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Agricultural Restructuring, Water Scarcity and the Adaptation to Climate Change in Central Asia: A Five-Country Study

(AGRIWANET)

Goals and academic relevance

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I. Goals, excellence and originality of the project

A. Overall goal of the project

The five Central Asian nations of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan (CA5) share many geographical and cultural characteristics, but they differ considerably with regard to population size, productive land resources, upstream-downstream patterns of water resources and the resulting agricultural production portfolios (Stadelbauer 2007). This cross-country diversity produces a variety of challenges for sustainable economic development in the region. The agricultural sector has remained important in terms of employment, rural livelihoods, food security and government earnings and as such for general economic development in all countries of the region. Scientific projections indicate that climate change will reduce water supply and increase its volatility, thus aggravating the risks of agricultural production in the region (Siegfried et al. 2012). While in terms of absolute availability the region is not water scarce, it is very vulnerable to water-related problems (Giese and Sehring 2007). Not only climate change but also local mismanagement of the dilapidated water infrastructure, the specific water needs of industrialized crop production and the diversion of water for electricity generation – serving an expanding industry as well as an energy-hungry, growing population – have increased the pressure on water supply and are likely to do so in the future (Dukhovny and Ziganshina 2011).

The improvement of the nations' adaptive capacity to growing water supply volatility and scarcity by rehabilitation and modernization of their irrigation infrastructures is costly. Furthermore, it is questionable whether a purely technical approach is effective in addressing the underlying problems. There are a number of arguments why deeper issues of *agricultural organization* need to be addressed in order to tackle the water problem. Generally, to what extent agricultural restructuring after the dissolution of the USSR took place has direct implications for water use:

- The continuation of industrialized mono-cropping for the generation of export revenue on irrigated land perpetuates excessive water dependency.
- Alternative cropping patterns on restructured family farms – such as wheat or vegetables – require new institutional solutions to water management.
- While new technologies in rainfed and irrigated crop production offer relief, their adoption depends, among other things, on the management capacity of managers and their access to finance.
- "Niche crops" with a local tradition which declined in the 1990s, such as tobacco, rice or sugar beet, may provide new opportunities for more flexible water use and a diversified income portfolio of farmers.
- New and traditional forms of livestock production on extensive grassland have the potential to alleviate water scarcity.

Therefore, agricultural reorganization is a crucial determinant of the regional resilience to climate change and water scarcity. It includes the restructuring of agricultural production, adjustments in farm structures and farming patterns as well as reforms in land and water use.

Twenty years after national independence, all five countries display a record of varying restructuring attempts and outcomes in agriculture, of unique experience in policy formation to address water-related problems, and of strategies to tackle climate change. However, at least in the judgment of international observers such as Pomfret (2008a, 2008b), agricultural restructuring has either followed a very one-sided strategy of export revenue generation that took little care of water-related issues (as in Uzbekistan or Turkmenistan with regard to cot-

ton) or it followed no coherent strategy at all (as in Kazakhstan and Tajikistan for most of the 1990s). Unfortunately, as we show below, there is also little independent research available that has a sufficiently broad focus to provide guidance in the complex interrelationships and their trans-boundary dimension. There are a number of reasons for this. First, domestic research is heavily underfunded and there is (mostly for political reasons) hardly any exchange of researchers between the five Central Asian countries. Second, the region tends to be bypassed by Western and international donors providing funding for internationally competitive socioeconomic research or such research is impeded by CA5 governments (Schuch et al. 2012). Third, the mere attempt of establishing a cross country database that covers basic statistics on agricultural production, restructuring and water availability is hampered by the reluctance of some governments to make such figures available to the international public. Finally, those studies that are available are often region-specific and focused on (important) technical details rather than their socioeconomic embeddedness.

The *overall objective* of this project is to tackle some of these obstacles on the way to an analytically sound and politically relevant understanding of the *water-farm restructuring nexus*. The selection of the project consortium and its methodological approach reflect the desire to improve analytical capacity and policy relevance *from within* the CA5 countries. Coverage of all five countries, support to capacity building and the education of young researchers as well as the utilization of statistical data provided by domestic agencies figure prominently in achieving this goal. Even so, the analysis has also much to offer for the international development research community. Twenty years of experience in CA5 provide a fertile ground for comparative analysis that speaks to general issues in agricultural development. For example, there is considerable disagreement on whether an agricultural development strategy should focus on the promotion of cash crops to generate export earnings or on food staples to improve domestic food security. A key aim is to learn the lessons from this experience by combining local insights with an international, cross-country research perspective.

B. Scientific aim of the planned research cooperation

The project uses cross-country comparison to investigate how vulnerable certain organizational forms or patterns of agricultural production are to water availability. The cross-country comparison will aim at an investigation of causal relations between agricultural restructuring and resilience to varying water supply. Among the key questions to be addressed are the following:

- What is the water dependency of certain farm types and how does it determine their performance?
- How does the varying progress in farm restructuring exacerbate or alleviate regional water scarcity?
- How do water availability and farm restructuring affect rural incomes?
- How did cropping and livestock patterns in different farm types evolve over time and which agricultural policies were implemented for ensuring this process?

Many of these questions can be answered by using national statistical data (at the regional level). Additional desk research and qualitative data will be used to explore the following issues:

- To what extent did restructuring policies take future climate risks, particularly growing water scarcity and water supply variability, into account?
- What is the track record of policymaking concerning trans-boundary water flows?

The methods employed for this research will comprise panel data collection, econometric techniques, spatial mapping and descriptive analysis.

Consolidated database: The project will develop a database that builds on the datasets collected by the CA5 national statistical agencies related to agricultural production, farm restructuring and water use in agriculture at the provincial (administrative) levels. This data should be available for the period of 1991-2013. More concretely, the information to be collected includes annual series of information on existing farm structures, cultivation area, average size, number and type of livestock, cropping structures, production of crops and livestock products, gross output value, employment, investments in agriculture as well as those related to water use and climate change: monthly water flow and water use, monthly mean temperatures and monthly accumulated rainfall in agriculture on the administrative level for each CA5.

Identification, description and analysis of geographical case studies relevant to the climate-water-agriculture nexus: Based on the available data plus the chronicle of policy events, specific geographical hotspots relevant to the theme of the project will be identified. These could be river basins with up- and downstream users, abandoned or planned irrigation projects, or areas with significant policy reforms over the period covered. The idea is to obtain a number of case studies on the most relevant clusters of water use in agriculture that are backed by empirical data. Spatial mapping and visualization will be used where appropriate. These case studies will then serve as a starting point for further analysis and policy dialogue.

Econometric analysis: In the synthesis study, the collected cross-national information will be analyzed more in-depth using econometric techniques. To this end, IAMO contributes a track record of methodological expertise in regional econometric analysis (e.g. Petrick and Zier 2011; 2012). Such analysis can explore possible causal relations between farm restructuring and water supply as well as between agricultural performance and water use. For example, the statistical influence of variation in upstream water availability on downstream agricultural performance can be tested. Discussions with partners will be held to identify appropriate empirical estimation techniques based on the data characteristics and availability.

The five countries chose very different reform paths, which is an asset for comparative research. However, it is important to note that many of the problems are of a trans-boundary nature. The project therefore undertakes an exceptional attempt to bring together the insights of researchers from all five countries and to provide a forum for mutual exchange and learning. The *transnational added value and innovation potential* of this research is its focus on providing a comprehensive understanding of the regional adaptive capacity to climate change via a set of comparative studies by researchers of IAMO and five research institutions in CA5.

The central reason for cooperation is the insight that the climate- and water-related problems to be tackled can only be solved by an intensified dialogue of stakeholders from all countries, not the least in research and academia. The approach of IAMO is that this is more likely to succeed if it is moderated from the outside and if it is embedded in an international research perspective. For this reason, international partner organizations form an integral part of the project. Moreover, cross-national cooperation typically provides a fertile ground for mutual learning and reflection on own ideas and positions. The project builds on already existing research cooperation of German, Kazakh, Kyrgyz, Tajik and Uzbek researchers, and aims to extend this to Turkmen partners.

C. Scientific excellence and originality of the project

As we show below, there are two main strands of literature related to the water-farm restructuring nexus in CA5. One strand focuses on collective action in management of water re-

sources under privatization and restructuring policies. A widely studied problem has been the formation of water user associations and collective action (Abdullaev et al. 2010, Djanibekov et al. 2012a, Wegerich et al. 2012). On the other hand, analysts of farm restructuring were mostly interested in their impact on agricultural productivity and farm incomes. For example, while recent surveys by Lerman et al. (2004) or Lerman and Sedik (2009a) provide national overviews of CA5, they focus only on land individualization and do not cover water-related issues at all. Hence, there is a gap in the understanding of linkages between these two strands. The availability of statistical information over 20 years offers a ground for conducting research on new approaches of sustainability of agricultural production and its resilience to water-related issues via agricultural reorganization. The following points highlight how the project will move beyond the state-of-the-art:

- This is the first attempt to provide a unified database of regional production and restructuring patterns as well as water use statistics that covers all five CA countries.
- It is also the first project that provides a focused chronicle of agricultural- and water-related political reforms for all five CA countries for a significant post-Soviet period.
- By bringing together leading researchers from all five countries in an international research consortium, it is in an ideal position to overcome constraints in access to statistical data.
- In selecting the research consortium, particular emphasis was placed on the partners' expertise in socioeconomic research.
- Based on these conditions, the project will provide unique insights into agricultural restructuring and water use patterns at the CA5 subnational level, making full use of the methodological opportunities provided by comparative research.

These achievements will also be of interest for researchers working on issues of transition and transformation in agriculture outside the Central Asian region and for the international development community.

D. Relationship of the project to the funding policy goals set out in the funding announcement

The project directly relates to BMBF's funding scheme for pilot projects for partnerships in science, research and education with the countries of Central Asia and the South Caucasus "Partnerships for sustainable solutions in transforming and developing countries – Research for development". The specific theme addressed is climate, energy, food production: transforming vulnerability into resilience and sustainable bio-economies, including research on sustainable land and water use systems, protection from climate change and the interactions among water and land use, food production and energy efficiency. Moreover, the project has an explicit focus on socio-economic and institutional characteristics of Central Asian agriculture.

The "Strengthening Germany's role in the global knowledge society - Strategy of the Federal Government for the Internationalization of Science and Research" (2008) postulates the "intensification of cooperation with developing countries in education, research and development on a long-term basis" as well as "assuming international responsibility and mastering global challenges" as central goals for future action. By establishing a unique network of partners from Germany and Central Asia who collaborate on analyzing the consequences of climate change for sustainable food production, this proposal directly contributes to these central policy goals set out by BMBF. It also speaks to the priority fields outlined in the "National Research Strategy BioEconomy 2030 - Our Route towards a bio-based economy" (2011), nota-

bly the overall goal to ensure global food security and the aim to achieve this by sustainable agricultural production

The project objective to establish the research network among CA5 and German researchers is in line with the discussions raised in the White paper on EU cooperation with Eastern Europe, Central Asia and South Caucasus in Science, Research and Innovation (Schuch et al. 2012). The project results will contribute to the existing knowledge on agricultural policies and institutional processes in Central Asia with emphasis on available options for addressing rural food and income security in scope of the climate change and thus contribute to the MDG.

E. Preparation of new partnerships

The project partners come from each CA5 country and include those centers which have been increasing experience and visibility in economic analysis of agricultural reforms. In this way, the project will initiate a scientific network on the socio-economic topics relevant to the region as a close and lasting cooperation in the interest of each partner to improve human capacities, strengthen economic sustainability and effective land and water use, promote prosperity and stability in the region, and expand further the research interests in Central Asia within the German and European scientific community. The emerging research partnerships can reduce the brain drain of researchers from the region and increase their motivation to reintegrate and stay active in research. There is no example of a similar partnership among researchers from all CA5 countries in the academic field of agricultural development.

F. Support for young scientists and equal opportunities

In order to contribute to their scientific establishment in the research topic and appropriate methods as well as to further their academic career, the project will involve young researchers from the region from its onset. With the participation of researchers from MLU, the project will organize two summer schools focusing on methodological needs for the project data analysis and interpretation of the results. The project results will be published in international and local journals, thus contributing to the visibility of CA5 researchers and generating further international research interest in the region within German and other international research centers. The core part of the research, country studies will be conducted by the young scientists from CA5 research centers. The project involves several female researchers for promoting equal opportunities in research in the region.

G. Needs orientation and contribution to the concept of “research for development” and “sustainability”

For most of the post-Soviet countries, independent think tanks that provide research-driven advice on policy making remain an organizational phenomenon founded primarily after 1991, with a still small number in CA5. Due to high political, financial and logistic barriers the partnership building and peer learning among researchers across the region is limited (Schuch et al. 2012). Their external links is usually with international organizations, while it is still hard for them to find research partners in other CA5 countries. The solution can come in form of a platform that joins common interests of independent research centers to learn from each other and bring new thinking and innovative dialogue and debate on most relevant issues of agricultural development. It is anticipated that merging the research interests and outcomes into an effective knowledge-sharing and discussion network will stimulate actions by other researchers, broaden the regional and international network in addressing common challenges as well as establish a basis for future research cooperation.

In terms of basic research, the project will provide unique insights into the complex issues of regional economic development addressing emerging regional climate risks with regard to

water supply. The project results will contribute to the understanding of available options of sustainable economic development in the region, particularly addressing the rural population that comprises the majority of people in CA.

H. Scientific and technical working goals of the project

The *scientific working goal* of the project is to extend the understanding of interlinkages between restructuring and reorganization in agricultural production and water use in a transition context. The experience of CA5 countries offers a unique platform with various non-linear paths of agricultural reforms and growing problems of the use of irrigation water.

To address the human development and promote international research cooperation, the project has the following *technical working goals*:

- To increase research capacity of partner organizations via training of young scientists. To this end, the project plans two summer schools by researchers from IAMO and MLU. They should provide the regional partner organizations an adequate degree of freedom and flexibility to conduct creative research on their respective countries.
- To establish a unique database on socio-economic development of each CA5 country using the detailed statistical information from official sources on economic development and water use in agriculture for 20 years of transition in the region.
- To establish a network among CA5 and German researchers working on the research topics of the project and create a background for their long standing cooperation. For doing this the project will initiate intensive discussions and exchange of knowledge via bringing other international experts on board.

II. Current state of research and previous work

A. Current state of research

The restructuring of agricultural production and water use have had high priority for CA5 countries recently and have been extensively described and compared from the perspectives of farm restructuring, land use rights, decentralization of agricultural production, collective action in water use, governance and management of irrigation systems (e.g. Lerman 1998, O'Hara 2000, Spoor and Visser 2001; Lerman et al. 2004, Pomfret 2008a, 2008b, Petrick and Carter 2009, Lerman and Sedik 2009a, Dukhovny and Ziganshina 2011). One lesson that is common in these studies is that despite the reforms implemented in the CA5 countries have differed in speed, degree and manner of implementation, e.g. farm restructuring (Spoor and Visser 2001), the beginning of agricultural recovery - agricultural growth and productivity - in all cases has been linked with the start of the reorganization of farms (Lerman and Sedik 2009a). The farming structures have varied between and across the countries depending on the country conditions and crops. While Kazakhstan has opted for larger farming units in rainfed areas of grain production (Petrick et al. 2012), the size of farmers in irrigated areas is much smaller and close to those in other CA5 countries. The individualization and fragmentation of farm operations in these countries allowed improving agricultural productivity (Lerman 2009). However, these processes have exacerbated the mismatch between farm scales and existing infrastructure, e.g. irrigation systems or service provision. Among the possible options to deal with this mismatch are the formation of agricultural production cooperatives (as in Kyrgyzstan and Tajikistan; Lerman and Sedik 2009b, Lerman and Wolfgramm 2011) or the forced reconsolidation of farms (as in Uzbekistan; Djanibekov et al. 2012b).

At the same time wasteful irrigation practices and the poor functioning of the irrigation system remain the principal factors that hamper future agricultural production, depress rural incomes and jeopardize food security in CA5 (Saverskiy 2004). Due to the highly inefficient surface irrigation practices as well as underdevelopment of other sectors of the economy, agriculture remains the major user of water resources in CA5 (Bucknall et al. 2003). Even without climate change, water stress is expected to rise due to the population growth and industrial development, while climate change is likely to alter the magnitude and timing of this stress (Siegfried et al. 2012). A wide range of solutions are presented in various studies, from micro-level options such as technical tools, drought resistant crop varieties, participatory water management, macro-level options of coordinated use of transnational water flow and trade openness.

What has mostly been missing in the existing studies, however, is an integrated view on the complex interrelations between farm restructuring and water management. Levels of analysis and proposed solutions are typically focused one-sidedly on one or the other or miss the multiple roles that farm organization has for the generation and distribution of rural incomes, food security and the sustainable use of water resources. These roles are reflected in the distribution of property rights, labor organization, cropping and livestock portfolios, as well as technology levels. Because access to longitudinal information is difficult, there are only few studies available on the role of agricultural reorganization and water use at the national level. Most of these examples are based on political and social studies (Veldwisch and Spoor 2008, Abdullaev et al. 2010, Hornidge et al. 2011, Van Assche and Djanibekov 2012) focusing on the effects of water management transfer to newly-established private farms. The existing studies typically offer isolated solutions that neglect the peculiarities of existing interlinkages between organization of irrigated agriculture and water use in the region.

Research is needed to analyze if there is more to gain from farm restructuring than just an increase in agricultural output, with particular emphasis on more efficient use of cross-passing water resources as well as resilience of agriculture to scarcity and supply variability of irrigation water. Such analysis would require careful consideration of agricultural reforms that CA5 nations have implemented since 1991, and taking into consideration the characteristics of supply and use of irrigation water in each country and in the region. The national statistical database that has been compiled by the national committees of statistics and ministries of agriculture and water resources of each country can offer valuable information at the level of administrative districts over all the years from 1992 to 2013. This data provides an excellent basis for comparative ex-post analysis as proposed in this research project. However, it is nowhere publicly available in a consolidated place and some countries even hamper the widespread distribution of statistical information.

B. Previous IAMO experience in cooperating with the countries and the topic

IAMO was established in 1994 as a foundation of public law to analyze agricultural development in the former socialist economies, to train scholars, and to be a forum for scientific exchange. Since the mid-1990s, IAMO has been conducting research projects on the successor states of the former Soviet Union, with a focus on Ukraine, Russia and Kazakhstan. For example, from 2004 to 2007, IAMO researchers worked on a project "Crop Insurance in Kazakhstan: Options for Building a Sound Institution Promoting Agricultural Production" funded by Volkswagen foundation. More recently, the scope of IAMOs Kazakhstan research was broadened and extended to Kyrgyzstan, Tajikistan and Uzbekistan. Since 2010, with support from the World Bank, IAMO has been investigating the productivity and distributional effects of farm restructuring in various Kazakh provinces. In 2011/12, four research consortia including work on Kazakhstan were inaugurated. These are "EPIKUR - Economic and natural potentials of agricultural production and carbon trade-offs in Kazakhstan, Ukraine, and Russia"

funded under the Leibniz Excellency Initiative in Research, "GERUKA - Globale Ernährungssicherung und die Getreidemärkte Russlands, der Ukraine und Kasachstans" funded by BMELV, "MATRACC - The Global Food Crisis – Impact on Wheat Markets and Trade in the Caucasus and Central Asia and the Role of Kazakhstan, Russia and Ukraine" funded by Volkswagen Foundation, and "Agroholdings im Agrar- und Ernährungssektor in GUS-Ländern: Entstehungsgründe, Funktionsweise und Entwicklungsperspektiven" funded by DFG. In 2012, a IAMO-funded research project on land and water use in Tajikistan was launched. In September 2011, a workshop for young researchers on agricultural development in Central Asia was held at IAMO as a pre-conference activity to the German Agricultural Economics Association's annual meeting in Halle. About 30 participants from the region and several German universities and research institutes met to exchange on their findings. New colleagues originating from Kyrgyzstan and Uzbekistan continued their previous research efforts in these countries after joining IAMO in 2012. Research contacts to Turkmenistan were established in November 2012. In November 2014, IAMO hosted the conference "ReCCA - Regional Economic Cooperation in Central Asia: Agricultural Production and Trade", supported by the German Academic Exchange Service (DAAD). Currently, approximately 20 IAMO researchers work on the CA5 region.

IAMO's emerging project portfolio is reflecting a strategic focus on the region with particular emphasis on issues of agricultural restructuring, overcoming productivity bottlenecks, ensuring regional food security, as well as sustainable use of natural resources. IAMO is committed to further develop its role as a coordinating body for scholars and research organizations from the CA5 region. The institute has been engaged for a long time in acting as a forum for scientific exchange and making its findings available to stakeholders from academia, administration and business in the form of publications, conferences and presentations.

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