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RESEARCH BRIEF

Agricultural water use in Southeast Kazakhstan: current challenges and adaptations to water stress

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Key messages

- There is widespread perception of declining water inflows and snow cover, possibly due to climate change.
- The poor state and performance of public infrastructure has resulted in a series of water supply issues. The issues are unevenly distributed geographically and among the farming population.
- Farmers and other local actors engage successfully in a number of short-term adaptation measures, but long-term structural adaptation requires state intervention or private investment, both of which are lacking.

Impacts of climate change and post-Soviet transformation on Kazakh agriculture

Climate change is projected to have significant impacts on agriculture in Kazakhstan. Scholars agree that the effects of climate change may likely be skewed against the mountainous areas of south and southeast Kazakhstan, where it is expected that precipitation during the growing season will decrease, and freshwater limitations and water stress will be experienced from the next decades due to changes in snow and glacier melt. In southeast Kazakhstan agricultural production is mixed (e.g. livestock and crops), small and medium landholdings predominate, and the adaptive capacity of farmers is often low, due to the lack of financial and other resources.

This Research Brief reports findings of a study that, for the first time, provides a place-based analysis of constraints and opportunities for agricultural adaptation to climate change, with a specific focus on water use, in southeast Kazakhstan. This study was the first to consider how post-Soviet institutional change converges with and affects adaptation to climate change, and to what extent current water management models support climate change adaptation in this semi-arid region.

By adopting a place-based social scientific perspective, this study contributes to filling two knowledge gaps. Firstly, it provides knowledge on a geographical area that has been largely neglected in earlier studies. Secondly, it complements earlier research that tended to be based on top-down climate, crop-climate, or climate-economic modelling, to engage little with communities on the ground, and to make limited use of social scientific theories to examine adaptation practices, or lack thereof, in specific places. Thus, this study focussed on cultural or social adaptation practices and a critical analysis of their socio-political context, which are generally overlooked in favour of more easily quantifiable technological or managerial adaptation measures such as drought resistant crop varieties, and insurance schemes.

The findings presented in this Research Brief were produced through a mixed-method study that involved participatory workshops, semi-structured interviews and the use of available statistics. The study was conducted in the two sites of Koram and Karaoi in the Almaty region in southeast Kazakhstan, and involved farmers and other important actors, such as water users associations, local authorities and scientists.

Agricultural water use: current challenges

The most important challenges identified by the above mentioned actors concern the poor state and performance of the public infrastructure, and a series of resulting water supply issues (Table 1).

Challenge	Problem area	Times identified
Poor infrastructure/maintenance	Infrastructure	41 (8)
Inadequate water supply	Supply	25 (6)
Water supply rules	Supply	22 (5)
Untimely water supply	Supply	12 (5)
No/bad consumption measurement	Infrastructure	10 (4)
Lack of irrigation technology	On-farm technology	9 (3)
High water prices	Finance	7 (4)
Water losses	Supply	7 (4)

TABLE 1. Challenges identified by local actors. Numbers denote the times each challenge was identified by individuals, and, in brackets, by groups of participants in two research workshops.

Climate change relates more directly to two challenges. Firstly, there is widespread perception of declining water inflows in both sites. Farmers and water users' associations officials report that water flow through the local Ulken Almatinka river system has declined, small channels have dried up, and some collector ponds have become so silted as to be almost unusable. These reported decreases contradict discharge measures in the undisturbed parts of the mountain river system, indicating that perceptions of decreasing supply occur in a context of increasing demand. Secondly, farmers also mention climate change with respect to snow cover. In rain-fed zones soil moisture content, and therefore a good year, depends on spring and early-summer rainfall and on snow lying on the ground during the previous winter, but the latter has become increasingly problematic in this region.

There are differences among actors in the identification of challenges. For example, small and large landholders concur on some challenges (e.g., poor infrastructure), but disagree on others (e.g., high water prices), which revealed the distinct experiences of these two types of farmers. Furthermore, scientists and agri-business representatives, who do not experience water use directly, tend to identify challenges (e.g., land use, lack of knowledge) that differ significantly from those identified by small and large landholders, water users associations and local authorities (e.g., poor infrastructure, water supply issues).

Finally, water use challenges are unevenly distributed in time and space. Water stress is unevenly experienced during the year, as it is especially felt in the summer at the height of the growing season. It is also apparent that the challenges faced by farmers strongly depend on the location of farmers' plots (e.g., up- or down-stream), and the presence of alternative water sources (e.g., creeks, reservoirs, or groundwater).

Agricultural water use: current adaptations

Farmers and other actors engage in a number of mostly short-term (i.e., 'day-to-day' operational, and seasonal 'tactical') adaptation practices that appear to have positive effects on agricultural production in the region (Table 2). However, longer term (strategic and structural) adaptation, either social or technical, seem not to be an option due to the costs of upgrading the infrastructure and the inflexibility of an established top-down decision-making

system (legacy of the Soviet times) that allocates responsibilities to lower administrative levels in principle, but actually maintains decision-making (and financial) power at higher levels. In fact, it is apparent that actors perceive the institutional and political environment and the decaying infrastructural and technical system as fixed boundaries. There is no sign of attempts to challenge those institutional and technical structures, which would effectively expand the adaptive space of farmers, water user associations, and local authorities.

This study did not quantify the diffusion of these practices in the region. However, it is clear that while operational adaptation practices are widespread across the two sites of Koram and Karaoi, and probably Southeast Kazakhstan more broadly, strategic practices depend more directly on specific farm profiles. Thus, for example, more efficient irrigation technologies, and shifting cultivation to less water demanding crops (e.g., alfalfa or safflower) is more likely to be experimented in larger and more technified farms.

Practice	Purpose	Type	Timeframe	Actor
Use of alternative water supply (e.g. underground water)	To make up for lower inflow from canals	Technical	Operational	Farmer
Additional use of fertilisers	To make up for lower inflow from canals	Technical	Operational	Farmer
Illegal access to water (e.g. diversion of water from other farmers' canals)	To make up for lower inflow from canals	Technical	Operational	Farmer
Monitoring of the water system (e.g. reservoirs levels)	To enable a timely response to water stress	Technical	Operational	Farmer, Water User Association
Coordination of water distribution among farmers (water supply rotation)	To enable fair distribution of water resource and of impacts	Institutional	Operational	Farmer, Water User Association
Efficiency improvement (e.g. cleaning or repairing intra-farm canals)	To reduce water losses	Technical	Tactical	Farmer, Water User Association
Change to less water demanding crops	To reduce water need	Technical	Strategic	Farmer
Adoption of more efficient irrigation technology	To reduce water need	Technical	Strategic	Farmer
Temporary or permanent exit from agriculture (non- voluntary)	To avoid risk of further crop failure and loss of livelihood	Economic	Strategic	Farmer
Establishment of formal responsibilities for water supply infrastructure management	To clarify water supply rules, and enable investment and management	Institutional	Structural	District Council

TABLE 2. Adaptation practices reported by farmers and other actors in the study sites.

Ways forward

The study revealed two specific entry points for adapting agricultural water use to climate change. First, farmers and other actors identified the **need for information on shorter and longer-term weather patterns and for improved communication of such information**. Knowledge of climate change projections and trends in water balance in the area is poor, and local actors (including farmers and heads of water user associations) are keen to obtain such knowledge. Provision of climate information would enable local actors to better plan, and to orient their activities towards the sustainability of agriculture in the area. Local organisations are well positioned to communicate to farmers and water users, but there seems to be a disconnect between these organisations and higher system levels, as well as a lack of trained personnel.

Second, the study highlighted the **need for infrastructural investment to be directed towards efficient use of water resources, i.e. prevention of water loss within the system**. The present-day irrigation infrastructure is a legacy of the Soviet period, much of which was destroyed or has deteriorated in the subsequent collapse. Water user associations, local authorities, and farmers cannot finance its rehabilitation, let alone invest in new infrastructure. The introduction of market mechanisms to water management was implemented with the intention that markets would pick up the slack left by state divestment from irrigation. However, in market conditions of full-cost recovery, water user associations struggle to meet costs and maintain already deteriorated infrastructure and are incapable of financing further investments. The state and, potentially, large scale private investment, are therefore expected by local actors to lead the upgrade of the infrastructure.

Finally, **the attitude of farmers, local administrations and NGOs (where existing) indicates receptiveness to adaptation innovations**. Farmers are already acting at the margins of what is possible, as evidenced by the working of marginal land and frequent risk of crop failure. Notwithstanding the need to address the aforementioned structural constraints, which are often associated with higher administrative levels, the levels of experimentation observed at local level in both study sites opens up opportunities for adaptation.

Further reading

A more detailed analysis of agricultural water use in Koram and Karaoi is available in: Barrett, T. Feola, G., Khusnitdinova, M., Krylova, V. Adapting agricultural water use to climate change in a post-Soviet context: challenges and opportunities in Southeast Kazakhstan. Unpublished; available on request.

A detailed description and discussion of the research methods adopted in this study is available in: Barrett, T. Feola, G., Krylova, V., Khusnitdinova, M. 2017. The application of Rapid Appraisal of Agricultural Innovation Systems (RAAIS) to agricultural adaptation to climate change in Kazakhstan: a critical evaluation. *Agricultural Systems*, 151: 106-113 [Open access at: http://centaur.reading.ac.uk/68364].

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