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REFORMS IN RURAL DEVELOPMENT AND THEIR INFLUENCE ON AGRICULTURAL EXTENSION OF UZBEKISTAN: EXPERIENCE AND CHALLENGES IN WATER MANAGEMENT

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Nowadays science applies agricultural innovations in a wide range all over the world; however, number of water users in innovations is in smaller amounts. This might happen to a number of factors, for example lack of adequate knowledge exchange system, nominal extension services at places, lack of well-defined policies, barriers in 'human' minds change', barriers at policy level. As for Uzbekistan, it could be said that practice of extension of innovations application and its diffusion in agricultural irrigation sector in Uzbekistan does not have much experience, however, before 1991 Uzbekistan was one of the Soviet Unions' republics and as it is known, the Soviet Union had high practice in innovations in different sectors, as well as in agriculture. Although, since independence, Uzbekistan has continued to experience innovations in agricultural sector independently, their diffusion is at a challenging shape. This article captures the policy issue, how Uzbekistan started to develop water management issues in its economic reforms, it describes a case research on application of innovative technique on a farm level and accordingly, it tries to propose the aspects that need to be involved in future reforms to make the current situation be better managed.

Keywords: agriculture, water, extension, innovations, policy

Water is the most distributed natural substance in our planet and the most important and critical resource which is unevenly distributed on the Earth. In the world, where number of inhabitants is expanding enormously the withdrawals from the water resources are exceeding. The surface area is constant but population is increasing. This indicates that from the same land we need to produce more crops. Basically, irrigation proved to contribute considerably to making land more productive, although especially large-scale irrigation often leads to disadvantageous impacts on the environment.

The FAO (2002) predicted that the irrigated area in developing countries needs to be expanded from 202 million ha in 1999 to 242 million ha in 2030 to meet the increasing food demand. The demand for irrigation will in particular increase in arid and semi-arid regions where more than 90% of agriculture depends on irrigation due to predictions on the impact of climate change that will reduce irrigation water availability. As for Uzbekistan, the World Bank (2010) forecasts, that climate change for Uzbekistan from 2005 to 2050 indicates that:

1. the water demand will increase from 59 km^3 to 62–63 km^3,
2. the supply will decrease from 57 km^3 to 52–54, km^3,
3. the present water deficit will increase by over 500% from about 2 km^3 to 11–13 km^3.

Moreover, Toderich et al. (2009) reported that approximately 20 000 ha of irrigated land in Uzbekistan are lost due to salinity and invariably abandoned every year.

Considering that the most applied irrigation technique in Uzbekistan is furrow irrigation, this technique increases the water management problem by applying about double water amount than is the actual need for plants. For example, Mohan et al. (2012) evaluated the performance of furrow irrigation in Fergana valley and the results showed that the application efficiency of the irrigation events in 2009 was 48% with an average runoff loss of 39% from fields. Moreover, the problem is becoming bigger taking into account that irrigation norms between farmers are hardly considered and water price is hardly valued.

The high population growth rate, degradation of agricultural lands and scarcity of fresh water have raised doubt about the future suitability of the dominant agricultural practices for irrigated drylands. In face of the environmental and economic challenges, there is an urgent need to reconsider the existing classical agricultural systems and to adapt agricultural systems that can help to prevent soil quality, soil fertility degradation, water management efficiency and hence increase productivity. In most countries, this issue is being solved by applying innovative techniques, however, innovative techniques are used rather in smaller amounts in comparison to what people are used to, under conventional approach. This might happen to a number of factors e.g. lack of adequate knowledge exchange system, nominal extension services at places (Levidow et al., 2014), lack of well-defined policies (Iglesias and Garrote 2015), barriers in 'human' minds change', barriers at policy level.

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Reforms in Agriculture and Gaps in Extension Services

From the first days of independence, the Central Asian countries started their reforms in agriculture. Instead of kolkhozes and sovkhozes (collective farms) there appeared a big number of water users. The first reforms in restructuring of land use did not help much in coordination between land and water sectors (Dukhovny et al., 2004). Later this had negative impact on on-farm irrigation.

Agricultural economic reforms of Uzbekistan that started in 1992 are still on-going nowadays. First reforms were applied in the manner of organizational aspects of agricultural enterprises where question of liberalization of agro production and sales markets were not much taken into account. By this, with the help of reforms (1992–1998) three types of agricultural enterprises were established; shirkats (shareholders), fermers (private farms with land leased from government) and dekhqans (rural households). Later (by 2008) all shirkats were dismantled and fragmented into fermers (Zavgorodnyaya, 2008; Veldwisch 2008; Trevisani, 2008; Lerman, 2008). Further, in 2008–2011 farmland was reconsolidated into larger cotton-wheat farms (Djanibekov et al., 2012). However, the legislation of property types on land has not been clarified until now. The reforms of land management took place under orders and legislative regulations from the Ministry of Agriculture and Water Resources (MAWR) as well as from the Cabinet. The changes in the agricultural sector occurred rapidly, including adjustment and adaptation processes of fermers. Fermers became a centrepiece of agricultural reforms in Uzbekistan (Law of the Republic of Uzbekistan from April 30, 1998 of No. 602-I "On farm" (amended in 2013)), Presidential decrees such as from March 24th, 2003 of No. УП-3226 "On the most important directions for deepening reforms in agriculture" (see also Knowledge Base of CaWater). These reforms became a platform for the establishment (in 2000) of a new player in agriculture at the level of water management – water user associations (WUA) as connecting units between private water users and state. The first WUAs did not have a sound legal basis and their establishment was legitimated only by Cabinet decrees and regulations. In 2003 after new reforms in agrarian sector, WUAs received special attention. The beginning of the reforms was initiated by the presidential decree from 24.03.03 № УП-3226 "On the most important extension directions of reforms in agriculture". Still, this reform wave was not directly aimed at transformation in water sector. According to empirical research done by different local and international scientists, "such forms of "governance" remained from Soviet time and carried negative impacts on management of agricultural systems, often braking whole reform processes of agrarian sector" (Taksanov, 2003; Sehring, 2009; Herrfahrdt, 2004; Schlüter and Herrfahrdt-Pähle, 2011, 2012). Decree № УП-3226 strengthened the main goals of MAWR. One of the goals was formulated as follows: water resources management providing transition from administrative-territorial to basin (Hydrographical principle, according to canals and irrigation systems) principle of irrigation systems, and also introduction at all levels of market principles in irrigation water use (President of the Republic of Uzbekistan, 2003). Organisational structure of MAWR was revised radically (Ministry, 2003). In the new structure basin management boards of irrigation systems (BUIS), management boards of main canals as well as management boards of irrigation systems (UIS) were presented for the first time (No. 290, Zavgorodnyaya 2008, Yalcin and Mollinga 2007). In 2009, according to the Resolution of the Cabinet of Ministers (from December 25th 2009, № ЗРУ-240), WUAs were renamed into Water Consumers Association (WCA). However, changes in water and land governance did not receive their appropriate implementation at practitioners' and users' level.

New reforms brought to a situation that if before the above mentioned reforms each kolkhoz or sovkhoz had its own specialists (agronomists, hydrotechnical personal and head) with specialized training in agricultural education to manage the complete agricultural process within these large farms, after dismantling of collective farms, each individual fermer was responsible for managing their piece of land without any special people in the background. This brought to a big decrease in extension practice.

Institutional bottlenecks for extension and advisory services in Uzbekistan are, according to Kazbekov and Qureshi (2011) as follows:

- Detachment of research from practice.
- Lack of state support for extension.
- Fermers had no accessibility to donor-driven extension services due to high costs and lack of awareness.
- Findings indicate the requirement of knowledge for 'new' fermers.
- Newly fermers in Uzbekistan are marked by different educational background not related to agriculture and have therefore lack of farming knowledge and management skills.
- Existing private extension advisory companies in Uzbekistan are not affordable for small fermers.
- There is a need in formal governmental extension for advisory organizations revitalized from existed ones and adapted to the given institutional frameworks.
- Policy framework for the development of agricultural extension services is crucial and needs to be developed.

Material and methods

Case Study

Our research was conducted in the province of Khorezm, south of the Aral Sea, in 2010–2011 under the framework of ZEF/UNESCO German-Uzbek Landscape Restructuring Project and local NGO KRASS "Khorezm Rural Advisory Support Service". The farming unit chosen for the research is located in the Urgench district, Water Users Association "Amir Temur", farming unit "Hudaynazarov Atamurod". The current research was conducted to find out the perception of agricultural innovation by fermer, to make fermer find the advantages from a certain innovation and understand if and how such innovations could be received and applied by other fermers.

The chosen agricultural innovation was application of laser land levelling (LL), which is a part of the Conservation Agriculture technology. For the control point (for comparison) a traditional method of land levelling (TL) was chosen. These two methods of levelling were applied on

2 similar plots of fermer located next to each other. Sizes of the plots were about a hectare each. Both plots were under winter wheat crop.

In accordance with the soil levelling methodology, the non-uniformity of the top soil was measured manually (by 20 × 20 meters) by using a laser emitter and laser receptor.

In the experiment, one part of the field was levelled with the help of the laser leveller (LL) and the other part of the field was levelled according to a traditional method of levelling (TL). For the laser levelling, a fermer used a tractor with a minimum capacity 80–100 horsepower. Qualitative laser levelling demands an appropriate calculation of the optimal soil movement. Before starting laser levelling activities, tractor driver – leveller received an appropriate training from the KRASS NGO specialists.

Advantages from the laser land levelling could be seen from the indicators as: water discharge for irrigation and leaching, time for irrigation and leaching, labour during water discharge, soil salinity level, yield etc. Weirs were installed on both fields (LL and TL fields) for the measurement of water discharge. Volume of water going through the weirs was measured every 15–20 minutes. In the end of the vegetation season, for the calculation of average yield, samples of winter wheat (whole plant above the soil, without root) were taken from both fields. Volume of taken samples was in the amount of 1 m^2 $plot^{-1}$ (by 3 plots from both fields). Calculation of time and labour that was consumed during the water discharge to the fields was done by the KRASS personnel in cooperation with the fermer. Soil salinity of the fields was measured before irrigation by the electromagnetic inductometer EM38. From EM38' readings, salinity maps (in mS m^{-1}) were created to analyse the soil salinity level of the both fields on the depth of a soil profile.

Participatory impact assessment (PIA) exercises were conducted with the fermer in order to identify the advantages and weak points of the LL. The PIA was done two times, the first one in the end of 2009 (December) and the second one in August 2010, which gave additional food for reflecting the process and gist of innovation. PIA tools used during the assessment: timeline, SWOT analyses, comparison. PIA Procedure: The first PIA was done by using of 'timeline' and 'SWOT' tools. A 'timeline' tool helped the fermer to define the project boundaries in time, an aim of which was to ensure that it is clear about the time period that is being assessed. Furthermore, creation of timeline table helped the fermer to recall the sequence of activities that were done during the period of collaborative work. The 'timeline' exercise was continued by the 'SWOT' exercise in which fermer assessed all LL activities in strong and weak points. The 2nd PIA helped to understand fermer' indicators based on which he made his judgments and took decisions about new technology.

Results and discussion

The fermer has made all expenses and agro technical actions on both fields equally, for example: the identical expense of mineral fertilizers, the cultivator application, the identical expense on harvesting and transportation. Results of field measurements (see Table 1) have shown that the salinity analysis taken from the field before the start of the experiment, has made 49.9 mS m^{-1} in the laser levelled (LL) field, whereas TL field' salinity made 43.6 mS m^{-1}. In spite of rather high salinity level in the LL field, a winter wheat yield was a little bit higher than in the TL field. From the LL field fermer harvested 6 862 kg ha^{-1} and 6 680 kg ha^{-1} from the TL field. Crop yield, crop germination, crop growth and development directly depended on uniform distribution of water at the field surface. The water discharge for irrigation of the LL field was much lower than the water used for the irrigation of the TL field. Water discharge for the LL field made 802 m^3 ha^{-1} for 1 irrigation, while on a TL field water discharge was 1 145 m^3 ha^{-1}.

Perception of the fermer from the results of a new innovative levelling technique was very much positive from all points:

- Fermer accepted the technology as it was not that complicated and in case of a need he could address questions to KRASS or could apply for the service from KRASS.
- Fermer saved and would save much in terms of financial input (in terms of labour input during levelling and irrigation activities, seeds and fertilizers).
- Fermer is ready to use a bit more expenses in terms of application for LL. Fermer understands that later this expenses would be covered by yields.
- Fermer would advise this innovative technique to other neighbouring fermers and his acquaintances.
- In terms of innovation diffusion, the fermer thinks that in case of governmental support this innovation might get its value among the majority. Fermer explained that most of the fermers might not use this innovation due to

Table 1 Results of field measurements

	Fermer' observation				Measurement results			
Field	**Activities related to mechanization in times**	**Expenses for mechanization (in %)**	**Time for irrigation in times**	**Labour needs in %**	**Soil salinity before LL in mS m^{-1}**	**Water used for 1 irrigation in m^3 ha^{-1}**	**Water need total in m^3 ha^{-1}**	**Winter wheat yields in kg ha^{-1}**
LL*	>4	>10-12%	>1.5-2	>30-40%	49.9	802	4010	6862
TL*	<4	<10-12%	<1.5-2	<30-40%	43.6	1145	5725	6680

Source: Own, 2011
*LL – Laser levelled field, *TL – Traditionally levelled field

expensiveness of the equipment and in case government would support in purchase possibilities of the equipment, fermers could use this technique. And moreover, taking into account that most of the fermers are used to apply what they are used to (conventional/traditional methods), governmental motivation would very much ease to switch to a new/innovative technique.

An example of such experimental results were presented to about 20 'big fermers' of the same WUA during a non-structured interviews and perception of those fermers in terms of use of innovations and motivation of fermers to apply new techniques was similar to a perception of the above mentioned fermer.

Conclusion

It could be said that Uzbekistan does not have much experience in practice of agricultural innovations, however, before 1991 Uzbekistan was one of the Soviet Unions' republics and as it is known, the Soviet Union had high practice in innovations in different sectors, as well as in agriculture. Although, since independence, Uzbekistan has continued to experience innovations in agricultural sector independently, but it has been done in much smaller and slower steps. Since independence until nowadays, we can count experience of Uzbekistan's innovations on hand. Except the numbers of different agricultural laws, decrees (e.g. law "On water and water use", "On eco control" etc.) and annual republic exhibitions on innovation ideas, technologies and projects (since 2008), Uzbekistan counts some international projects which tried to research and keep research of some innovative agricultural techniques. Such projects are:

1. BMBF funded ZEF/UNESCO Project (2001–2011) "Economic and Ecological Restructuring of Land- and Water Use in the Region Khorezm (Uzbekistan)" in development research (some of the results are shown in Ul-Hassan et al., 2011; Abdullaev 2011).
2. IFAD funded ICARDA Project to streamline the creation and use of knowledge about sustainable land management (SLM) in the five Central Asian countries (since 2006) (results shown in Akramkhanov, 2015).
3. The Swiss Agency for Development and Cooperation (SDC) funded and implemented by IWMI in partnership with the Scientific Information Centre of the ICWC (SIC ICWC) Project "Integrated Water Resources Management in the Fergana Valley (IWRM-Fergana)" (since 2001) (results shown in SIC, IWMI 2008).

As documented elsewhere (Qamar, 2002; KasWagAgriConsulting Worldwide, 2008; EBRD, 2008; Nazarov, 2008), agricultural extension in Central Asia and Uzbekistan in particularly remains a challenge.

Despite reforms, number of laws, decrees, research and presented research results that took place in Uzbekistan, innovative agricultural techniques which showed positive results within the Republic conditions are not well diffused and admitted at all levels (fermers and government). For example, the first trial of the CA technology had been applied about 10 years ago in Uzbekistan. Its effectiveness in terms of conservation (water, labour, time, financial input, yields) was presented on official governmental level in 2011; moreover, it was well admitted by experimental field neighbouring fermers.

Despite apparent advantages of Conservation Agriculture technology (such as similar or higher crop yields, and safe resources including fuel, seeds, and labour, thus reducing fermers' costs, reduce of water use) has recently been introduced in Uzbekistan, consequently, the effects of water productivity and its effect on soil salinity under the specific conditions of the irrigation system and practices in Uzbekistan are still poorly understood (Gupta et al., 2009).

Considering that the literature on innovations with regard to developing countries distinguishes 4 main issues: product vs process innovations; innovations as small and medium technologies; incremental innovations; and absorptive capacity (Levintal and Cohen, 1989, 1990; Edquist, 2001); for Uzbekistan, diffusion of product innovation (i.e. new type of crop) has been researched by Turaeva and Hornidge (2013), however diffusion of process innovation (i.e. new technology) has not been taken into account. There is a large gap on research of process innovations development and their diffusion in Uzbekistan as on field level (fermers), so on governmental.

Uzbekistan government has already launched incentive program for fermers. According to this program, a fermer is released from land taxes for 5 years on lands under drip irrigation system. Government needs to motivate water users by providing incentives to a wider list of innovations, including innovations as for example conservation agriculture and other conservation irrigation technique and by that little by little solve the issue of conservation of natural resources.

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