber. Due to data limitations, it was not possible to include transaction costs in the following calculations, and it was assumed that the government of Uzbekistan receives the full differential between border prices calculated with official and market exchange rates (Figure 10-11). While the grey columns in Figure 10-11 show the maximum potential revenues, the black columns are a hypothetical result under the simplifying assumptions that the official exchange rate applies and that there are no transaction costs.

Figure 10-11: Gross margins and debt write-offs, 2000 to 2004, in percent of GDPf



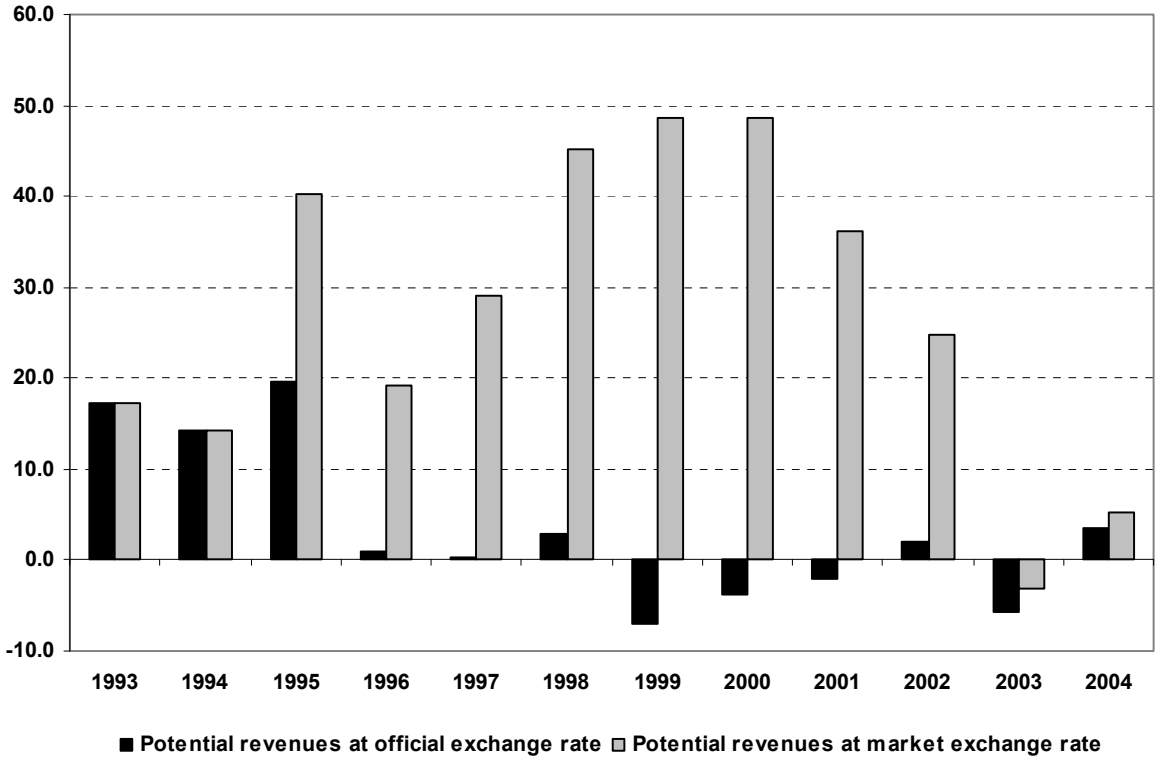
Source: GUADAGNI et al., 2005; author's calculations.

Governmental revenues from cotton market regulations vary between 49 % of total revenues (grey columns for 1999 and 2000) and -2 % (black column for 1999). The inclusion of debt write-offs for farmers, subsidies for ginneries, and transaction cost for cotton traders, would shift both, black and grey columns further downwards.

Likewise, the appropriate incorporation of the market exchange rate would also raise the production cost for raw and ginned cotton, thus having an impact on subsidies and debts, and finally decreasing the government revenues from the cotton market regulations. It is also questionable to perceive the exchange rate policy as a policy only for the cotton market, as it applies for other commodities as well.

In summary, it can be concluded that the government revenues from cotton market regulations are not necessarily as high as often assumed, and cotton market regulations in exceptional years may even cause budgetary losses for the government.

Figure 10-12: Potential governmental revenues from cotton market regulations, 1993 to 2004, in percent of actual revenues



Source: Author's calculations.

5 CONCLUSIONS

The aim of this study was to generate a consistent analysis of existing cotton market regulations in Uzbekistan and to answer the question, who gains and who loses under existing policies. Although it is frequently stated that the state order system is meant to generate revenues for the public budgets at the cost of the agricultural sector, clear and distinct evidence for this statement for the period 1993 to 2004 could not be found. Farmers are partly or perhaps even fully compensated by the provision with input subsidies and debt write-offs. The ginneries appear to carry

a significant share of the burden of the regulations as calculations of their gross margins showed the tendency to be negative. As the ginneries are mainly owned by the government, that would then also cause losses for the public budget.

The governmental revenues on the export markets appear to be tremendous with peaks in the late nineties, mainly because of the multiple exchange rate system. For 2003 and 2004, during which time the exchange rates converged, the estimated revenues range between -1.5 and +1.3 percent of the total governmental revenues. In general, a clear tendency that the government of Uzbekistan transfers significant amounts of money out of the agricultural sector could not be identified for the observed period: if the policies are meant to generate revenues for the public budget by transferring money out of agriculture, then they are of questionable efficiency.

An other explanation for the motivation behind the cotton market regulations could be that it is meant to provide a secure, although low, level of income for the rural population in order to mitigate negative effects occurring during the transitional stage of the economy. If this is the case, then it is also of questionable efficiency as the administrative setting of production targets hampers the ability of farmers to adapt their production systems to the requirements of a market-oriented economy.

The final conclusion from the considerations above is that Uzbek cotton market regulations are in neither case an efficient instrument to achieve the underlying political goals, and that there is a clear research demand to develop strategies to reform the current policies-changes which incorporate the linkages and feedbacks between the partial markets for raw cotton and cotton fiber, and the resulting impacts on the governmental budget.

ACKNOWLEDGEMENTS

This study was funded by the German Ministry for Education and Research (BMBF; project number 0339970A).

REFERENCES

ASIAN DEVELOPMENT BANK [ADB] (2006): Uzbekistan. Key indicators 2006, <www.adb.org/statistics>.

BRITZ, W., WIECK, C., JANSSON, T. (2002): National framework of the CAPRI database: The CoCo-Module, *CAPRI working paper 02-04*.

BRITZ, W. (ed.) (2005): CAPRI modelling system documentation, Bonn, <http://www.ilr1.uni-bonn.de/agpo/rsrch/capri/capri-documentation.pdf >.

CENTRE FOR ECONOMIC RESEARCH [CER] (2005): Linking macroeconomic policies to poverty reduction in Uzbekistan, Tashkent.

CENTRE FOR EFFECTIVE ECONOMIC POLICY, MINISTRY OF ECONOMCY OF UZBEKISTAN [CEEP] (2003): Uzbekistan economy: Statistical and analytical review, *Annual Issue 2002,* Tashkent.

CENTRE FOR EFFECTIVE ECONOMIC POLICY, MINISTRY OF ECONOMCY OF UZBEKISTAN [CEEP] (2004): Uzbekistan economy: Statistical and analytical review, *Annual Issue 2003,* Tashkent.

CENTRE FOR EFFECTIVE ECONOMIC POLICY, MINISTRY OF ECONOMCY OF UZBEKISTAN [CEEP] (2005): Uzbekistan economy: Statistical and analytical review, *Annual Issue 200*4, Tashkent.

CENTRE FOR EFFECTIVE ECONOMIC POLICY, MINISTRY OF ECONOMCY OF UZBEKISTAN [CEEP] (2006): Uzbekistan economy: Statistical and analytical review, *Annual Issue 2005*, Tashkent.

CHAUDHRY, M. R. (2005): Cost of production in the USA and other countries, International Cotton Advisory Committee (ICAC), Technical Information Section, Washington, D.C.

CHAUDHRY, M. R. (1997): Harvesting and ginning of cotton in the world, International Cotton Advisory Committee (ICAC), Technical Information Section, Washington, D.C.

FAOSTAT (2006): Various agricultural production and trade indicators.

FOOD AND AGRICULTURE ORGANIZATION/WORLD FOOD PROGRAM [FAO/WFP] (2000): Global information and early warning system on food and agriculture (GIEWS): Crop and food supply assessment mission to the Karakalpakstan and Khorezm regions of Uzbekistan, <www.fao.org/WAICENT/faoinfo/economic/giews/english/alertes/2000/SRuzb12.htm>.

GUADAGNI, M., RAISER, M., CROLE-REES, A., KHIDIROV, D. (2005): Cotton taxation in Uzbekistan: Opportunities for reform, *ECSSD Working Paper 41*, Washington, D. C.

INTERNATIONAL MONETARY FUND [IMF] (1998): Uzbekistan: Recent economic developments, *IMF Staff Country Report No. 98/116*, Washington, D. C.

INTERNATIONAL MONETARY FUND [IMF] (2000): Uzbekistan: Recent economic developments, *IMF Staff Country Report 00/36*, Washington, D. C.

MÜLLER, M. (2006): A general equilibrium approach to water and land use reforms in Uzbekistan, University of Bonn [Dissertation].

POMFRET, R. (2003): Central Asia since 1991. The experience of the new independent states, Adelaide.

REGIONAL DEPARTMENT OF THE MINISTRY OF MACRO-ECONOMICS AND STATISTICS OF THE REPUBLIC OF UZBEKISTAN IN KHOREZM OBLAST [OBLSTAT] (2002a): Socio-economic indicators for Khorezm. 1991-2000, Urgench.

REGIONAL DEPARTMENT OF THE MINISTRY OF MACRO-ECONOMICS AND STATISTICS OF THE REPUBLIC OF UZBEKISTAN IN KHOREZM OBLAST [OBLSTAT] (2002b): Agricultural indicators for Khorezm *oblast*. 1998-2001, Urgench.

RUDENKO, I. (2006): The cotton chain in Central Asian Uzbekistan: One step forward, two back? Poster presented at the Tropentag 2006: Prosperity and Poverty in a Globalized World – Challenges for Agricultural Research, University of Bonn.

SPOOR, M. (2004): Agricultural restructuring and trends in rural inequalities in Central Asia: A socio-statistical survey, *Civil Society and Social Movements Programme Paper 13*, United Nations Research Institute for Social Development.

WORLDBANK (1999): Uzbekistan: Social and structural policy review, *Report No. 19626*, Washington, D. C.

ZETTELMEYER, J. (1999): The Uzbek growth puzzle, *IMF Staff Papers 46 (3)*, Washington, D. C.

Studies on the Agricultural and Food Sector in Central and Eastern Europe
edited by Leibniz Institute of Agricultural Development in Central and Eastern Europe (IAMO)
ISSN 1436-221X

Vol. 1 **The importance of institutions for the transition in Central and Eastern Europe with emphasis on agricultural and food industry**
ed. by Klaus Frohberg and Witold-Roger Poganietz
1998, 137 pages, ISBN 3-8175-0258-3

Vol. 2 **The significance of politics and institutions for the design and formation of agricultural Policies**
ed. by Klaus Frohberg and Peter Weingarten
1999, 254 pages, ISBN 3-8175-0289-3

Vol. 3 **Food processing and distribution in transition countries. Problems and perspectives**
ed. by Monika Hartmann and Jürgen Wandel
1999, 349 pages, ISBN 3-8175-0293-1

Vol. 4 **Die private Nachfrage nach Nahrungsmitteln im Transformations-prozeß Tschechiens und Polens**
Stephan Brosig (PhD)
2000, 171 Seiten, ISBN 3-8175-0319-9

Vol. 5 **Integrating Estonia into the EU: Quantitative analysis of the agricultural and food sector**
Achim Fock (PhD)
2000, 286 pages, ISBN 3-8175-0320-2

Vol. 6 **Competitiveness of agricultural enterprises and farm activities in transition countries**
ed. by Peter Tillack and Frauke Pirscher
2000, 216 pages, ISBN 3-8175-0322-9

Vol. 7 **Конкурентоспособность сельскохозяйственных предприятий и фермерской деятельности в странах переходного периода**
под редакцией Петера Тиллака и Фрауке Пиршер
2000, 253 страницы, ISBN 3-8175-0324-5

Vol. 8 **Perspectives on agriculture in transition: Analytical issues, modelling approaches, and case study results**
ed. by Witold-Roger Poganietz, Alberto Zezza, Klaus Frohberg and Kostas G. Stamoulis
2000, 433 pages, ISBN 3-8175-0323-7

Vol. 9 **Land ownership, land markets and their influence on the efficiency of agricultural production in Central and Eastern Europe**
ed. by Peter Tillack and Eberhard Schulze
2000, 485 pages, ISBN 3-8175-0325-3

Vol. 10 **Landwirtschaft und Industrie in Russland – Der Transformationsprozeß in der Ernährungsindustrie**
Jürgen Wandel (PhD)
2000, 361 Seiten, ISBN 3-8175-0334-2

Vol. 11 **Food consumption in Russia. An econometric analysis based on household data**
Karin Elsner (PhD)
2001, 256 pages, ISBN 3-8175-0335-0

Vol. 12 **Alexander Wasiljewitsch Tschajanow – Die Tragödie eines großen Agrarökonomen**
hrsg. u. übers. von Eberhard Schulze
2001, 192 Seiten, ISBN 3-8175-0342-3

Vol. 13 **Analysis of food consumption in Central and Eastern Europe: Relevance and empirical methods**
ed. by Stephan Brosig and Monika Hartmann
2001, 253 pages, ISBN 3-8175-0349-0

Vol. 14 **Wettbewerbsprozesse und Firmenwachstum in der Transformation am Beispiel der polnischen Fleischindustrie**
Agata Pieniadz (PhD)
2002, 291 Seiten, ISBN 3-8175-0360-1

Vol. 15 **Agricultural enterprises in transition: Parallels and divergences in Eastern Germany, Poland and Hungary**
ed. by Ludger Hinners-Tobrägel and Jürgen Heinrich
2002, 455 pages, ISBN 3-8175-0366-0

Vol. 16 **Agricultural technology and economic development of Central and Eastern Europe. Results of the workshop in Halle, 2nd-3rd July 2001**
ed. by Peter Tillack and Ulrich Fiege
2002, 160 pages, ISBN 3-86037-199-1

Vol. 17 **Региональные аспекты аграрных преобразований: Политика, реструктуризация, рыночная адаптация**
под редакцией Петера Тиллака и Виталия Зиновчука
2003, 236 страницы, ISBN 3-928466-55-0

Vol. 18 **Alexander Vasilievich Chayanov – The tragedy of an outstanding agricultural economist**
ed. by Eberhard Schulze
2003, 188 pages, ISBN 3-86037-201-7

Vol. 19 **Development of agricultural market and trade policies in the CEE Candidate Countries**
by the Network of Independent Agricultural Experts in the CEE Candidate Countries
2003, 72 pages, ISBN 3-86037-212-2

Vol. 20 **Large farm management**
ed. by Alfons Balmann and Alexej Lissitsa
2003, 396 pages, ISBN 3-86037-213-0

Vol. 21 **Success and failures of transition – The Russian agriculture between fall and resurrection**
ed. by Eberhard Schulze, Elke Knappe, Eugenia Serova, Peter Wehrheim
2003, 521 pages, ISBN 3-9809270-1-6

Vol. 22 **Subsistence agriculture in Central and Eastern Europe: How to break the vicious circle?**
ed. by Steffen Abele and Klaus Frohberg
2003, 233 pages, ISBN 3-9809270-2-4

Vol. 23 **Pfadabhängigkeiten und Effizienz der Betriebsstrukturen in der ukrainischen Landwirtschaft – Eine theoretische und empirische Analyse**
Andriy Nedoborovskyy (PhD)
2004, 197 Seiten, ISBN 3-86037-216-5

Vol. 24 **Nichtmonetäre Transaktionen in der ukrainischen Landwirtschaft: Determinanten, Spezifika und Folgen**
Olena Dolud (PhD)
2004, 190 Seiten, ISBN 3-9809270-3-2

Vol. 25 **The role of agriculture in Central and Eastern European rural development: Engine of change or social buffer?**
ed. by Martin Petrick and Peter Weingarten
2004, 426 pages, ISBN 3-9809270-4-0

Vol. 26 **Credit rationing of Polish farm households – A theoretical and empirical analysis**
Martin Petrick (PhD)
2004, 254 pages, ISBN 3-9809270-6-7

Vol. 27 **Drei Jahrhunderte Agrarwissenschaft in Russland: Von 1700 bis zur Gegenwart**
Alexander Alexandrowitsch Nikonow und Eberhard Schulze
2004, 232 Seiten, ISBN 3-9809270-8-3

Vol. 28 **Russlands Weg vom Plan zum Markt: Sektorale Trends und regionale Spezifika**
Peter Voigt (PhD)
2004, 270 Seiten, ISBN 3-9809270-9-1

Vol. 29 **Auswirkungen des Transformationsprozesses auf die sozio-ökonomischen Funktionen ukrainischer Landwirtschaftsunternehmen**
Helga Biesold (PhD)
2004 182 Seiten, ISBN 3-938584-00-9

Vol. 30 **Agricultural policies and farm structures – Agent-based modelling and application to EU-policy reform**
Kathrin Happe (PhD)
2004, 291 pages, ISBN 3-938584-01-7

Vol. 31 **How effective is the invisible hand? Agricultural and food markets in Central and Eastern Europe**
ed. by Stephan Brosig and Heinrich Hockmann
2005, 361 pages, ISBN 3-938584-03-3

Vol. 32 **Erfolgsfaktoren von landwirtschaftlichen Unternehmen mit Marktfruchtanbau in Sachsen-Anhalt**
Kirsti Dautzenberg (PhD)
2005, 161 Seiten, ISBN 3-938584-06-8

Vol. 33 **Agriculture in the face of changing markets, institutions and policies: Challenges and strategies**
ed. by Jarmila Curtiss, Alfons Balmann, Kirsti Dautzenberg, Kathrin Happe
2006, 544 pages, ISBN 3-938584-10-6

Vol. 34 **Making rural households' livelihoods more resilient – The importance of social capital and the underlying social networks**
ed. by Gertrud Buchenrieder and Thomas Dufhues
2006, 106 pages, ISBN 3-938584-13-0

Vol. 35 **Außerlandwirtschaftliche Diversifikation im Transformationsprozess. Diversifikationsentscheidungen und -strategien ländlicher Haushalte in Slowenien und Mazedonien**
Judith Möllers (PhD)
2006, 323 Seiten, ISBN 3-938584-14-9

Vol. 36 **Accessing rural finance – The rural financial market in Northern Vietnam**
Thomas Dufhues (PhD)
2007, 166 Seiten, ISBN 3-938584-16-5

Vol. 37 **Страхование посевов в Казахстане: Анализ возможностей эффективного управления рисками**
Раушан Бокушева, Олаф Хайдельбах, Талгат Кусайынов
2007, 82 Seiten, ISBN 3-938584-17-3

Vol. 38 **Rethinking agricultural reform in Ukraine**
Zvi Lerman, David Sedik, Nikolai Pugachov, Aleksandr Goncharuk
2007, 167 Seiten, ISBN 3-938584-18-1

Vol. 39 **Sustainable rural development: What is the role of the agri-food sector?**
ed. by Martin Petrick, Gertrud Buchenrieder
2007, 293 pages, ISBN 3-938584-22-X

Vol. 40 **Efficiency of selected risk management instruments – An empirical analysis of risk reduction in Kazakhstani crop production**
Olaf Heidelbach (PhD)
2007, 223 Seiten, ISBN 3-938584-19-X

Vol. 41 **Marktstruktur und Preisbildung auf dem ukrainischen Markt für Rohmilch**
Oleksandr Perekhozhuk (PhD)
2007, 274 Seiten, ISBN 978-3-938584-24-8

Vol. 42 **Labor market behavior of Chinese rural households during transition**
Xiaobing Wang (PhD)
2007, 140 Seiten, ISBN 978-3-938584-25-5

Vol. 43 **Continuity and change: Land and water use reforms in rural Uzbekistan. Socio-economic and legal analyses for the region Khorezm**
ed. by Peter Wehrheim, Anja Schoeller-Schletter, Christopher Martius
2008, 211 Seiten, ISBN 978-3-938584-27-9