Innovation and Knowledge Adoption for Local Firms in the Value Chain: The Story of "White Gold" from Uzbekistan*

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Despite the end of the Soviet era, cotton production continues to play a major role for the economies of Central Asia, regularly named the "white gold" of Uzbekistan. The present paper looks at the current system of cotton production as state-order crop in Uzbekistan and discusses possibilities of integrating environment and innovation in the value chain subsystem as an effort to move away from exporting cotton as raw material towards developing a cotton processing industry. Through a game theoretic and value chain mapping, we conducted an assessment of the likelihood of cotton farmers adopting knowledge and technology *vis a vis* government price. We showed that the adoption of innovations in the agricultural production and processing sectors in Uzbekistan is hampered by strict state norms, as well as by a lack of support services, and legal, social and market infrastructure. Current production quota system is accepted by the state officials as an incentive for farmers to produce cotton rather than switching to other crops. In reality, low procurement price for cotton causes the principal-agent problem where farmers overexploit natural resources by growing marketable but more water consumptive crops like rice instead of following the government quota. The data analysis argues for a reduction of state control over the agricultural sector in order to increase the space for bottom-up creativity and knowledge adoption to take place. While the chosen game theoretical approach is limited in acknowledging the top-down planning structures of Uzbekistan, it achieves to empirically illustrate bottom-up potential for, further developing the cotton processing industry through knowledge and innovation adoption by individual agents.

Keywords: knowledge-adoption, innovation, value chain, Uzbekistan, agriculture.

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1 Introduction

In an increasingly fragmented but cosmopolitan world, the means of production in international production networks has shifted. Firms break down the value chain into discrete functions and locate them wherever they can be carried out most effectively and where they are needed to facilitate the penetration of important markets (Ernst, et.al: 1998). Liberalization in a way has cemented the ways for value chain to flourish, though to gain full benefits of this a concerted effort from the government should be taken at the national and local level (Humphrey: 2004). Studies have been carried out to show how governance structure affects the value chain (Gereffi: 1999, Humphrey: 2004) or to explain the different trajectories of upgrading within the value chain (Kaplinsky, Morris: 2002). This includes the difficulties in transferring so-called tacit knowledge between firms (Saliola, Zanfei: 2009). Tacit knowledge is defined by Polanyi as "knowledge that is known but cannot be told." There are difficulties in articulating it because it has become internalized in the unconscious mind (Polanyi: 1967, Yue Wah Chay, et.al: 2005). However, current approaches in looking at knowledge in value chains are deficient. Notably, the assumption is that by conceptualizing knowledge as tacit knowledge and by looking at embededness and/or bounded groups (Bair, Gereffi: 2001, Sengenberger, Pyke: 1991, Morrison, Rabellotti: 2005) one can at least deal with the issue of knowledge transfer. In fact it is much more complex than this (see, Engel: 1990, Long: 2001). Knowledge is often associated with power. This includes political system as demonstrated by Flyvbjerg that in modern societies, what makes one party more powerful than other is by and large determined by its capacity to facilitate or control knowledge (see: Meusburger: 2008). The complex picture of knowledge should at least touch upon this issue of power and political system.

The main issue to be discussed in this paper is the assessment of the need and possibility of firms in this case cotton farmers to adopt knowledge and to innovate. This article will try to contribute in this area by identifying the barriers in adopting knowledge especially in the context of where strict state control exists. The term of knowledge will be referred to as 'intangible' resource and will be used, generated and transformed by multiple actors and firms at the local and global level. The process of transforming and adapting knowledge is a social process on which individuals or groups continuously alter and adapt their knowledge in response to changing intentions, opportunities and circumstances (Long: 2001). Included within is the changing of ecological circumstances and economic situations. Firms in this paper however shall be used to refer to local farmers.

This article will describe the difficulties of knowledge adoption using a case study, in the title noted as a "story", relating to an agricultural value chain: namely the Uzbekistan cotton value chain. The Uzbekistan cotton is a "white gold" which refers historically as a chief cotton-growing region of the former Soviet Union. Moreover cotton has been the main source of hard currency from exporting. In the 1990s, cotton provided more than 70% of national export (Curtis: 1996). Uzbekistan is by far Central Asia's biggest cotton producer (International Crisis Group: 2005). Within the country internally, this cotton gained importance as state ordered norm as well as quota are in place (Veldwisch: 2008) to ensure the production of this agricultural product.

The reason of opting Uzbekistan is due to post-soviet history surrounding the political-economy system. It is a developing country that still enforces relatively strong norms on its economic and political aspects (Veldwisch: 2008, Hornidge et.al: 2009, Wall: 2006). Agriculture still remains a vital sector for many developing countries (Pardey et.al: 2006).By focusing on a case study of agricultural value chain namely cotton in Uzbekistan, hopefully one may grasp the problems and challenges of knowledge adoption for upgrading in local firms in developing countries.

The theoretical construct of the analysis will be carried out through mapping and game theoretic analysis. The map will incorporate a technological and environmental element to describe the process of cotton production in Uzbekistan. Then, game theory will be used to explore the possibilities of local firms in Uzbekistan adopting new knowledge to move up in the local value chain. In this case, game theory will be utilized to observe what would occur if government of Uzbekistan undertook a liberalization measure specifically to relax the procurement prices of cotton and how this would affect farmer decision on innovation at the farm production level.

Based on the analysis, we contend that knowledge adoption and acquiring new technology by local firms would enable them to move up in the value chain, but in order to do so there should be a reduction for state control. However, these processes of learning are complex and non linear (Roeling, Fliert: 1994), as such they require diversity of learning processes to allow a bottom up creativity.

The structure of this paper will be comprised as follows; the following part will discuss in general the agricultural based value chain. The third part will focus in mapping the value chain in Uzbekistan taking into account the environments and mapping barriers to innovation. The fourth part will delve in the game theoretic approach in the cotton industry in Uzbekistan. The fifth part will conclude and provide policy proposal.

2 Towards an Agricultural-based Value Chain

Value chain analysis is essential as it can assist with the estimation the value added to processed commodities, as well as to identify potential bottlenecks and options for further development. At the same time, the essentiality lies in the fact that the value chain can uncover power relations by agents/players in the value chain which often cannot be unmasked in developing countries due the prevalence of formal-informal work (Kaplinsky, Morris: 2002).

Value chain is described by various literatures in many different ways, some defined it from an economic perspective, some more to a governance perspective. According to Gereffi (1994), a value chain is defined in four different strands, first, as input-output structure with the flows of raw materials, intermediate goods and finished products as well as knowledge linked together in the process of value creation. Second, a map of the geographic concentration or dispersion of production and marketing networks comprised of a chain actors. Third, a governance structure, understood as authority and power relationships that determine how financial, material, and human resources are distributed within a chain. Last, is an institutional framework provisioning the national and international context for the interaction of chain segments.

Current developments have attempted to integrate the environment in value chain analysis (Faße et.al: 2009), owing to the fact that economic activities, and particularly agricultural production, are largely based on natural resources. The environment also provides the capacity to dispose of emissions and waste. In addition the environmental impact of products has become a major aspect of environmental policy programs (Boons: 2002).

This paper attempts to provide a consistent regional agricultural value chain, including all agricultural commodity production processes. In addition, the chain map allows the potential for technological improvement as well as knowledge adoption to be assessed. The map will provide a portray of knowledge exchange, and possible threats to the environment at every stage of the chain.

3. The "White Gold" of Uzbekistan: A Value Chain Map

3.1 Cotton and the water context. A starting point for a value chain analysis

Agriculture is the backbone of Uzbekistan's economy, contributing almost one-third to the annual GDP (year of 2000) and about 50% of the regional domestic product in regions like the Khorezm province in the northwest part of the country (Abdullaev et.al: 2009; Rudenko: 2008). As in whole Central Asia, irrigation has been determinant to maintain agricultural production due to the dry mid-latitude desert climatic conditions and an annual precipitation of 100-300 mm (Ibragimov et.al: 2007). But the issue of concern when referring to agriculture and environment in this area is the overuse of water to maintain high levels of production of the so called "white gold" since times of the former Soviet Union, putting water under stress as an available resource (Kuzmits: 2006). Up to now, and as in the previous centralized system, newly formed farmers still have to follow government orders on main crops (cotton and wheat), which occupy almost 70% of the total irrigated area (Figure 1).

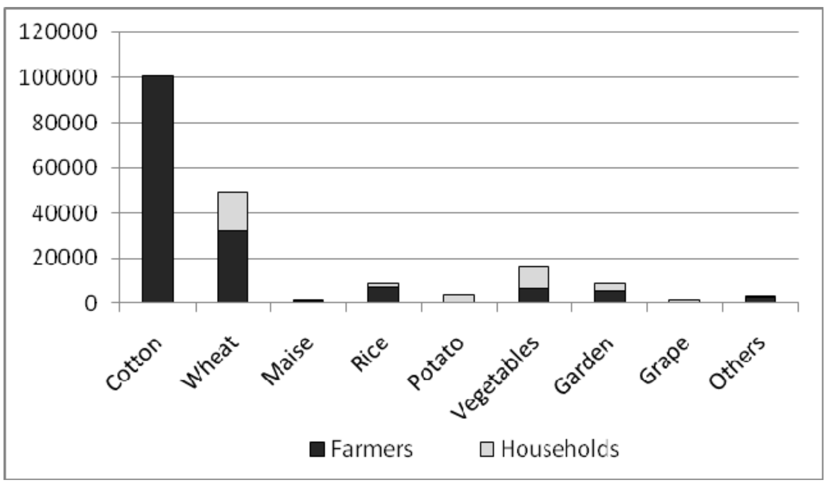

Fig. 1. Crop land structure in the Khorezm region. Source: OblStat (2008).

Around 90% of the total water budget in Uzbekistan is destined to irrigation (UNEP: 2005). The large increase of nonreturnable consumption of water from the Amu Darya River and the consequent decrease of runoff in the lower course of the river, has led to the progressive and irreversible desiccation of the Aral Sea, by many accounts the worst environmental tragedy of the twentieth century (Selyametov et.al: 1992; Baffes: 2005). Thus, water and environment play a significant role in the cotton and agricultural production in Uzbekistan.

3.2. A local agricultural value chain map for the Khorezm region, Uzbekistan

Since agricultural production strongly relies on irrigation water in the region, irrigation processes should be considered for a proper development of an agricultural value chain. Figure 2 illustrates a local value chain map that incorporates production, environment and technology sub-systems. The production sub-system starts from irrigation process ending at domestic or external consumption via farm production and processing. The technology sub-systems at the right side of the chart provide possible options of modernization in each level of the chain, while the environmental sub systems at the left side of the chart show the environmental impacts of each stage. The chart allows the identification of economic, financial, legal, social, and business problems in each part of the chain that hinder development of the agricultural and processing sectors in the Khorezm region.

The actors in the cotton value chain are identified as follows: the private farms which are mostly independent enterprises taking part in the agricultural production on leased lands, the ginneries which are the industries or factories assigned for processing raw cotton, the oil extracting companies as well as textile companies (Rudenko: 2008). Cotton production and processing heavily rely on farmers for production and firms for processing (Rudenko: 2008).

Soil salinization and waterlogging in downstream areas like Khorezm (caused by the steady accumulation of salts due to capillary rise and evaporation of highly mineralized groundwaters) are the most severe environmental issues threaten the production not just of the main cash crop (cotton), but also important food crops for local consumption and sale (Selyametov et.al: 1992; Wegerich: 2001). The intensive surface irrigation in the prevalent mono-cropping system is also causing soil erosion and loss of organic matter, which in addition greatly reduce not only the sustainability of agriculture, but the long term security and income of rural communities.

Furthermore, the water shortage is being aggravated by the poor functioning and imperfection of the irrigation infrastructure due to the absence of watertight linings on the irrigation canals, the lack of water controlling instruments for flow rate, and accumulation of erosion sediments in the drainage systems (Hedge, Toderich: 2009; Selyametov et.al: 1992).

With respect to agricultural practices, the massively overuse of agrochemicals in the area (UNEP: 2005) must be considered as well. By 2005, up to 66% of irrigated fields in Uzbekistan were reported as polluted and some chemical concentrations exceeded standards twenty or forty-fold (Strickman, Porkka: 2008). Much of the drainage effluent from fields, along with sewage and industrial wastes, is returned directly to waterways, and these waters are used for drinking, washing, and further irrigation (Strickman, Porkka: 2008).

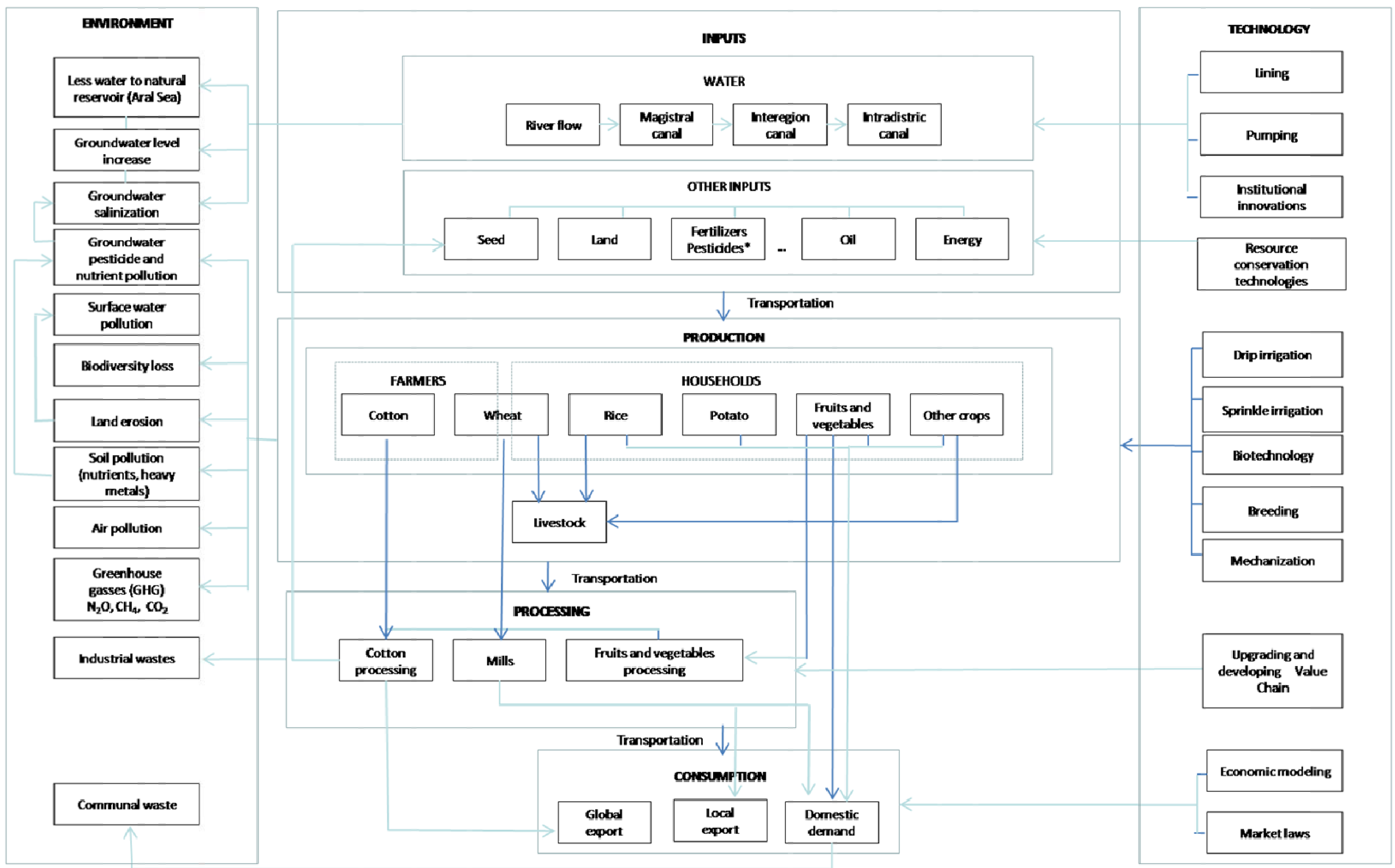

Fig. 1. The agricultural value chain of the Khorezm region and its relationship with technology and environment subsystems, Uzbekistan. Source: own presentation.

Apart from agricultural practices, the impacts of processing sector are also crucial. In the industrial stage, there are two major impacts on water: extraction of process water from surface or groundwater, and pollution of water as a result of the waste flows from the cotton processing industries (Chapagain et.al: 2006). In fact, in most developing countries, wastewater treatment remains below 5% (Eurostat: 2005, Hoekstra, Hung: 2005).

Taking into consideration the aforesaid issues, it can be seen that there is an imperative need for policies, practices and technology that allow to use water efficiently in all levels of water conveyance, distribution, and application, alleviate pollution related problems and increase efficiency in agricultural production and processing as well as develop agro-processing industries instead of exporting raw cotton. However, without technological improvement, low spending on environmental improvement potentially threatens food security and rural livelihoods in the region and economy and environment could still be negatively impacted as depicted by the lines Economy- and Environment- in a perspective scenario in the Figure 3. Thus, technological improvement and a strong knowledge base would provide a realistic sustainable economic and environmental scenario for firms to upgrade.

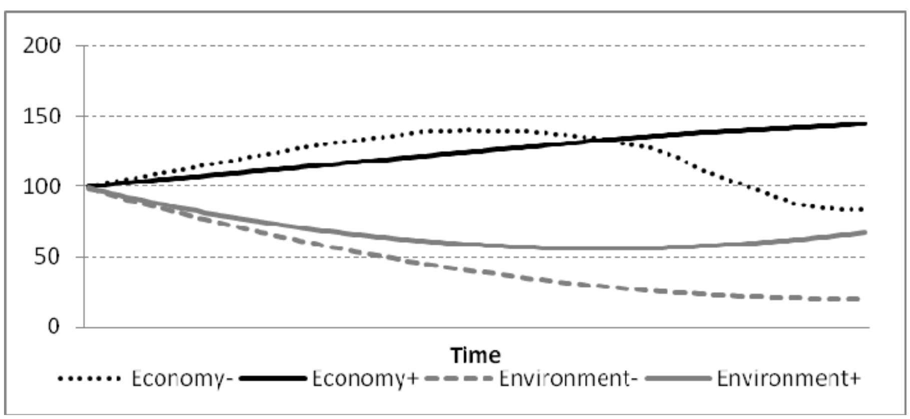

Figure 3. Economic and environmental state with and without technological improvement. Note: numbers are optional and only for illustration purposes. Source: own presentation.

Regression analysis on the basis of World Bank data across some countries also proves a positive fairly strong relationship between the expenditures on Research and Development (R&D) and agricultural productivity (r^2=0.43, Figure 3). For example, 1% increase in R&D expenditure would provide 1.3 % growth of agricultural productivity.

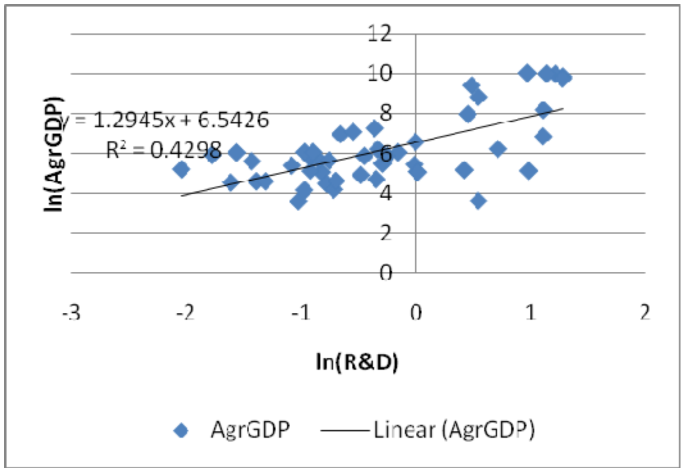

Fig. 4. Relationship between agricultural R&D expenditure and agricultural productivity. Source: own results on the basis of data from the World Bank (2007).

3.3. Barriers for knowledge adoption

Despite attempts to liberalize or privatize markets in Uzbekistan, in reality little change has really occurred. Since procurement prices for cotton and wheat are set much lower than alternative market prices there is no incentive for farmers to invest in land and water conservation technologies. The domination of administrative methods of regulation does not permit the world-experienced technologies and progress in agricultural research to make its way to the farmers fields (Bekchanov et.al: 2009) nor it permits the usage of farmers' knowledge (Hornidge et.al: 2009). Controlled cotton and wheat land allocation restrict farmers from switching to other cash or environmentally tolerant crops such as potato, indigo and soybean, limiting crop biodiversity (Bobojonov et.al: forthcoming).

Main barriers of knowledge and innovation transfer in Uzbekistan based on the value chain map may be described as follows: inappropriate management structure, lack of technical specialists, influence of local authorities, and implementation of strict state orders and norms. Rudenko (2008) systematized main barriers of local value chain development in Khorezm region in Uzbekistan by relying on a small-scaled survey of 121 farmers (out of 13621), 10 ginneries (out of 10), textile companies (out of 26), 4 state wheat mills (out of 4) (see table below). She identified the barriers to growth and upgrading of the cotton value chain in Uzbekistan, to name a few, high prices and late delivery of inputs, underdevelopment of mechanization, high energy input use, imperfect bank and legislation/regulation system, and lack links and infrastructure to global value chains. It suggests there is a huge need for social-economic, technological and institutional environmental friendly technologies to develop and upgrade the agroindustrial value chain in the region. Despite the attempts to liberalize and opening up shown above, the state in Uzbekistan still retains a certain level of knowledge control which is deemed central to control the agricultural production process (Wall: 2006).

This control of knowledge in Uzbekistan is related with the idea of power. Knowledge is often associated with power. It is a central feature of the activities, projects and plans of the government and to the inception of its objects, as government is a: " domain of cognition, calculation, experimentation and evaluation" (Rose, Miller: 1992). Expertise which consists of a set of complex of actors, powers, institutions and bodies of knowledge holds an important role in establishing the possibility and legitimacy of government (Rose, Miller: 1992). The conceptualization of knowledge to a certain extent is influenced by the political system in place and the range of authoritarian or democratic system in the country (Hornidge: 2007).

In Uzbekistan, agricultural knowledge pertaining local farmers are embodied in the 'master.' This term of 'master' refers to an advanced state of practical knowledge, the possession of certain skill or expertise in which that this knowledge must be applied to enabled to be valued (Wall: 2006). Masters in this sense encapsulate a double meaning, on the one hand they may take advantage of their knowledge to improve their socio-economic position. On the other hand, they can also embark on the ex-officio capacities within the farming system which link them to the power structure (Wall: 2006). The significance of the master is signaled by the fact that a death of the master may bring a knowledge loss. Knowledge loss occurs when the local knowledge system disappears or ceases to be available. This phenomenon of knowledge loss shows that the lack of capacity to instutionalize the avenues to pass on local knowledge (Wall: 2006). This research follows up from this thinking and advances the analysis by looking at specifically the possibility of local farmers herewith referred to as firms to adapt knowledge and innovate despite the prevailing conditions. This possibility will be explored through game theory in the next part.

4. Exploring the Potential for a Cooperative Growth in the Cotton Industry Value Chain in Uzbekistan: a Game Theory Approach

The structure of top down planning is a feature of formerly independent state like Uzbekistan. Basically the cotton plan is decided in accordance to a strictly technical criteria, taking advantage of this set of norms and calculations which convey a definitive result (Wall: 2007, Trevisani, 2006a; Kandiyoti, 2002). Production quotas for cotton and wheat and financial punishment proportional to deviation from the quotas are considered by government as a motivation tool for farmers to keep production levels more stable and close to the plan. In reality, this system makes farmers think out different ways of increasing their own profit and reduces their trust in the system. A rather flexible approach takes place which gives advantage to those who has knowledge and information (Wall: 2006). In other words, there appears space for a *principal-agent dilemma* because of low procurement prices and the quota system. Producing other cash crops, such as rice in some part of the fields, not informing state organizations or purposefully flooding the cotton field before cropping, thus missing cropping deadline and making the field available for only some specific marketable crops are just few examples.

In sociology, this would create the possibility of individuals to mobilize the bureaucratic knowledge and social capital to advance one's interest (Wall: 2006). In economics, this problem is phrased as asymmetry of information whereby market failures cannot simply be understood under the headings of optimizing human actions in the situation of unavailability of information (Beckert: 1996). This shows the notion that the principal and the agent have different capacity of mobilizing information namely a principal agent problem. Both perspectives though pointed out how this unequal position and flexibilities may lead to failures, a market failure (Beckert:1996) and knowledge failure (Evers, Wall: 2006). We acknowledge this principal-agent problem in our game theoretic approach whilst our value chain map attempts to deal with knowledge and environmentally related barrier.

It would be interesting to see what would occur if government relaxed procurement prices and how this would affect farmer decisions on innovation adoption at the farm production and processing levels. Game theory modeling is best suited to analyze the impact of different farmer/government strategy combinations on total value chain income and income distribution. Applications of different game theory models from static to dynamic and from deterministic to stochastic in supply chain analysis are discussed briefly Kogan and Tapiero (2007).

This paper presents a static game theory model of cotton value chain that imitates the relationships between farmer producers and processing industry to show how low prices and state quota do not allow bottom-up technology adoption initiative. This static game theory may not capture holistically knowledge as a social process outcome in sociological terms, amid the strict political system in place in Uzbekistan. But it attempts to capture the dynamic of knowledge adoption by local farmers. In the model farmers try to increase their own benefit (π_{farm}) which depends on cotton procurement price (P_{gov}), yield with and without technology (y^+, y^-), technology adoption rate (r), deviation of farmers from planned cotton crop area (s) which matches to the area share of marketable crop, additional income – *opportunity cost* (IN_{alt}) and yield (y_{alt}) of alternative marketable crop, variable production costs with and without technology (VC^+, VC^-):

$$\pi_{farm} = P_{gov}(y^+rX + y^-(1-r-s)X) + IN_{alt}y_{alt}sX - VC^+rX - VC^-(1-r-s)\,X$$

where X is total cotton area planned,

or

$$\pi_{farm} = (P_{gov}y^+ - VC^+)rX + (P_{gov}y^- - VC^-)(1-r-s)X + IN_{alt}y_{alt}sX$$

and

$$obj \rightarrow \max_{r,s} \pi_{farm}(P_{gov}, r, s)$$

Processing industry planners also try to maximize their benefit (π_{pr}) which is determined by world price of cotton fiber (P_{world}), raw cotton amount required to produce one unit of cotton fiber (η), procurement price paid to farmers (P_{gov}), variable costs of processing (VC_{pr}), value added by other processing industries such as cotton oil production (VA_{oth}) and amount of raw cotton delivered by farmers $(y^+rX + y^-(1-r-s)X)$:

$$\pi_{pr} = (P_{world}/\eta - VC_{pr} - P_{gov} + VA_{oth})(y^+rX + y^-(1-r-s)X)$$

and

$$obj \rightarrow \max_{P_{gov}} \pi_{farm}(P_{gov}, r, s)$$

Neglecting the *principal-agent* problem may cause declined levels of potential cotton production and irrational expectations of farmer's adoption of technologies. This would keep prices low in practice and create conditions for non-cooperative game that increases the load to environment gradually making chances of economic and environmental threat more possible.

In spite of complicated regulation and quota system, dependence of technology adoption rate on procurement price should be considered for more favorable performance of the production system:

$$r = f(P_{gov})$$

Moreover, the relationship between diversion rate of farmers from planned cotton crop area and marketable crop and procurement price difference ($\Delta(P_{alt}, P_{gov})$) is also important to determine optimal procurement price:

$$s - f(\Delta(P_{alt}, P_{gov}))$$

In practice, quantification of the last two relationships requires cross-sectional data on farmers' technology adoption rates and deviation from a planned area which may be undesirable to be responded by farmers. Thus, here we simplify our calculations applying discrete model. The response of farmers to price change was not considered in these calculations due to lack of data. However, without this data still we can build game theory model which shows benefits/losses of farmer and government under different strategies of these players. Approximate values of exogenous variables of the model are estimated based on previous survey results at ZEF/UNESCO (Khorezm) project.

Table 1. Estimated input data

Variable	Amount	Unit	Description
P_{world}	2500	\$/ton	World price
η	2.5		Raw cotton amount required to produce one unit of cotton fiber
VC^{-}	400	\$/ton	Variable cost of cotton production without technology
VC^{+}	500	\$/ton	Variable cost of cotton production with technology
VC_{pr}	300	\$/ton	Variable cost of cotton processing
$\Delta\%$	20	%	Yield increase under technology adoption
α	{0,1}	Binary	1, if farmer adopts innovation, otherwise 0

Source: Own compilation

Farmers benefit is simplistically calculated as a difference between (P_{gov}) government procurement price and variable costs of cotton production:

$$\pi_{farm} = P_{gov} - (1-\alpha) \cdot VC^{-} - \alpha \cdot VC^{+}$$

Processing benefit is estimated as a difference between cotton fiber world price (P_{world}) and government procurement price plus variable costs of cotton processing:

$$\pi_{gov} = (P_{world}/\eta - P_{gov} - VC_{pr}) \cdot (100\% + \alpha\Delta\%)$$

Gains by farmer and government under different price and innovation adoption scenarios are given in Table 2.

Table 2. Income of farmers and processing industry under different strategy scenarios

a) Farmer:

Government

Farmer		300	450	600
	innovation-	-100	50	200
	innovation+	-140	40	220

b) Government:

Government

Farmer		300	450	600
	innovation-	400	250	100
	innovation+	480	300	120

Source: Own results

As shown in Table 2a) Farmer loses under low procurement prices if he or she adopts innovation and only high prices paid by processing industry can make innovation advantageous. If the farmer expects lower prices, like in the case of Khorezm region, he or she will never implement the technology. Or, in contrast, according to Table 2b) government prefers low procurement prices since it can gain the highest profit. In result, there is no incentive for technology adoption although it is more economically efficient with cooperation. This situation is defined in the literature as the *prisoner's dilemma*, which is one of the main reasons for innovation adoption failures in the region, consequently increasing distrust between value chain agents and lowering sustainability of agricultural production system.

Thus, it is emphasized that determining and setting optimal value of procurement price under cooperation which provides optimum social income and optimal technology adoption rates plus sustainable development is one of the prior problems of agricultural value chain development.

The data analysis thence argues for a reduction of state control over the agricultural sector in order to increase the space for bottom-up creativity and knowledge adoption to take place. While the chosen game theoretical approach is limited in uncovering the details of the top-down planning structures of Uzbekistan and the implication of this toward agencies and action, it achieves to empirically illustrate bottom-up potential for, further developing the cotton processing industry through knowledge and innovation adoption by individual agents.

5. Conclusion and Recommendation

Knowledge in here is constructed as an outcome of a social process on which individuals or groups continuously alter and adapt their knowledge in response to changing intentions, opportunities and circumstances, including ecological circumstances and economic situations. This paper concludes that adopting knowledge would allow local firms to upgrade themselves in the value chain. Regression analysis shows that 1% increase in R&D expenditure would contribute 1.3% agricultural productivity growth. Interaction with other actors/firms and a more favorable policy framework would create better conditions for knowledge adoption and utilization.

The value chain mapping utilized in this paper incorporated knowledge and environment in the subsystems. We have showed how environment including water has an unquestionable importance for cotton production in Uzbekistan. Degradation of environment poses more challenges for the "white gold" producers. It is also important to note that there are technical, social, and institutional needs relating to water conveyance for among others cotton production. Through the value chain mapping, we have specified the difficulties of knowledge adoption namely due to inappropriate structure, lack of technical specialists, influence of local authorities as well as implementation of state orders-norms.

Game theory modeling allows to strategically analyze prize distribution among the players in competitive and cooperative scenarios and thus more practical to simulate social, economic relations of value chain actors quantitatively. The game theoretic analysis demonstrates *prisoners dilemma* in cotton value chain. Although state procurement price and quota system was thought as a powerful measure by government officials, in reality, it creates *principal-agent problem* which is favour of neither processing manufacturers nor raw cotton producers. Due to the model knowledge adoption would not likely to be successful unless necessary conditions are fulfilled in this case by increasing cotton procurement price.

Thus to conclude, the qualitative and quantitative approaches employed in the paper have shown that despite the existing barriers, reducing the power of the state and specifically through not curtailing the price of cotton are key to new technology and knowledge adoption in developing countries. The cotton case in Uzbekistan have shown that due to high government intervention farmers do not have enough platform of possibilities to change their role of primary producers of cotton for the state. It is sometimes the case that the farmers are not being perceived capable of utilizing agricultural knowledge as well as to collaborate with other actors of the chain due to the so called state quota and procurement price system.

The policy proposal on the basis of our analysis for Uzbekistan and perhaps for developing countries in transition with a historical background of centralized system is to embark on the possibility of liberalizing the cotton and agricultural sector to enable more space from the bottom to innovate and also for a conducive climate for creativity. By liberalization, we meant liberalization that is supported with a concerted effort in the national and local level, especially in this case releasing the state control. It is through liberalization, the control of state norms including state imposed quota of agricultural production and monopoly by the state over agricultural knowledge can be reduced. This will allow a window of opportunity for the local farmers and firms to adopt and use knowledge, including local knowledge pertaining to agriculture. The second reason is that reducing the monopoly of state conceptualization of knowledge would enable local knowledge systems to flourish and curb the phenomenon of knowledge loss.

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