**Barriers to Sustainable Land Management in Central Asia**

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**Summary**

Challenges to broad uptake of sustainable land management (SLM) practices are multifaceted, and particularly so given contemporary policy and natural environments within post-Soviet Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan). What currently unites these five countries is a shared Soviet legacy, characterized by reactionary approaches to problem solving, but still (generally) lacking in more proactive multi-disciplinary approaches which seek to uncover systemic solutions to natural resource degradation. Central Asia houses a number of agricultural production systems - irrigated, rain-fed, rangelands, and mountain – with each republic harboring unique opportunities for adoption of more effective sustainable land use management technologies (SLM) and practices, as well as those which are generally applicable across the region. Yet, adoption rates continue to remain low. In developing a conceptual framework for linking institutional, organizational and economic concerns, within the broader rubric of agricultural innovation, this chapter identifies key barriers to the acceptance and adoption of SLM technologies within the region, as well as contemporary opportunities for enhancing broad uptake. A shift in focus, away from a long standing concern for land reform, and towards agrarian reform, is argued to be of importance for all republics within Central Asia. State mandates and centrally planned production targets for strategic commodities (cotton and wheat in particular) are not necessarily barriers to private investment in technologies and practices which enhance soil health and land productivity. The primary challenge for republics within the region is how to foster enabling policy, institutional and economic environments which embrace inclusivity and equity within national systems of innovation for both private landowners as well as those engaged in the production of state strategic crops. This requires an enhancement in various capacities for sustaining effectiveness in the continuum between discovery and adoption of production technologies and practices which embody sound environmental underpinnings. It would also appear timely for greater advocacy in the need for shifting mindsets towards more of an appreciation for multifunctional production systems and land use planning and away from a historical concentration on commodity and sectoral based planning.

# 1. Introduction

Agriculture accounts for 5 to 20% of the GDP for Central Asian republics (World Bank, 2014a). While the contribution to national GDP for each republic appears to be relatively small, given the large contribution of non-renewable natural resource extraction (oil, gas and minerals) to national economies, a significant proportion of the population within regional republics is rural – estimated at 65% by most publicly available accounts. Agriculture, therefore, is of immense importance for security and livelihoods, and with a dependency on land, water and environmental resources likely to continue for some time to come. One challenge to improving livelihoods and well-being within rural communities within the region has been prolonged delays in enacting contextual (structural) reforms to the agricultural sector, upon the dissolution of the Soviet Union, and with varying experiences. Much of the attention, despite close to three decades since independence, has and continues to be focused on aspects related to land reform. With a continued focus on the production of key strategic commodities (primarily cotton and wheat), some republics have been slow in the release of land from the state to private farmers with clear ownership rights. Where land use rights are not clear, together with a lack of effective enabling environments to support investments in sustainable land use management technologies, growing concerns over land degradation and implications for agricultural productivity is predictable within all production systems.

A number of important agro-ecosystems exist within the region, and within those, two are dominant in characterizing regional production systems. In terms of size, rangelands are by far the largest, occupying approximately 260 million hectares or 65% of the total land mass within the region (FAO 2006). Relative to this vast area, irrigated land areas occupy approximately 8 million hectares; yet it is estimated that close to 75% of the rural population which is engaged in agriculture within the region depends on irrigation, and particularly so in both Uzbekistan and Turkmenistan. Quite apart from income and nutritional security, irrigated systems of production are important for social stability within local communities, given concerns over access to water and efficient use, as well as limited opportunities for employment within urban centres. Over 90% of water withdrawal (with the exception of Kazakhstan at 66%) is destined for agricultural use (FAO 2013), and largely delivered through publicly maintained pumps into surface canals. Given aging Soviet irrigation infrastructure and limited investment in maintenance and replacement, water use efficiency has become extremely low and inequity in access to irrigation water is growing.

While a systematic and comprehensive assessment of the degradation of natural resources is lacking, common wisdom suggests that soil salinity within irrigated lands and soil erosion in both rain-fed and mountainous areas are prevalent within Central Asia (Pender et al. 2009). In Kazakhstan alone, wind erosion has resulted in the degradation of 11 million hectares of rain-fed land (ibid). The dependence of close to 25% of the population in Kazakhstan and Uzbekistan on degraded lands, 2.5 times higher than in other Central Asian republics, and far above the world average (HDR 2010) is of significant concern for environmental and human well-being. Croplands in irrigated areas are affected by secondary salinization, largely due to elevated groundwater tables which result from poor and insufficient drainage systems, together with what is purported to be irrational water management (Gupta et al. 2009). Regionally, 40-90% of irrigated lands are affected by secondary salinization (Qadir et al. 2008), with more than 30%-40% in Tajikistan and Kyrgyzstan, approximately 60% in Uzbekistan, and close to 90% in Turkmenistan (Ahrorov et al. 2012).

Primary causes of land degradation, applicable to all agroecosystems within Central Asia, are summarized in Figure 1. Gupta et al. (2009) have generally grouped these causes into broad categories: (i) mismanagement and over-use of natural resources; (ii) insufficient economic infrastructure and market mechanisms; and (iii) insufficient development of capacity with weak inter-sectoral coordination. Given implications for environmental services, each of these is likely to lead to negative consequences in terms of social, economic, and political instability; through increasing poverty and shifting populations, declining measures for attaining food security, and more generally in terms of

issues related to human and environmental well-being (CACILM National Programming Frameworks, Uzbekistan 2006).

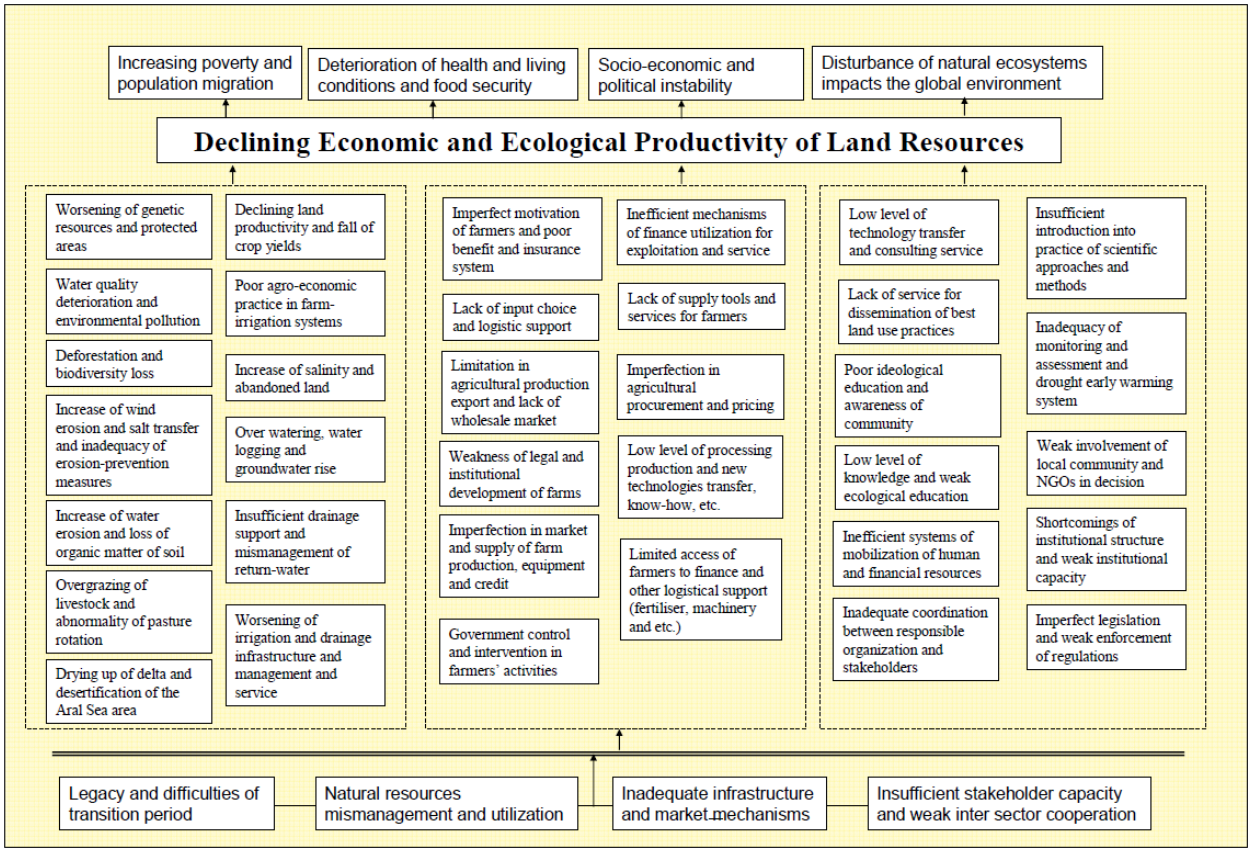


Figure 1. Land degradation 'Problem Tree' and its influence on human wellbeing
Source: Gupta et al. (2009)

Earlier estimates have indicated alarming levels of productivity decline, with a fall in agricultural yields by 20-30% reported across the region, and within the first decade of independence (World Bank, 1998). While some of this early decline was also due to structural adjustment and the nature of transition from a command economy towards a market driven economy, it is generally accepted that poor agricultural production practices, coupled with state mandates for cotton production and deteriorating infrastructure were key reasons for decline in productivity. To be sure, soil salinization alone was estimated to have resulted in a loss of at US$2 billion in agricultural production within the first decade of independence (World Bank 1998). Mirzabaev et al. (2015a) estimated annual costs of rangeland degradation due to poor rangeland management to have equaled US$4.6 billion between 2001 and 2009, with the poorest parts of the region having been most severely impacted by land degradation (Mirzabaev et al. 2015b). In addition, latest predictions suggest that temperature rises within the region are likely to be well above global mean values (World Bank 2014b), which in turn will continue to exacerbate levels of desertification. Estimates further suggest that the demand for irrigation water is likely to increase by 25% towards the middle of the century, while water availability may decline by 30–40% over the same period (ibid ). Concurrently, increasing population, intensive irrigation agriculture practices, and a heavy reliance on livestock as stores of asset wealth and security are likely to place even greater pressure on land and water resources. Concerns exist, therefore, over soil health within irrigated land areas, the ability for rangelands throughout the region to sequester carbon and to maintain resilience in environmental services, and generally in terms of options for sustaining livelihoods and well-being within rural areas dependent on agricultural production.

Identification, dissemination and adoption of sustainable land use management practices (SLM) is therefore crucial in terms of mitigating further loss and enhancing both social and environmental

resilience. Where feasible, SLM adoption may also be of significant relevance to sustainable intensification of agricultural production systems. Despite testing proof of concept and demonstration of a number of sustainable land and water management practices/technologies within the region, adoption continues to remain low (Pender et al. 2009, Gupta et al. 2009). The aim of this study is to better understand existing barriers to successful discovery and adoption of technologies and practices with sound environmental underpinnings, through a review of existing literature, and a synthesis of lessons learned through project based interventions within Central Asia, in order to uncover potential avenues for improving adoption rates.

## 2. Conceptual framework

One avenue for assessing effectivity in the development and broad uptake of SLM is through an analysis of the interlinkages between, institutional, knowledge, economic, and technological related capacities (Figure 2). This complex interplay of different capacities can either hinder or facilitate the development and benefits (perceived or real) of SLM technologies and practices. More effective market access, efficient and equitable access to extension and advisory services, farmer to farmer exchange , land tenure security, the nature and extent of livestock ownership, household demographics and lower dependency ratios are key factors which have been identified as having an influence on SLM adoption within the transitional economies of Central Asia (Mirzabaev 2015b). This framework is helpful in terms of a better understanding these factors (e.g. as presented by Mirzabaev (2016)), as well as in better understanding the ability for each element, on its own or through interactions with other elements, to approach contextual challenges to both development and adoption.

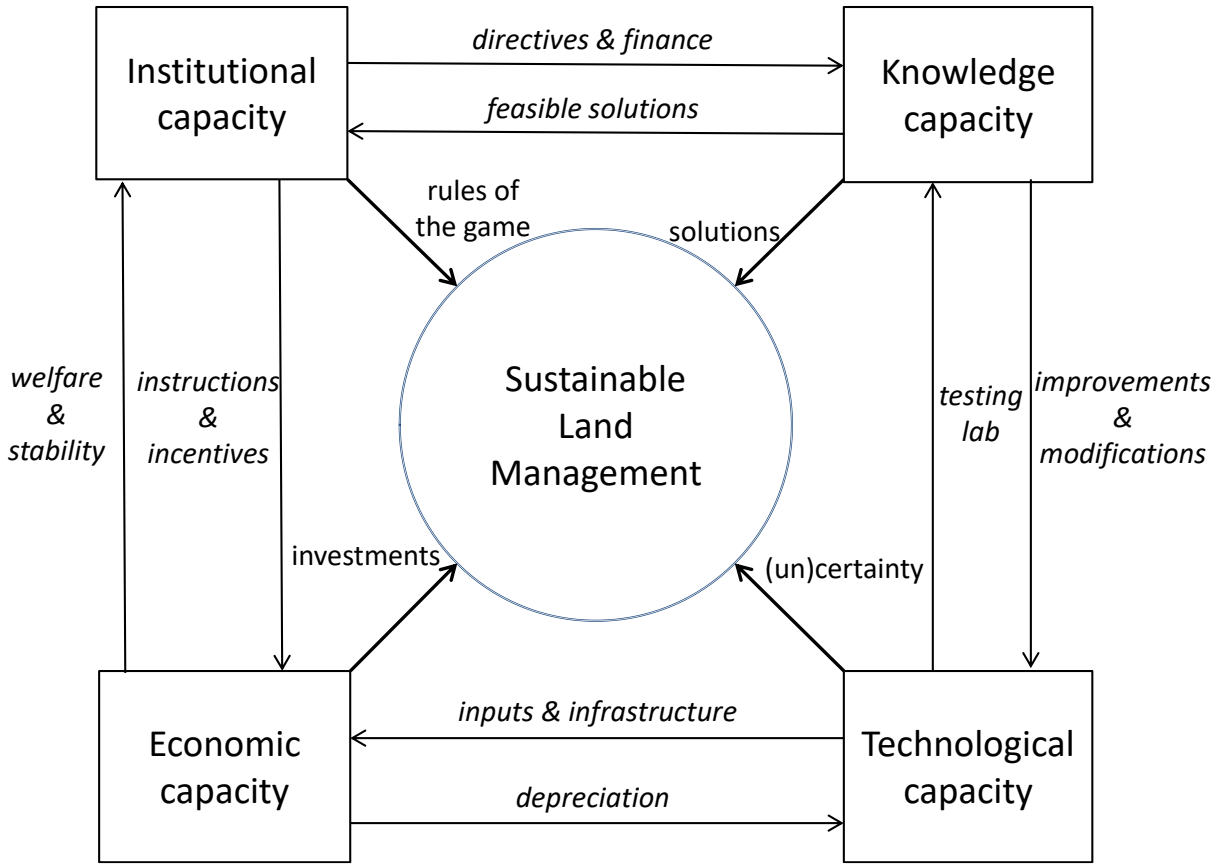


Figure 2. Interlinkages between institutional, economic, knowledge and technological capacity to adapt SLM practices.

Institutional capacity relates to norms and 'rules of the game', which are accepted by society, and as opposed to organizational mandates. The former is related to norms which have been accepted and

internalized over time, whereas the latter relates to a set of rules which are enforced through a system. Existing norms and practices may have remnants of Soviet legacy or they may embody shifting changes towards the need and acceptance for more effective enabling environment for innovation which is driven by societal needs, as opposed to (dogmatic) state defined needs. Defined as a process of continuum from discovery (invention) through to adoption – innovation - and an enabling environment for it to thrive, is contingent on the nature of laws and norms which either foster or impede creativity and incentives for adoption. For the research and development community, institutional capacity provides clear signals (and sometimes boundaries) for addressing challenges and avenues for disseminating contextually relevant and permissible options for addressing these challenges. For adopting farmers, institutional capacity within the region continues (at least within irrigated production systems) to be based on expectations of the state in terms of production choices and economic incentives to foster the production strategic commodities.

The role of extension and advisory services, within the framework of national innovation systems, plays an important role in access to knowledge for farmers as well as in the flow back of knowledge for more effective technology development. In moving away from a historical concentration on linear technology and dissemination approaches, from research to farmer through public extension services, there has been much global attention paid to fostering more inclusive and participatory approaches for innovation. Yet, for Central Asia, public systems of agricultural extension did not exist within the Soviet Union, given that collective farms were linked directly to state plans for productions, and systems for technology dissemination which were mandated to meet these plans embedded within state farms. The advent of both public and private extension and advisory services is therefore in its infancy within the region. Where governments maintain state plans for key strategic commodities, knowledge delivery continues to be in the form of advice (sometimes edicts) which is aimed at ensuring that state quotas for production are met. Within such an environment, the creative role for research in seeking solutions to mitigate environmental harm is often limited. Research mandates are therefore shaped by a national desire for productivity increases of key strategic crops, with potentially limited interest in production systems which embody sound environmental underpinnings. This has a direct impact on the availability choices for farmers to experiment with and adopt SLM technologies or practices, and poor incentives for national centres of research to uncover alternative land use management practices which are based on 'optimal' crop mix choices. Optimality in this case is defined as an index of social, economic and environmental concerns which are based on priorities that are of both public and private interest; and in the production of a diverse range of crops which are of importance for food and nutritional security as well as export revenue.

For a number of Central Asian economies, institutional norms and knowledge delivery is largely geared towards the production of cash crops (predominantly cotton), which are of importance in attaining foreign currency through trade; and wheat, which continues to be a significant drain on the national treasury given high levels of import to support domestic consumption and therefore a desire to reduce the gap between national production and consumption. Why Central Asian republics continue to concentrate heavily on state led production of cotton is a matter of political economy; and particularly so given what appears to be a lack of profitability in the production of cotton (Kassam, 2011). Notwithstanding issues of choice in the range of crops produced on irrigated land areas, concerns related to land tenure, and specifically the ability to collateralize land in order to access credit and finance limits the ability and incentive for fostering paradigm shifts from conventional land use management practices to more (contemporarily) environmentally sound practices on rain fed lands. A close connection between state policies on quotas and national production plans is therefore inextricably linked with policies on land tenure but with distributional impact. As a case in point, Uzbek farmers are able to avail of state financing mechanisms in the production of cotton and wheat, including crop loss insurance, but the same level of access is not accorded to farmers producing tree fruits, forage crops or livestock on rain fed or marginal lands. Here, financing for cotton and wheat is provided on the basis of land placed under cotton, verified by local authorities, and production of which is delivered to

the state. Where production of non-cotton crops is destined for local or national markets, opportunities for credit and finance are limited to informal channels.

Figure 2, in essence, depicts the notion of national capacity to innovate in so far as it provides a number of areas which are of significant importance for sustained innovation (inclusive and participatory knowledge generation, knowledge dissemination and enabling environments). Capacity for knowledge generation and dissemination can be understood as the ability of knowledge generators to achieve societal outcomes through discovery and experimentation, learning-by-doing, demonstration of innovative approaches and dissemination of approaches which are contextually relevant. The capacity to develop contextually relevant technologies within specific agro-ecological zones and climatic conditions is, however, not strictly limited to hard infrastructure or embodied knowledge in the form of machinery or seed. To be sure, technology in its broader form includes innovations which are related to organizational innovations (contemporary cooperatives, financial institutions, et cetera) as well as soft technologies in the form of improved production practices and knowledge which fosters shifts in mindsets and behaviour. Viewed in this manner, the laboratory for development and testing is not strictly limited to a physical place, but extends into the realm of social and psychological arenas such that existing social, cultural and political norms evolve with contemporary challenges and needs. While these needs are generally related to reactive measures, such as in the face of climate change, an enabling environment which concurrently supports more proactive approaches for enhancing environmental and human well-being through foresight requires dedicated resources (financial and human) as well as supportive policy. We are careful, however, not to romanticize such a framework given potentially negative feedback loops. For instance, increased variability in access to water resources and frequent bouts of drought can affect economic capacity as well as hinder effective generation of knowledge for enhancing sustainable land use management practices. The ability to bear risk and to take calculated risk in the face of uncertainty is an inherent component of capacity to innovate and in the adoption of sustainable land use management practices. State plans for specific commodities are not necessarily conducive to an enabling economic, policy and institutional environment which mitigates risk, given a lack of support in the ability for choice in production practices (including crops) which embody sound environmental underpinnings and diversity in crop choice. Equally important are the lack of incentives to invest in sustainable land use management practices when rights to land are not clear and inequitable in terms of ownership between men and women; and when knowledge delivery systems are limited to those which are geared towards ensuring that national production targets are met, as opposed to efficiency in production.

# 3. Barriers

## *3.1. Institutional capacity*

Within Central Asia, in general, there is an ostensible lack of a systemic approach in both uncovering contextually relevant technologies and practices for sustainable land use management as well as in fostering more inclusive enabling environments to support broad uptake and adoption. A continued emphasis on traditional commodity based focus policies and plans with a wide variety of reform in policies, legislation, and state organizations is an aspect of political economy which is endemic within the region. To be fair, one could reasonably argue that agricultural reforms within the region have simply been delayed and not avoided. To be sure, there are widespread differences in how republics within the region have approached reforms in terms of both breadth and speed. A civil war in Tajikistan shortly after independence delayed the process of structural adjustment and took the republic onto a different trajectory. Uzbekistan has taken a more cautious approach, largely due to the heavy influence of cotton production to national revenues and GDP (Pomfret 2008a, 2008b). Kazakhstan has divested the role of the state in agricultural production but continues to maintain significant policy influence and state provided incentives in the production of wheat, a key national strategic commodity. Kyrgyzstan

has been the most active in terms of enhancing structural reform but with some concern in terms of issues of equity and in relation to land ownership rights.

Kyrgyzstan is considered more advanced with respect to land reforms and its farmers now maintain a large share of land under private use (Lerman 2009). Yet, with over 400 thousand private farms established, most of them neither have the means nor the capacity to manage land sustainably given weak institutions which impede coordination of small-scale farmers to share responsibilities in managing resources (Kazbekov et al., 2007). Accordingly, land fragmentation in farmers' plots continues to impede productivity growth in agriculture. In Tajikistan, Turkmenistan and Uzbekistan, land reforms are incomplete. Initial reforms in irrigated agriculture were in line with a pre-independence movement for *destatization* as opposed to *land reform* (Kassam et al. 2016). The nature of lease agreements and the fragility under which lease agreements were (and are) being honored is indicative of devolution of direct state intervention in the planning of key strategic crops and not necessarily privatized ownership of land assets. In these countries most of the land is not in private use, and farmers lease the land from the state. When land ownership is unclear or under threat of confiscation, the incentives for investing in sustainable land use technologies and practices is minimized. Land tenure insecurity in Turkmenistan and Uzbekistan has been argued to be one reason for why farmers prefer not to invest in conservation agriculture (Sommer and De Pauw, 2010), while in the Kyrgyz Republic farmers own the land but do not adopt such practices (Gupta et al., 2009) indicating that secure land tenure may be a necessary condition in the decision to invest, but not sufficient on its own for adoption of sustainable land use management practices. Supportive institutions and policies which enhance both having access and gaining access to affordable financial instruments (credit and insurance) as well as in access to markets for both inputs (seeds, fertilizer, equipment, labour) and outputs are still in their infancy within much of the region, at least in so far as private production is concerned.

Within Turkmenistan and Uzbekistan, and to some extent Tajikistan, crop production policies for cotton and wheat continue to function within the norms of the Soviet Union in terms of both planning and norms related to input use, thereby orienting the sector towards providing suitable conditions and resources for fulfilling the state target crop output (Spoor, 1999). While Spoor's argument was made within the first decade of independence, not much has changed in contemporary Turkmenistan and Uzbekistan. Public subsidies, through priority in the supply of irrigation water, timely access to fertilizers and other agricultural inputs, together with directed marketing and set prices support state strategic crops. For those farmers who lease irrigated lands, contracts with the state for cotton and wheat permit security in the form of access to productive inputs, subsidized credit and crop insurance mechanisms; yet, the incentives for both classes of farmers are not necessarily conducive to investing in sustainable land use management practices (Kassam et al. 2016). In Tajikistan, there is some evidence to suggest that state driven systems for cotton production provide incentives which lead to an indifference between the production of cotton for the state and wheat for private sale in local markets (Kassam, 2011). This indifference can only occur when there are poor incentives and low profitability in private production. In such cases, an uncovering of opportunities for how to leverage public investments in the support of state strategic crops with opportunities for improving profitability of private production through efficiency in local markets is one of immediate and contemporary concern.

Despite the range of reforms undertaken by each nation state, one observable trend is the lack of knowledge and delivery systems which support systemic approaches to agricultural production; and a reliance on piecemeal approaches which are supported through internationally funded projects. Independence from the Soviet Union led to a cadre of farmers who were not familiar with non-state led production and marketing systems, as well a significant number of new farmers (previous state employed doctors, teachers, technical personnel) who had inherited land use rights within dismantled state farms. Given unfamiliar territory and a range of emerging issues, a heavy reliance on international donor support was natural and continues today in terms of short to medium term project initiatives in a wide range of areas. One drawback of such support has been continuous delays in the formation of

effective national systems of agricultural innovation, supported through an enabling policy environment, and given piecemeal approaches with somewhat uncoordinated project delivery mechanisms. Short (3 to 5 year) project funding cycles inevitably result in the delivery of knowledge through consultancy and project specific technical advice. With the closure of projects, there is little in terms of coordinated systems for knowledge generation and delivery which are left behind, and particularly so when knowledge delivery has been provided through the engagement of international consultants. When international development agencies engaged in initiatives within the agricultural sector are not directly in contact with systems of national and international research, the use of on shelf technologies are prevalent. How effective these are within different contexts, and the efficacy with which they are disseminated remain unanswered, at least in terms of empirical enquiry and independent oversight. Perhaps even more concerning is a general ineffectiveness of approaches developed and lessons shared within the international development community, and between the development and research community. Notwithstanding literature devoted to promoting outcomes achieved, there is little in terms of lessons learned (inclusive of shortcomings) which are able to aide in the reform or promulgation of national policy in relation to knowledge generation and delivery systems.

## *3.2. Economic capacity*

Some three decades after the collapse of the Soviet Union, the republics of Central Asia have made notable efforts to restructure their agricultural sectors through a variety of structural and policy reforms. These measures have varied throughout the region, both in terms of speed and manner of implementation (Spoor and Visser 2001, Djanibekov and Wolz 2015) and particularly so for those which relate to issues related to land and water resources. In all countries, the transition from a planned to a market economy has been driven by mixture of economic objectives (Csaki and Nucifora 2005) and conditioned by geo-politial concerns. Many have been influenced by natural resource endowments and the need for economic independence, with often little regard for household demographics and availability of labour within rural areas. Large collective production units were replaced by smaller individual, often family-based farms (Lerman et al. 2004), or through land reforms were nonlinear (Djanibekov et al. 2012) and which did not take into account cultural and social norms which have regained much importance after independence. In Kyrgyzstan, land tenure rights accord equality in ownership between men and women, under law, but in conflict with cultural norms within rural areas which frown upon female land ownership. With significant out migration of males for employment generating opportunities, the ability for women household heads to collateralize land, in order to access formal systems of credit and finance is limited, and with implications for investments in sustainable land use management practices. While this is true for the Kyrgyz Republic, other republics have been generally slow in adopting policies aimed at relaxing the ability for collateralization of land assets and in the privatization of land.

Large farms continue to dominate in the rainfed grain producing areas of Northern Kazakhstan, while post-Soviet reforms across the rest of the region have resulted in a progressive increase in the number of small units. Without significant investment in the maintenance and replacement of physical infrastructure, together with a lack of private economic incentives, productivity and efficiency of land and water in agricultural production has clearly been impacted (Lerman and Sedik 2009). Agricultural sector restructuring has been oriented towards a strategy of export revenue generation (such as via cotton production in Uzbekistan, Turkmenistan) or with no coherent strategy such as in Kazakhstan and Tajikistan for most of the 1990's (Pomfret 2008a, Pomfret 2008b) and with continued difficulty today. In Uzbekistan and Turkmenistan, farmers are required to place a significant share of their farmland under cotton (for export) and wheat (the backbone of food self-sufficiency policy), both of which are nationally mandated strategic crops (Pomfret 2008b). Such institutional settings influences the flexibility of farmers' decision making and limits their economic capacity (revenue from these two crops) to invest in contextually relevant SLM technologies. Provision of more flexibility in crop choices and decisions on land use may lead to diversification and broad uptake of SLM practices and technologies (Bhaduri and Djanibekov 2015, Djanibekov and Khamzina, 2016). While there are a number of good economic and geo-political reasons to suggest why a number of republics will likely need to maintain control over the

level of production of key strategic commodities, there are limited arguments for why this cannot be undertaken through innovation aimed at incorporating sustainable land use management practices within state mandated plans and targets. These, among others, include a shift towards the production of organic cotton (Franz et al., 2010) and no-till wheat (Nurbekov et al. 2016), with beneficial outcomes related to improved livelihoods and reduced pressure on land and water resources.

Limited adoption of SLM technologies is not, however, limited only to lands under the production of key state strategic commodities. In those regions where land privatization has been successfully attained, and in the production of non-cotton and no-wheat commodities, land fragmentation has proven to be a disadvantage to productivity growth (Lerman 2013). One reason for this is that the restructuring of institutional capacities to support newly established systems of small farm production took considerably longer than the process of farm restructuring (Djanibekov and Wolz 2015). Historical services provided within former state farms, such as large-scale machinery, intensive fertilizer application, centrally-managed irrigation facilities or technical services were not replaced quickly enough in order to serve the newly established small farms. Equally important is a continued delay in the entry of private and public providers of financial services, marketing, the delivery of supplies and equipment, and extension/advisory and information services, with densely populated regions and farms reliant on irrigation facilities and labor-intensive sectors (e.g. fruit and vegetable or livestock farming) relatively more exposed to these deficiencies (Djanibekov and Wolz 2015). While this is generally true for the region as whole, specific examples of state led efforts at inducing the uptake of SLM technologies do exist.

Subsidies provided by the Kazakh government of approximately 6 USD $ha^{-1}$ in the delivery of incentives for adopting no-till production has accelerated adoption but is largely restricted to large land areas under agricultural joint-stock companies (Kazakhstan Farmers Union, 2011). The establishment of fruit plantations, through public subsidies in Kazakhstan, is equally focused on large land areas, with a minimum of 5 hectares and requirements for installation of drip irrigation technologies for consideration of state subsidies (Lapeña et al., 2014). These types of programmes and policy continue to reflect the states desire for mandating agricultural production in terms of type of crop, as well as volumes, and which may not be in line with the needs and aspirations of small private farm households. For this cohort of farmers, existing Soviet built machinery is of little relevance given issues of size and efficacy. With small landholdings, Soviet equipment designed for large land areas are ineffective and import of smaller equipment limited by the nature of profitability and availability of private machinery service providers within rural communities. Where the state continues to embrace economies of scale in agricultural production, while still maintaining a desire for land reform and privatization, it is easy to understand why there continues to be limited (though growing) numbers of private knowledge and technical service providers targeting small farm holders.

Notwithstanding concerns regarding the crowding out of private services, public subsidies and incentives do have an important role to play in so far as considerations related to environmental services. One challenge faced by farmers in the decision to adopt SLM practices is delayed economic returns given a lag between investment and return in terms of higher yields. While farmers are naturally inclined to focus on economic benefits, the benefits of SLM adoption of environmental and ecosystem services are typically neglected given their public good nature. For example, survey analysis reported in Djanibekov (2015) revealed that farmers in northwestern Uzbekistan are not familiar with the range of ecosystem services provided by afforestation on degraded cropland, e.g., land rehabilitation and climate change mitigation, or fail to recognize them and thus their perceived value is low. In the same study, farmers also mentioned that they would start to adopt such land use practices if they observed the benefits and adoption by other farmers.

## 3.3. Knowledge and technological capacities

A rich knowledge base of technologies and practices which are able to contribute to SLM is now available. Yet, while many research and developmental programmes engage in the development or contextual adaptation of SLM technologies, there is often little in terms of systems for effective dissemination of knowledge and technical services to support adoption. At the same time, there are global as well as regional initiatives which compile synthesize the stock of best practices into accessible databases. Of the many global initiatives, World Overview of Conservation Approaches and Technologies (WOCAT) is worthy of mention given that it has systematically collected SLM practices and technologies globally, and assessed and described these within a unified template. Such initiatives provide an opportunity for workable solutions, both simple and complex, to be available and accessible through print and online media.

Central Asian Countries Initiative for Sustainable Land Management (CACILM) is an initiative that has been operational since 2006 and has also contributed to the collection of tested SLM options now housed on the WOCAT database. In parallel with, and supporting the WOCAT database, a more recent undertaking within CACILM has led to the development of a regional *Knowledge Sharing Platform* led by the International Centre for Agricultural Research in the Dry Areas (ICARDA). This recently established knowledge sharing platform (www.cacilm.org) aims to collect, share, develop and promote contextually relevant SLM which have been deemed to be of value by national countries as well as those drawn from external databases and found to be suitable for adoption within the region.

**Error! Reference source not found.** indicates seven selected types of SLM technologies, grouped by production systems, described in detail in Mirzabaev (2016).

Table 1. Types of SLM technologies in different production systems of Central Asia

| SLM types | Rainfed | Irrigated | Pasture | Mountains |
|---|---|---|---|---|
| Agroforestry-amelioration, agroforesty, reforestation/ improving of soil vegetation cover | KZ, KG, TJ, UZ | TJ, UZ | TJ, TM, UZ | TJ, TM, UZ |
| Cultivation of slopes, erosion prevention | KG, TJ | KG, TJ, UZ | TJ, TM | TJ |
| Improving methods of sowing/ planting crops and soil tillage | KZ, KG, TJ, TM, UZ | KZ, KG, TM, UZ | UZ | KG, TM, UZ |
| Improving rangeland/ fodder production | KG | KG | KZ, KG, UZ | KG |
| Increase of soil fertility | KZ, KG, TJ, UZ | KZ, KG, TJ, UZ | | KG, TJ, UZ |
| Increasing capacity of land users/environmental education | TJ | KZ, TJ, UZ | TJ | KZ, TJ |
| Management of water demand (improving of furrow irrigation and resource-saving irrigation technologies) | KG, TJ, TM | KG, TJ, TM, UZ | | KG |

Source: CACILM (2016) Database (http://www.cacilm.org/en/visual/table).
Note: KZ – Kazakhstan, KG – Kyrgyzstan, TJ – Tajikistan, TM – Turkmenistan, UZ – Uzbekistan.

Availability of SLM options does not however necessarily translate to successful adoption. In order to address the validity and potential of SLM technologies, techniques and practices, there is an urgent need for similarity maps at a regional scale for Central Asia and ones which can assist public, private and developmental organizations with relevant information to support broad uptake. Similarity maps identify areas/locations/ecosystems where a particular SLM has the potential for success, based on environmental criteria. Suitability analyses is fine-tuning of similarity analyses with more specific data and resulting in information relevant to classifying areas/land as highly, moderately, or marginally suitable for particular SLM. Harnessing resources for such an initiative, and political will to support the

same, requires continues national, regional and international advocacy in parallel with the development of more effective and contextually relevant systems for knowledge generation, dissemination and within the framework of national systems of innovation.

An analysis of existing rural advisory services within the region (Kassam et al., 2016) indicates a number of challenges to efficacy and effectiveness. These include: (i) limited and erratic funding, largely through international donor support or limited fee for service revenue; (ii) short-term (project based) focus with limited geographical coverage; (iii) insufficient attention in building coordinated (national) systems of innovation; (iv) obsolete curriculum within universities and vocational institutions which largely fail to introduce the notion of sustainable land use management; and (v) largely ineffective (farmer-to-farmer) knowledge transfer systems.

The combination of these barriers inhibits implementation of SLM practices, and particularly within low priority forestry and pasture use sectors. While positive examples of pilot initiatives in the field on pasture management, joint forestry and community forest management, crop diversification, and conservation agriculture in rain-fed areas exist, and demonstrate principles to be applicable within the region, successful piloting of SLM interventions have limited geographic coverage and remain restricted to tested location or cease to continue once the project or intervention cycle is completed. Better, and more effective linkages between the communities of national and international research, civil society and international development agencies is critical in this regard, in order to strengthen practical experience and know-how of key national and local authorities of selected approaches and practices which can be most effectively applied in the field and locations which are more likely to result in success. These types of collaboration, still in their infancy within the region, would be on good footing for enhancing knowledge dissemination and successful broad uptake of SLM practices – but only when there is a paradigm shift in mindsets such that historical norms related to land use management are not based on a commodity or sectoral focus. Conventional approaches for agricultural production within the region generally adopt the stance that arable land is only for crop production, rangelands must be used for livestock production and forests are limited to engagement in the production of wood. The notion of multi-functionality in land use has not been firmly adopted in the post-Soviet era and is one critical constraint in the acceptance and adoption of sustainable land use management practices.

# 4. Conclusions

Agriculture will, for some time to come, continue to be a key sector for livelihoods and well-being for supporting the largely rural based population within Central Asia. A contemporary focus on natural resource management is therefore crucial, and particularly so given significant evidence of environmental damage through the prolonged transition since independence from the Soviet Union. Despite significant investments in research and knowledge dissemination, technologies and approaches for enhancing sustainable land use management have not been taken up at scale within the region. In large part, this can attributed to a general lack of supporting policy mechanisms, as well as a growing dependence on internationally financed project based support - with short time horizons - and lack of attention to sustainable (business driven) approaches to agricultural innovation. A continued desire for national plans to support the production of cotton within a number of Central Asian republics limits the economic incentives for private sector participation within the process of innovation. Equally important has been continued international attention on the process of land reform (or lack thereof).

Secure land tenure is a powerful entry point for addressing issues of land degradation, resilience in the face of climate change, and in ensuring sustainable livelihoods for rural populations. In the absence of such, a number of options exist in order to achieve a second best solution, and which are likely to yield a range of desired outcomes in relation to investments in sustainable land use management practices as well as *agrarian reform* more generally:

Desirable outcomes from land privatization include those of efficiency within economic theory; and when concurrently analyzed through gender based theories and arguments, for inclusivity, equity and well-being. However, when privatization is not an option due to issues of polity, there are alternative measures for approaching benchmark indicators and particularly in terms of influencing sustainable land use management practices. The ability to trade lease agreements can provide a strong measure of efficiency, in terms of ensuring greater measures of productivity and investment through the placing of market-based economic values on lease rights. Yet, in an environment where land privatization has been delayed for ostensibly policy related reasons, tradeable lease rights may have limited appeal. A second best option is to permit the ability for farmers to collateralize lease agreements. In most republics, farmers are provided access to land on the basis of long term lease as opposed to ownership through evidence of a certificate and a functioning land cadastral system. Two immediate beneficial outcomes can arise from the ability to collateralize lease agreements. The first is a sense of security in terms of land use rights, both in terms of lower perceived risk of loss to rights, as well as in terms of the incentive to invest in soil health and land productivity. The second, linked to an incentive to invest in land productivity, relates to an ability to access finance to adopt and adapt sustainable land use management technologies. With freedom in crop mix choice, even if influenced by economic incentives for production of key state strategic crops, the ability to collateralize land provides powerful incentives for investing in sustainable land use management practices which may be compatible with both private and public interests for agricultural production.

The contemporary challenge for Central Asian countries remains one of an overwhelming (external) focus on land reform, as opposed to agrarian reform, and leads to a lack of acknowledgment that the republics have taken a various paths to reform. More specifically, there have been significant policy reforms enacted over the past three decades. Where key reforms have not been undertaken, concerns over instability and geo-political concerns have influenced a cautious move towards reform. Notwithstanding these contextual challenges to policy reform, shifting the focus to agrarian reform is likely to be more conducive to the development of a range of innovations to support sustainable land use management. These include, but are not limited to, organizational innovations in the form of more contemporary cooperatives (service, marketing, producer, et cetera) as well as institutional innovations in the form of permissible access to finance mechanisms and access to both private and public extension and advisory services. Equally important is the need for inter-sectoral linkages and particularly in terms of linking agricultural production to issues of nutritional security within rural areas.

How ready national governments within the region are in effectively supporting the development of, and incentivizing the adoption of sustainable land use management technologies continues to remain a question of political economy. One immediate area of attention which would appear to be relevant, therefore, is for a paradigm shift away from commodity based and sectoral planning of land use management, towards a greater appreciation for multifunctional land use production systems which embody sound environmental underpinnings.

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