Institutions of Sustainability for Common Pool Resources Management in Central Asia

Ulan Kasymov and Ahmad Hamidov

Humboldt University of Berlin - Department of Agricultural Economics - Division of Resource Economics - Philippstrasse 12 - D - 10099 Berlin - Germany

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Abstract

Central Asian countries have experienced transition from a centralized state-managed to a decentralized market-oriented economy and gained valuable experience in designing new institutions in common pool resource (CPR) management. However, the on-going institutional reforms are facing challenges in implementation and adaptation to the existing contexts. This paper demonstrates an empirical application of “Institutions of Sustainability” (IoS) framework analysing ‘rules in use’ and formal institutions, and governance structures in irrigation water and pasture management. It studies the determinants of ex-post and ex-ante institutional change and addresses how the physical nature-related transactions are institutionalised through the operationalization of “discriminative alignment” principle. In this paper, authors claim that the change of properties of transactions observed in CPR use can indeed determine the change of governance structures in the future and show that actors’ interdependence caused by attributes of nature-related transaction play a decisive role in the institutional transformation in CPR management in Central Asia.

Keywords: Institutions, governance structure, nature-related transactions, common pool resources, Central Asia.

1. Introduction

Policy interventions in common pool resources (CPR) management struggle to deal with the challenges of post-Soviet transformation in Central Asia (CA) and stabilize the spontaneously changed informal rules and structure social interactions in resource use. The consequences of pastoral and irrigation water reforms in Kyrgyzstan and in Uzbekistan respectively, have been extensively discussed (for pasture use in Kyrgyzstan, see Undeland, 2005; Steimann, 2011; Crewett, 2012; Dörre, 2012; and for irrigation water use in Uzbekistan, see Zavgorodnyaya, 2006; Abdullaev et al., 2010; Dukhovny et al., 2013).

In pasture management most authors observe the massive reduction of pastoral mobility after 1991 in Central Asia due to the privatisation of livestock, dissolution of large organisational structures (former kolkhozes and sovkhozes) and deterioration of infrastructure. Reduction of mobility had environmental and economic consequences. It caused degradation of rangeland by overuse of near village pastures and under use of remote summer pastures (Ludi, 2003; Undeland, 2005; Farrington 2005; Shigaeva et al., 2007; Kerven et al., 2012; Kreutzmann, 2012) what led to decrease in livestock productivity as well (Wright et al., 2003).

In Kyrgyzstan agro-pastoralists experience legal and institutional transformation and deal with the situation of legal pluralism, which is characterized by many institutional levels coexisting, overlapping, conflicting or collaborating. Legal pluralism creates an opportunity for negotiations among pastoralists, but if frameworks for negotiations are missing, some groups of pasture users may have difficulties to get fair access to the resource (Bonfoh et al., 2011: 553). Moreover, livelihood, institutional and ecological uncertainties resulted from agricultural reforms are important characteristics of the pastoral context in Kyrgyzstan. Under uncertainty, pasture users refer to different legal orders to pursue their interests depending on interaction situations and their power resources (Steimann, 2011).

With the breakdown of the Soviet system, where agricultural production was well-organized and each entity or individual had clear responsibility over who has rights for land use and who manages irrigation canals, this system was no longer functional in Central Asian countries, particularly in Uzbekistan. This was most noticeable in the irrigation sector. There was a huge “vacuum” over who
shall manage and maintain secondary and tertiary irrigation and drainage canals, which had been managed and maintained by collective farms (kolkhoz) during the Soviet era (Jumaboev et al. 2013). As a result, there was a need of social interaction among irrigation water stakeholders to assign the responsibility over the ownership of these assets (Wegerich 2000; Veldwisch 2008; Abdullaev et al. 2008).

The deterioration of irrigation canals was apparent. Most canals were built during the Soviet era but needed regular investments in maintenance. This lack of attention put much of the infrastructure in a critical situation. Dilapidated infrastructure has led to a reduction in crop yields, an expansion of weeds and silt in the farm canals. It has hindered the timely allocation of water to users and caused farmers’ dissatisfaction. Additionally, despite having clear formal rules what individual resource users have or supposed to do, there are still practices where people follow their own traditional customs (Hamidov, 2014). For instance, farmers formally agree and sign the agreement with local water consumers associations (WCAs) to financially contribute for irrigation services but in most cases, either they do not fulfil their promises or contribute through in-kind services to certain WCA employers.

Based on the comparative experiences of Kyrgyzstan and Uzbekistan in the design and implementation of CPR reforms, it can be observed that despite the fact that different agricultural policies and formal institutions were introduced for different resource management, the problems remained similar, namely: weak, newly established institutions; poor public acceptance and lack of legitimization of new regulations and governance structures among resource users; and the growing gap between the implemented policies and the resource users’ practices.

This paper aims to reconstruct and theorise how have the ‘rules in use’ and formal institutions and governance structures been shaped by nature-related transactions in CPR management thereby contributing to an understanding of the determinants of the bottom-up transformation processes of CPR management in CA.

We follow the conceptual framework of Institutions of Sustainability (IoS) (Hagedorn, 2008) and in line with Hagedorn (2008), we define institutions as sets of “rules-in-form” and “rules-in-use”, which shape social relationship and governance structures as forms, modes and processes of organisation to make institutions effective (Hagedorn, 2013: 106).

Following Hagedorn (2013), in our analysis we employ “discriminative alignment” principle by which “transactions are aligned with governance structures” (Williamson, 2000: 599) by incorporating the perspective of physical transaction of resources and concept of hybrid governance structures.

Research results confirm our assumption that the nature-related transactions in pasture and irrigation water use are important determinants of the institutional change in CPR management in CA.

This paper structured as follows: first, we introduce the concept of nature-related transactions and hybrid governance structures. Second, we outline the CPR reforms describing ‘rules in use’ and formal institutions and governance structures. This is followed by detailed analysis of empirical cases and the questions of how properties of physical nature-related transactions in pasture and irrigation water use are institutionalised. And how the properties of transactions are related to existing governance structures. Lastly, we interpret our findings in the context of the understanding of institutions and governance structures and ex-post and ex-ante institutional change in CPR management in CA.
2. Conceptual framework

We advocate that rules and regulations are only effective, if they are accepted and generally applied by resource users at the local level. Many rules and regulations in CA are currently not effectively implemented, in the sense of not achieving the purpose for which they have been designed. Moreover, conflicts may not only remain unresolved but new might emerge in case of institutional failure. In our target area, we largely deal with effective institutions, which are defined as a mix of formal and informal institutions. Contemporary literature argues that especially in a transition context, discrepancy between formal rules (e.g. constitutions and laws) and ‘rules in use’ (e.g. rules which are followed by resource users) exist. We therefore focus on the study of locally accepted effective institutions and governance structures.

The study applies the conceptual framework of Institutions of Sustainability (IoS) developed by Hagedorn et al. (2008). Authors assume that institutions regulate relationships among individuals and between social systems and the ecological system, i.e. rights and duties as well as costs and benefits of actions. Therefore, institutions are the essential linkage between social and ecological systems (Gatzweiler and Hagedorn, 2001).

In order to place the analysis of transformation and institutional change in a more specific pastoral and irrigation system management context, the concept of nature-related transaction is applied.

Commons (1931) defines the transaction as the main unit for institutional analysis. Individual action and transactions create conflicts of interests over scarce resources and institutions are an effort to mitigate conflict, create order and realise mutual gains. The transaction is defined as “alienation and acquisition between individuals of the right of property and liberty created by society, which must be therefore negotiated between the parties concerned…“ (Commons, 1931: 652). Commons underlines the institutional dimension of transactions; for him transaction is a “unit of transfer of legal control” or “transfer of property rights” (Hagedorn, 2009: 5). He differentiates between bargaining transactions along with managerial and rationing transactions. Four economic issues are related to the bargaining transaction: competition (fair or unfair), discrimination (equal or unequal opportunity), economic power (equality or inequality) and working rules, which changes with changes in custom, class dominance and so on. These “relations of possible conflict of interests“ are institutionalised in four classes of working rules (Commons, 1931: 652).

Hagedorn (2008) assumes that the social world and characteristics of actors, as well as physical world and related characteristics of physical transactions are important for institutional analysis in agriculture. He stresses the importance of linkages - interrelation between activities, actors and natural systems. Actions and transactions cause interdependence between actors, affect their opportunities to access goods and to use resources, and may result in conflict or cooperation. Institution and governance structures are understood as regularising the interactions between these actors. Physical transactions can include psychical flows and movement of natural resource between actors or it can also be a social transaction, which has some physical implications to other actors. Transaction is “a physical phenomenon that is induced by a decision of one or more actors and affects one or more actors” (Hagedorn 2009: 5). Hagedorn (2002, 2009) suggests that properties of nature-related transactions resulting from the attributes of the production system (asset specificity, frequency and uncertainty) as well as the ecological system (modularity and functional interdependence, excludability, rivalry, separability, complexity, measurability, irreversibility, legitimacy, heterogeneity and variability) have to be taken into account. Definition of individual properties of transactions, based on Hagedorn (2002, 2008) and Schleyer et al. (2013), is provided below:
Modularity and functional interdependence – are key dimensions of nature-related transactions. They are related to types of transactions. The assumption is that the physical systems are subject to social construction and humans decompose the complex and interconnected systems in to modules. The inappropriate modularisation results in transaction costs. Thus “the question is how a module is defined in terms of physical transactions or governance arrangements” and how the boundaries of modules are delineated.

Asset specificity – it describes individual transaction. In natural resource context, asset specificity requires specific site, capital and knowledge investments for the realisation of specific transactions.

Frequency – to what extent the certain transaction is taking place relatively frequent. Hagedorn reiterates that in socio-ecological system, most of the transactions show relatively high frequency. In case of recurrent transaction, the transaction costs are distributed over many transactions and can be saved due to learning effect, economy of scale/scope and trust. As a result high frequency it “is easier to invest in specialised governance structure “ (Hagedorn, 2002: 6).

Uncertainty – relates to the degree of certainty about characteristics of specific transactions (affected actors, costs and benefits). Whether it is difficult for actors to define transaction partners as well as costs and benefits.

Excludability – to what extent actors can be refrained to obtain benefits from the certain resource. It applies to the mechanism and cost of exclusion from access to natural resources and environmental goods within the technological boundaries.

Rivalry – the degree of rivalry implies to the level and scale of social dilemma. It also influences the incentive of society to overcome the social dilemma in coordinating common pool resource management.

Separability/jointness – it is an ability to distinguish which individual transaction causes which outcome. It implies whether the transaction can be separated from other transactions in order to establish transaction outcome relationship.

Complexity – it refers to the degree whether the transaction is complex, meaning that it is “difficult/impossible/costly” to identify transacting partners and costs and benefits. In natural resource context, it is often difficult due to the complexity of causal relationship of ecological systems. Thus, there is a high probability of opportunistic behaviour requiring coordination.

Measurability – whether costs and benefits from the certain transaction or activity can be identified, assessed and measured in regard to transacting partner. It often depends of availability of necessary technology and knowledge for identifying these costs and benefits.

Irreversibility – it relates to the outcome of transaction, whether the transaction is subject to reversibility. When the transaction is irreversible, it requires greater attention and need for coordination.

Legitimacy – it relates to whether the transaction is “compatible with the normative views of actors and groups concerned by or even involved in the decision making and implementation activities” (Hagedorn, 2002: 8).

Heterogeneity/variability – it is related to spatial and temporal dimension of a transaction (“site and situation specificity”). The effect of transactions, related costs and benefits depend on specific spatial
and temporal dimensions. Thus the coordination of transaction may require specific mechanism (Hagedorn, 2002: 8).

**How a physical transaction can become institutionalised?**

Hagedorn (2013) argues that institutions arise or change due to the nature-related transactions, which cause or reveal interdependence between actors.

In order to analyse the interdependence between transactions, institutions and governance structures Hagedorn (2013) suggests employing “discriminative alignment” – an analytical process by which “transactions are aligned with governance structures” in “…ex post stage of contract” (Williamson, 2000: 599). Theoretical assumption is that “…transactions, which differ in their attributes, are aligned with governance structures, which differ in their costs and competence, in a discriminating- mainly transaction costs economising – way” (Williamson, 1996: 17).

The concept of hybrids governing CPR resource use is employed differentiating three core elements of this type of institutional arrangement: pooling, contracting and competition. Resource users pool their resources retaining their rights to make individual decisions, they have contractual relationship (often incomplete), and they compete between themselves and with other hybrids. Two main types of cooperatives can be distinguished here: resource users pool natural (e.g. common pasture) or human made (e.g. irrigation infrastructure) resources (Hagedorn, 2008, 2013).

The physical transactions under study are ‘provision of fodder to livestock’ on pasture in Kyrgyzstan and “an activity of removing weeds and silts from the canal (i.e. maintaining irrigation canals)” in Uzbekistan. The transaction implies the social dilemma, when social rationality may lead to social sub optimality. For instance the decision of herders for seasonal migration or non-migration has an impact on pasture conditions and affects other pasture users. In the irrigation sector, carrying out irrigation canal maintenance may improve the overall water flow for users located in the downstream of the canal. In contrast, leaving out removed trashes by the side of the canals, which is a regular practice in Uzbekistan, may create a negative consequence to local residents. Furthermore, odor and noise may cause environmental problems as well as disturbances to locals residing in the vicinity. Specifically, this transaction may directly or indirectly affect actors, such as farmers, households, and the state.

### 3. Empirical cases

Qualitative data for the empirical study have been gathered from two case studies in Uzbekistan and Kyrgyzstan. The case studies investigate formal as well as informal, undocumented arrangements for regulating natural resource use and analyses the causes and different factors, which determine the development of ‘rules in use’. Our case selection strategy has the objective of achieving maximum variance along relevant dimensions (Seawright and Gerring, 2008). We have included two communities in Kyrgyzstan and Uzbekistan in order to compare the two different local institutional contexts in management of two different resource systems (pasture use and irrigation infrastructure), but also to explore each of them in detail, with special attention to their sub-units (interactions between resource users, ‘rules in use’ and formal institutions and governance structures in transformation).

#### 3.1. Case study: Pasture use in Kyrgyzstan

Policy makers designed formal institutions combining different principles and approaches and adapted them to existing governance structures. For instance the perception of pasture as a state property,
spatial categorisation of pastures and management competences were combined with the decentralised administration and later with the participatory resource management principles (Dörre, 2012: 136).

The World Bank and other international agencies supported the Kyrgyz government in the development and implementation of the new pasture law which introduces radical changes to the pasture management system: (1) It abolishes the thee level system of pasture management based on spatial pasture characteristics; (2) it creates Pasture User Associations (PUA) and Pasture Committees (PC); (3) it transfers the competence for pasture management to municipalities; (4) it abolishes the area-based long term pasture lease system and introduces an annual livestock-based pasture fee (‘pasture ticket’); (5) and finally the new law introduces a planning and monitoring system for pasture use and management.

After intensive discussions among experts and responsible organizations at the national level, the new law “On Pasture” was adopted in February 2009 by the Kyrgyz Parliament and came into force by government resolution in June 2009. By 2011 Pasture User Associations and Pasture Committees had already been created in all 475 Ayil Okmotys in Kyrgyzstan. The World Bank’s Agricultural Investment and Services Project (AISP) and Community Development and Investment Agency (ARIS) supported the creation of the new governance structures.

*Jergetal community*

After the dissolution of “Jangy Talap” kolkhoz and the privatization of livestock, machinery and agricultural land, the Jergetal municipality was formally established in the mid-nineties (Steinmann, 2011). Today about 1164 households reside in the community with a total population of 5225 inhabitants (Communal statistics, 2013). The community consists of three villages: Jergetal, Jalgyz Terek and Kyzyl Jyldyz.

Out of 1650 ha, about 1000 ha of agricultural land is irrigated in Jergetal. 65 % of all arable land is used as hay meadows and for the cultivation of fodder crops (sainfoin and clover). The rest is used for wheat and barley production. Large livestock owners own a greater share of the arable land and combine cultivation of different crops (Steinmann, 2011: 142).

Jergetal community has about 91597 ha of pasture land. Most winter pastures located near the village are overgrazed. For instance, the Aktash pasture is used throughout the whole year. Also some accessible spring/autumn pastures such as Kabyrga Bulak and Acha Kamdy are overused (Jergetal Base Line Study, 2008: 13). The most distant summer pasture Aksay is not used by herders from Jergetal community. About 146 bars on winter and spring/autumn pastures are owned by large and medium livestock owners.

Livestock is the core of Kyrgyz nomadic culture and is an important economic basis for securing people’s livelihoods in Jergetal community. Livestock is important for establishing and maintaining social relations in the community and has become important as financial capital. The value of livestock is increasing and livestock can be easily sold for cash. Livestock numbers have strongly increased in recent years.

An average household owner has livestock, which comprises about 80 % goats and sheep, and 5-10 % horses and cows (Steinmann, 2011). There is a high asymmetry in the livestock ownership in Jergetal. While 1 % of households own 16.8 % of livestock and 61 % of households own only 39 % (Isakov, 2013). Wealthy households keep more horses and cows, while small and medium livestock owners prefer goats and sheep.
‘Rules in use’ and new formal governance structures

After the dissolution of the kolkhozes and sovkhozes, the traditional institutions and practices have been adapting to the new realities and many different institutional arrangements have been developed. Steinmann (2011) argues that local herding practices and forms of cooperation emerged and have become institutionalized, adapting to the changing socio-economic context. During the on-going process of “social reorganisation” Farrington (2005) differentiates between a variety of coping strategies employed by pasture users: migration organised by individual families, partnerships, extended family and reorganised herding cooperatives. While the most common are extended herding family, mixture of herding herder’s own livestock together with the livestock from sedentary clients, much less common is a transhumance practiced by a single family. The author confirms that the strategy of “ending of all nomadic herding practice completely” is on the increase (Farrington, 2005: 178). Many small and medium livestock owners pool their livestock together in order to collectively use common pastures. Herder have the same costs if they move with their own livestock, but the benefit for the herder may increase strongly by collecting livestock and providing herding services to ‘clients’. Providing herding services has become a popular ‘business’. Wealthy herders and livestock owners are herding their livestock individually, but many provided herding services in the past, stopping as soon as their own livestock increased and they are not managing any more to take care for other’s livestock.

‘Mal koshuu’ is practised in both communities. For instance, more than 70 % of herders in Jergetal community provide services for livestock owners collecting livestock and moving to pastures. Herders have their own livestock and may collect some additional from ‘clients’. Up to 700 sheep can be collected by a herder in Jergetal.

In spring, livestock owners agree with herders about the conditions of cooperation.

A herder explains: “livestock owners approach me them self. If the price is right I herd their livestock. We get livestock from people because we feed livestock well on summer pastures” (experienced herder/small livestock owner in Jergetal).

The work of a herder is a risky one. Livestock can be lost, eaten by wolves or succumb to extreme weather conditions on high pastures. Herders have to pay the price of lost livestock to the owner in such case. Herders offering this service therefore have to have certain professional experience and assets.

Rules differ regionally and parties may have specific individual arrangements, but certain rules are generally accepted:

- The herder is responsible for herding on spring, summer and autumn pastures and protecting livestock
- In case of livestock being eaten by a wolf, the herder has to show the evidence (head and skin of the animal). If there is nothing left, he pays the price of the livestock. Likewise, if livestock is lost, the herder pays the price. The payment can be made in kind by replacing the animal with another one or by providing service for free in future.
- The livestock owner is responsible for illness in his livestock. In such case he has to come to the pasture bringing medicine and treat animal. The herder is responsible only for informing the owner and, if requested, for sending livestock back to the village
- The herder takes care for mares for free (bee baylap), in turn the herder may have milk products for himself
There is no signed contract and the conditions are agreed verbally.

“We are Kyrgyz- nobody writes agreements” (‘mal koshuu’ herder).

Each writes on his own paper the agreed price for the herder’s service and how many heads of livestock are being given for pasturing. They also write down the age and marks of the livestock. Based on these documents, livestock are returned. Each livestock owner has to remember his animals and their marks in the autumn. There is a certain trust between herder and livestock owner during their cooperation every year.

Livestock owners prepare winter fodder and get their livestock in the autumn. Some of the livestock is sold at this point by livestock owners as livestock have their highest value at this time.

In Jergetal small and medium livestock owners cooperate by taking part in ‘Mal kesüü’- a neighbourhood based rotational herding scheme (picture 1). Each participating household appoints a herder to collect livestock in the morning and after the herding on near village pastures bring it back to the owners in the evening. Respected people and elders coordinate the cooperation. For instance, they define the starting day and when to stop. It may stop by end of April in Naryn when work in the field starts. They discuss and decide together with the community about the rules and conditions.

The rules are mainly informal, however the Head Ayil Okmoty intervene and officially approve the decision when the pasturing in fields and near village pastures have to be stopped and livestock have to move to summer pastures. Sometimes there is an agreement that ‘Mal kesüü’ continues after field work starts, but livestock- mainly milking cows and some weak animals can stay at pastures and are not allowed to enter the fields. If livestock enter fields, livestock will be ‘arrested’ and owners or herders have to pay a fee.

**Picture 1. ’Mal kesüü’ herding in Jergetal community**

These rules are not strict and many individual arrangements exist. For instance herders take the livestock of their relatives for free. Instead relatives may help with the work on the herder’s arable land during summer, contribute to the transportation costs or help to prepare winter fodder. Herders herd cows or mares for free and take milk etc. A lot depends on the relationship between herder and livestock owner and the household’s strategy. Some herders provide services for only one or two households; others provide service for up to twenty ‘clients’. For instance, livestock owners do not want to give all their sheep to the herders who move to summer pasture, as they may need some sheep.
close to village to sell. So the livestock owner may look after some sheep himself in the garden. Livestock owners may also agree with a herder who has bars on a near village pasture and is not moving to a summer pasture. There are some regional differences as well. For instance herders in Naryn take horses for free from relatives during summer and take care in winter, while in Chui the responsibility in winter is that of the owner.

In Jergetal, a Pasture Committee (PC) was established in 2008 without registration after the Central Asian Mountain Program (CAMP) funded by the Swiss Agency for Development and Cooperation started development project activities in the village and conducted awareness building workshops on pasture management. The Pasture Committee and Pasture User Association were officially registered in March 2011. The Pasture Users Association is legally registered as a Territorial Public Self-governance (TPS) Organization. The highest Body is the General Meeting of Pasture Users and the executive body of the organization is the Pasture Committee (PC) and Revision Commission (RC). The PC is responsible for: pasture use planning and implementation, monitoring of pasture status, defining and collection of pasture fees (to be approved by Ayil Kenesh), pasture use related conflict management, management of funds collected from pasture use for pasture improvement and management.

One of the first tasks for the newly established PC is the collection of pasture fees. The collected pasture fees are supposed to finance the overhead costs of the Pasture Committee and to be invested in pasture infrastructure and pasture improvement. The pasture fee is defined annually by the Pasture Committee for each type of livestock and eventually for each type of pasture. It cannot be lower than the basic tax for using the pasture and has to be approved by the Ayil Kenesh. The pasture fee is calculated according to the annual budget of the Pasture Committee and collected according the annual pasture use plan. The collection of pasture fees is quite a difficult task as the reporting of livestock is a problem. The head of the Ayil Okmoty in Jergetal complains: “it is difficult to collect the pasture fees as people do not report truthfully about their livestock”. Nevertheless, the Pasture Committee in Jergetal managed to collect 80 % of its pasture fee in 2012, spending 50 % of the money on overhead costs (salaries, transport costs etc.) and investing the rest in the improvement of pasture infrastructure (repairs to roads).

The Pasture Committee develops an annual pasture use plan allocating pasture to herders by taking in to account the capacity of pastures. The objective is to have a more balanced distribution of livestock on pasture. The capacity and condition of pasture (productivity, level of degradation etc.) has to be monitored and accessed annually as a basis for the next year’s pasture use plan. Pasture use plans have to be approved by the Ayil Kenesh.

Properties of nature-related transactions

Herder/livestock owners are involved in many interactions involving different actors at local, regional and national level and related to informal and formal institutions and organisations (Table 1).

The actions of pasture users may have consequences for other actors. Some of their actions become nature-related transactions when they have desired or undesired consequences and are mediated through biophysical processes in pastoral system. Such transactions may result in conflict or cooperation and require coordination by institutions and governance structures.

The physical transaction under study is the ‘provision of fodder to livestock’ on pasture. This transaction implies a social dilemma, when social rationality may lead to social sub-optimality. The decision of herders for seasonal migration or non-migration has an impact on pasture conditions and affects other pasture users. This transaction may be affected by other transactions. For instance the
decision to ‘build and use bars on pastures’ and ‘fence pasture land’ for fodder production or ‘sell pastoral products and livestock’ affect the transactions under the study as it may change the pastoral migration pattern.

Table 1. Relating actions, transactions, actors, institutions and organisations in pasture use

<table>
<thead>
<tr>
<th>Actions</th>
<th>Transactions</th>
<th>Actors involved</th>
<th>Institutions</th>
<th>Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negotiating prices, place terms and conditions for herding</td>
<td>Negotiating conditions for herding</td>
<td>Individual herders and herding households, Livestock owners, Head of AO, Head of PC and Members of AK</td>
<td>Mal Koshuu/Bada/Kesüü, Tulöö meeting Labor market Pastoral commodity market</td>
<td>Household, family, kin, AO &amp; AK, AC &amp; ACC and PC</td>
</tr>
<tr>
<td>Acquiring pastures (informally)</td>
<td>Acquiring pastures (informally)</td>
<td>Individual herders and community herders</td>
<td>Tooganchilik Mal Koshuu Bada and Kesüü</td>
<td>Household, family, kin and tribe</td>
</tr>
<tr>
<td>Concluding pasture lease contracts</td>
<td>Acquiring pastures tickets (formally)</td>
<td>Individual herders and herding households, Livestock owners, Head of PC, Rayon representative of the State Forester Department</td>
<td>Planning of pasture use Pasture ticket</td>
<td>Pasture Users’ Association (Pasture Committee) AO &amp; AK Forest Department</td>
</tr>
<tr>
<td>Moving to/from pastures</td>
<td><strong>Provision of fodder to livestock</strong></td>
<td>Individual herders and herding households Livestock owners / ‘customers’ Truck drivers</td>
<td>Mal Koshuu Kesüü Bada Planning of pasture use</td>
<td>PUA &amp; PC AO &amp; AK veterinarians</td>
</tr>
<tr>
<td>Selling pastoral products and livestock</td>
<td>Selling pastoral products and livestock</td>
<td>Individual herders and herding households, Traders and middlemen</td>
<td></td>
<td>AO Communal veterinarians</td>
</tr>
<tr>
<td>Building and using bars informally</td>
<td>Building and using bars (informally)</td>
<td>Individual herders and herding households</td>
<td></td>
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</tr>
<tr>
<td>Getting permissions for building and using of bars</td>
<td>Building and using bars (formally)</td>
<td>Individual herders and herding households Communal land use specialist</td>
<td>National pasture legislation</td>
<td>AO Rayon GosRegistr &amp; Architecture Giprozem</td>
</tr>
<tr>
<td>Fencing pasture land</td>
<td>Fencing pasture land</td>
<td>Individual herders and herding households</td>
<td></td>
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</tbody>
</table>

Source: Based on Appendini and Nuijten (2002); Steimann (2011).

The following characteristics of nature-related transaction for ‘provision of fodder to livestock on pasture’ and their changes have been identified:

**Modularity and functional interdependence** are related to types of transactions. The transaction is complex, it occurs physically within structures with low modularity and decomposability and highly interconnected with other transactions. ‘Providing fodder to livestock’ is an individual transaction within a module as a pastoral production system. It is functionally interdependent with e.g. pastoral product markets.

**Exclusion** is related to the mechanism and costs of exclusion in pasture use. It is difficult and costly.
There is a difference in their characteristics between different types of pasture. The exclusion is very low on remote summer pastures, higher on winter, spring/autumn pastures and very high on pastures near villages, where herders own bars, fence small plots for fodder production and transform the use of pasture (e.g. building irrigation systems for wheat production). The enforcement of the new law by the Pasture Committee decreases the excludability within the community by not prolonging long-term pasture rent contracts. The transfer of the management competence to the community level has increased the excludability between communities and external pasture users.

Rivalry is again different depending on pasture location and quality. It may be high on accessible winter, spring/autumn pastures, close to the community and local markets and low on remote pasture or low productive pasture. The increase in livestock, their value and the number of herders leads to higher rivalry for all types of pasture, intensifying the social dilemma in pasture use.

Asset specificity (capital and knowledge) is moderate, the transaction requires certain specificity of site capital (livestock adapted to local conditions, bars on pasture, prepared winter fodder) and herders who have knowledge about livestock management as well as about pasture conditions. There is an increase in asset specificity as many herders build bars on spring/autumn pastures, change the herd structure (more cattle than sheep) and transform winter pastures and low productive pastures in rain fed or irrigated land.

Separability is low and is decreasing even further as many herders diversify their income generating activities combing herding livestock with selling livestock products, producing fodder and working for the mining company in Jergetal or working in the capital in Tösh-Bulak. For instance the strategy of combining herding with selling livestock products leads to the overuse of pastures near to local markets.

Frequency (seasonal use) is high as this transaction is related to the seasonal variation of pasture productivity. Herders and livestock migrate from winter to spring/autumn and summer pastures following the life cycle of pasture plants (fodder). The migration has decreased compared to the pre-Soviet and Soviet period, but is increasing again as more herders provide herding services and move to summer pastures.

Uncertainty is high. This is related to difficulties and costs of measuring pasture degradation, and gathering real information on livestock. This can be decreased with the enforcement of new pasture legislation, specifically monitoring and planning.

Complexity is high as the causal relationship between pasture use and related problems, such as overgrazing and degradation is complex. For instance the impact of overgrazing on pasture soil and vegetation may be different on winter pasture, which is more resistant to shocks compared with the sensitive ecological system on summer pastures (Isakov 2013).

Heterogeneity and variability (or site situation specificity) is high as the transaction depends on many factors: the seasonal productivity of a pasture, the distance, location and exposition of pastures, weather and precipitation etc. The uncertainty related to this characteristic may be partly reduced by the annual planning of pasture use by the Pasture Committee based on the monitoring of pasture conditions and information on livestock. However the cost of collecting such information is high.

Legitimacy of the transaction is high in Jergetal as the herding is important for securing the livelihood of the community, is highly respected as a traditional practice strongly related to the social life (e.g. celebrating lifecycle events). For instance, punishing herders for not moving to summer pastures by
the Pasture Committee is well supported in the community.

**Measurability** is low. For instance the statistics on livestock are not only reduced by rich and medium livestock owners in order to pay less pasture fees, but also increased by poor herders in order to get loans from micro-financing organisations and banks. However there is an increase of uncertainty with the implementation of monitoring pasture conditions and planning of pasture use by the Pasture Committee.

**Reversibility** is low as a limited amount of irrigated and rain fed land is available for fodder production. The Irreversibility is decreasing further with the increase of demand and fodder price.

### 3.2 Case study: irrigation water management in Uzbekistan

The problems associated with unequal water distribution and worsening of community-level irrigation infrastructure soon after the collapse of the Soviet Union became the main reason behind the irrigation reform and forced the government to develop a new organization for water management and maintenance of irrigation facilities at the on-farm canal level. It became important to introduce farmer-oriented organizations in place of the poorly functioning *shirkats*. In 1996, the Ministry of Agriculture and Water Resources (MAWR) of the republic of Uzbekistan contracted the Irrigation and Water Problems Research Institute (former SANIIRI) to study the experience of different countries with WCAs and to set up a framework for the establishment of WCAs.

In the meantime, co-financed by the Uzbek government in 1998, the European Technical Assistance to the Commonwealth of Independent States (TACIS) started implementing a project in the areas of former *sovkhозы* with the aim to rehabilitate the irrigation system, to train the farmers, and to establish the first WCA (Bucknall et al. 2003). Unfortunately, the government could not provide the promised funds and subsequently the project was terminated.

In 1999, however, SANIIRI completed the study and presented its recommendations to MAWR. As a result, the first WCA was born in Uzbekistan in February 2000 in the Khorezm Region, based on six liquidated *shirkats*. Initially, the WCA was regulated by the Civil Code on voluntary membership. Later on, they were regulated by the Decree No.8, adopted in 2002.

In the next section, we describe one association in detail and apply the concept of properties of transactions. The case study area was selected based on secondary data obtained from MAWR and with the help of knowledgeable people.

*Khalach Kalti community*

The *Khalach Kalti* water consumers association is located in Vobkent district of Bukhara region and was established in October 2006 in the territories of former *Ruzi-Khusenov shirkat* farm. On 18th of October 2010, the WCA was re-established on the basis of canal principles and registered at the Ministry of Justice as a non-governmental organization (NGO).

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1. *Shirkat*: A cooperative large farm enterprise, oriented to family-based production, which was established after Uzbekistan’s independence in place of the former *kolхоз* and *sovхоз*. The *shirkat*’s production output had to be delivered to the state.

2. In accordance with the law on NGO, the association’s aims should not be targeted towards profit maximizing, instead all incomes or benefits need to be distributed among its members. Most importantly, the association needs to manage its activities independently, without external interventions (Article 2 Law on NGO). Upon
At first, the WCA comprised of 111 members entirely oriented to cotton-wheat production. Due to the government’s 2008, 2009 and 2010 land consolidation policies to benefit from an economies-of-scale, the number of members has sharply declined and currently, the WCA contains 34 members. Of this, 30 members cultivate cotton-wheat, three members oriented to livestock production, and one member towards orchard production. It has three employers: a chairman, a chief accountant and an agricultural machinery driver. The name of Khalach Kalti came from the combination of two irrigation canals – Khalach and Kalti.

The WCA has 2073 ha of irrigated land, of which 52% are devoted to cotton production and about 30% for cultivating wheat. According to the chairman, the WCA decided to charge ISFs per hectare basis. The total amount of expected costs to distribute water to individual farm’s territories is divided into the total hectare that WCA serves. Since it is yet to install individual metering for each farm gates, the decision is made per hectare basis and amounts at UZS\(^2\) 25,000 per ha. It is important to note that about 50% of the members lift water using electrical pumps. Electricity costs are thus, an additional burden to farmers. Most WCAs that use pumps have huge debts from electricity companies. In order to overcome these challenges, the WCA general assembly decided to calculate the whole expenses for the entire year including potential electricity costs and costs associated with pump maintenance. These costs are equally divided into all members. As a result, the amount charged for ISF reflects the costs for water distribution, electricity cost, and maintenance of pumps.

‘Rules in use’ and formal governance structures

Khalach Kalti WCA is located in the downstream of main canal in the middle of two drainage canals. Whenever water is abundant or unused, the upstream WCAs let water to drainage system. Apparently, this WCA enjoys being in the downstream. Five WCAs are located in the same canal as an upstream before water riches this WCA.

Despite being a water-scarce season in 2012, the WCA using its pumps lifted water from drainage systems and achieved full delivery of water to its clients. In general, it does not experience much water scarcity. Since it is located in the middle of two major drainage canals, where WCA installed two SNP-500 pumps, water shortage is not a major problem. Water may not be a scarce resource but electricity cost can be an additional burden to most farmers.

Due to his long-term managerial skills, the chairman was able to overcome any disputes without involving external actors. Moreover, local authorities are in a weak position to intervene WCA’s internal decision-making process with regards to irrigation water allocation.

In spite of lacking appropriate facilities to held major meetings, WCA workers acknowledged that at least there are meetings once per week to discuss about various issues related to water allocation and canal maintenance, particularly during vegetation period (April to September). Some meetings held in the conference room of local irrigation systems authority (ISA) or in the territories of the WCA farm. Discussion with farmers demonstrated that all members were actively participating in these meetings or at least, their farm managers attend these meetings.

De jure the Khalach Kalti WCA has five employers: a chairman, a chief accountant, two mirabs, and an agricultural machinery driver. However, de facto the chairman was aware of water skills and thus, did not employ mirabs. All activities related to water allocation within the WCA was carried out by

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the official registration at the Ministry of Justice, NGOs are exempted from certain taxes for three years. This also holds true for farmers within the WCA (Article 90 of the Tax Code).

\(^3\) Local currency in Uzbekistan is called Soum (or UZS). 1 Euro \(\approx\) 2700 UZS.
the chairman. Additional reason of leaving out mirabs’ positions vacant is due to the absence of adequate amount of money to pay their salaries.

The chairman was elected by the members during the WCA’s general assembly and has served since its establishment. He was a head of kolkhoz during the Soviet era as well as the chairman during the shirkat period. The chairman acquired vast experience through working in the area and well-accepted by the community and local authorities. According to local water officials and the WCA members, using his reputation and networking abilities the chairman was able to overcome issues related to internal conflicts as well as water availability. He completed his high degree in Agronomy specialty from the Andijan Cotton Institute and has an extended practical experience in this sphere.

Concurrently, the chairman is a farmer and the member of the WCA. This is also true with chief-accountant who is a part-time employer at the WCA, responsible for financial management and is a farmer with about 100 ha of irrigated land. The priority of the WCA is to collect ISF contributions to mainly pay-off electricity costs and maintain irrigation facilities (including pumps). Due to his own farm profits, the chairman was able to purchase a private car to monitor the fields during the vegetation period for water allocation and organize collective canal maintenance.

Using his knowledge and networks, he has established a discipline in the group where farmers receive their water shares in accordance with agreed schedules. It is important to note that when the chairman of this WCA was contacted through local Irrigation Service Authorities (ISAs) who provide with water, the chairman informed that his WCA had NGO status and could not be hierarchically approached by external actors. It is striking to see that the WCA manager was fully aware of his rights and duties.

WCA charges farmers additional cost to cover canal maintenance, electricity cost, taxes and salaries for the employers. When canal maintenance is required, the WCA requests local ISA to provide an excavator and the WCA covers all expenses from its budget. They do not charge farmers for the maintenance, separately. This is the case when large canals are maintained. In the case of smaller farm level canals, farmers hire seasonal workers to clean these canals (Picture 2). According to the WCA chairman, farmers support mobilization of community action in canal maintenance and fully participate.

---

4 Kolkhoz: A large collective farm comprising several agricultural experts and farm labours responsible for the collective management of the production system and delivery of targeted outputs to the state. They had their own budget and could distribute their production surpluses among the members or sell it at local markets.
In terms of households, they are exempt from paying for irrigation services and instead, contribute with community action. According to the WCA, there are some households who refuse cooperation but overall, local households provide their support during public community action for canal maintenance.

Properties of nature-related transactions

The main focus of the analysis is to understand how canal maintenance (nature-related physical transaction or action) is organized to address collective action dilemma in the territories of water consumers associations. In particular, an activity of removing weeds and silts from the canal (i.e. maintaining irrigation canals) is taken as a transaction, as conceptually it may have some positive or negative effects to other actors. For example, carrying out irrigation canal maintenance may improve the overall water flow for users located in the downstream of the canal. In contrast, leaving out removed trashes by the side of the canals, which is a regular practice in Uzbekistan, may create a negative consequence to local residents. Furthermore, odor and noise may cause environmental problems as well as disturbances to locals residing in the vicinity. Specifically, this transaction may directly or indirectly affect actors, such as farmers, households, and the state. Ostrom (1990) calls irrigation systems as a common pool resource (CPR), where the physical characteristics of the resource (in this example, irrigation canal) make communities experience difficulty to exclude someone from the use but at the same time, depending on canal capacity there is a strong rivalry among the users of irrigation canals. An empirical case of the study corroborates this theoretical assumption. It shows difficulty to exclude non-payers or non-contributors involved in canal maintenance due to the social and natural structure of the canal. The canal belongs to the society, where each household or farmer is able to withdraw the resource unit (i.e. water) and benefit from consumption. However, it is feasible to sanction those free riders but involves huge transaction costs, such as coordinating and monitoring individuals who do not comply with the community rules. Since the infrastructure capacity is finite, there is a strong rivalry among different resource users to benefit from its use. Naturally, the transaction of cleaning irrigation canal requires some knowledge, site, and capital (machinery) fixed asset specific investments. It is important to highlight that cleaning of irrigation canals in this association is a moderate in frequency because of recurrence and seasonality of the transaction. It is relatively certain that carrying out canal maintenance as a form of collective action results in improved cooperation in the association. This particular transaction is separable as
the transaction can be separated from other transactions in order to establish transaction-outcome relationship.

Traditionally, elderly and respected people would call for community labor mobilization (khashar) to collectively remove weeds and silts using garden tools, such as hoes, shovels, spades, rakes, and trowels. The research stay in the association revealed that most canals in the associations were not out of cement requiring physical capitals (such as excavator or bulldozers) to remove weeds and silts, which leads to the high complexity of the system. It is generally difficult to identify transacting partners, which leads to opportunistic behavior requiring coordination. The WCA management team informed that when canal maintenance is required, the association rents the agricultural machinery from local ISA and the cost is covered from the budget. The timing of carrying out canal maintenance is determined by the association and less depends on human mobilization. As such, variability in terms of timing of the transaction is low. However, this does not mean that the association undertakes canal maintenance on its own. It is important to note that bigger canals are cleaned by the WCA, whereas farm level canals are cleaned with the help of locals. Nonetheless, WCA is in charge of coordinating and monitoring this entire canal cleaning process. This particular transaction is non-heterogeneous in terms of spatial variation, meaning that irrigation canal maintenance has no major implications to wider ecosystems. Consequently, costs and benefits emerging from canal maintenance are measurable, i.e. can be identified and evaluated. The WCA chairman highlighted that the association is located in the downstream of the main canal and in the middle of two drainage canals. During water scarcity, water is lifted using electrical pumps for the irrigation from drainage water. As a result, this particular transaction is rather reversible, but bearing certain costs, as the users can benefit from alternative sources, such as drainage canals. Since the resource scarcity is not so apparent in this case in comparison to cases located in desert areas with frequent water scarcity problems, there is a rather moderate degree of modularity and decomposability. Last but not least, due to the chairman’s competence in leadership skills, the association has more legitimacy to sanction different actors who do not participate in the canal maintenance or comply with community rules with regard to the transaction (i.e. an activity of removing weeds and silts from the canal).

4. Explaining interdependence between nature-related properties of transactions and governance structures

In this chapter, we analyse the relationship between transactions, institutions and governance structures through employing the “discriminative alignment” principle (Williamson, 2000: 599).

We proceed following analytical steps:

(1) describe and define the differences between properties of physical nature-related transactions in pasture use and irrigation water management;
(2) describe and define the differences between core elements of the governance structures;
(3) align the difference of transactions to the core elements of the governance structures;
(4) conclude about key characteristics of the governance structures.

Comparing transactions

The characteristics of the transactions we study show some similar properties (Table 2). Resource users face difficulties to exclude others from the appreciation of the resources. Both transactions are highly respected as a traditional practice and important for securing the livelihood of the communities. Also both transactions share feature of complexity of the causal relationship of pastoral and irrigation systems.
We have found that the most of the properties are substantially different. We explain the differences by relating them with the three core elements of the governance structures.

**Table 2: Comparing properties of physical nature-related transactions**

<table>
<thead>
<tr>
<th>Properties of transaction</th>
<th>Maintaining irrigation canals (A)</th>
<th>Difference</th>
<th>Provision of fodder to livestock (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modularity &amp; functional interdependence</td>
<td>Moderate modularity and high functional interdependence</td>
<td>A&gt;B</td>
<td>Low modularity and high functional interdependence</td>
</tr>
<tr>
<td>Excludability</td>
<td>Difficult but feasible (non-payers/non-contributors can be excluded)</td>
<td>A=B</td>
<td>Difficult, costly, but feasible (e.g. constructing bars and fencing)</td>
</tr>
<tr>
<td>Rivalry</td>
<td>Strong rivalry (finite resource)</td>
<td>A&gt;B</td>
<td>Moderate, rivalry is depending on pasture location and quality</td>
</tr>
<tr>
<td>Asset specificity</td>
<td>Yes - canal maintenance requires knowledge, site and physically fixed, asset specific investments</td>
<td>A&gt;B</td>
<td>Moderate - requires asset specific investments (livestock, bars, winter fodder and experienced herders)</td>
</tr>
<tr>
<td>Frequency</td>
<td>Moderate (recurrent and seasonal but not regular)</td>
<td>A&gt;B</td>
<td>High - this transaction is related to the seasonal variation of pasture productivity.</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>Relatively certain (action-outcome linkage)</td>
<td>A&lt;B</td>
<td>High as many factors may affect outcome</td>
</tr>
<tr>
<td>Separability / Jointness in production</td>
<td>Separable - transaction related to the outcome</td>
<td>A&gt;B</td>
<td>Low due to diversification of income generating activities</td>
</tr>
<tr>
<td>Complexity</td>
<td>High – due to complex relationship between human-designed and natural system</td>
<td>A=B</td>
<td>High - the causal relationship between pasture use and related problems, such as overgrazing and degradation is complex</td>
</tr>
<tr>
<td>Heterogeneity/ Variability</td>
<td>Non-heterogeneous - irrigation canal maintenance has no spatial implications.</td>
<td>A&lt;B</td>
<td>High - transaction depends on many factors: the seasonal productivity of a pasture, the distance, location and exposition of pastures, weather and precipitation etc.</td>
</tr>
<tr>
<td>Measurability</td>
<td>Measurable - cost and benefit streams emerging from canal maintenance can be identified and assessed</td>
<td>A&gt;B</td>
<td>Low (e.g. unreliable statistics on livestock)</td>
</tr>
<tr>
<td>Reversibility and irreversibility</td>
<td>Reversible - drainage canals provide alternative source of resources</td>
<td>A&gt;B</td>
<td>Low as a limited amount of irrigated and rain fed land is available for fodder production</td>
</tr>
<tr>
<td>Legitimacy</td>
<td>High legitimate - association sanctions actors who do not participate in canal maintenance</td>
<td>A=B</td>
<td>High - highly respected as a traditional practice and important for securing the livelihood of the community</td>
</tr>
</tbody>
</table>

*Source: Adapted from Hagedorn (2002: 7-9) and Thiel et al. (2011: 9).*
Aligning the difference in nature-related transactions with institutions and governance structures

We assume that institutions and governance structures are shaped by contracting among economic actors for coordinating transaction, considering the costs of coordinating actors and organization of transaction (transaction costs).

In order to align the transactions with institutions and governance structures, we refer to the concept of hybrid governance structures (Hagedorn, 2008, 2013) and relate transactions with three core elements of this type of institutional arrangement: pooling, contracting and competition (Table 3).

Resource users pool some of their resources: in case of pasture management, it is common pastureland, and in case of irrigation system, it is human made irrigation infrastructure. This difference can be related to the difference of the modularity of transactions. For instance, high modularity of the transaction ‘provision fodder to livestock’ reflects high coherence of the non-designed pastoral system that is pooled in this type of hybrid institutional arrangement. This means also that this transaction is relatively more complex and more difficult to coordinate.

Individual choices of resource users are coordinated by contracts (usually incomplete). In pasture use we observe informal contractual arrangements between herders and livestock owners as well as formal agreements between livestock owners and PCs. In irrigation water management, there are informal and formal agreements between water users and WCAs. High uncertainty, high frequency and moderate assets specificity of the properties in pasture use require the flexibility of institutional arrangements and need less protective governance than in the case of irrigation water management, where we observe moderate uncertainty, moderate frequency and high assets specificity.

Resource users compete between themselves and other hybrids (other WCAs and pastoral communities). In case of irrigation water management, we observe low excludability & high rivalry between water users within WCA, which may lead to high competition and social dilemma. Low excludability & moderate rivalry between pasture users within and between communities create relatively moderate competition.

Table 3. Aligning physical transactions with governance structures in CPR management

<table>
<thead>
<tr>
<th></th>
<th>‘Khashar’ &amp; water use plan</th>
<th>Difference</th>
<th>‘Mal Koshuu’ &amp; pasture use plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pooling</td>
<td>Moderate modularity, measurability, reversibility &amp; variability of the transaction is related to fact that the human designed system is pooled in this type of institutional arrangement</td>
<td>Human designed &amp; natural systems</td>
<td>Low modularity, measurability, reversibility &amp; high variability of the transaction reflects the high coherence of the non designed natural system that is pooled in this type of hybrid institutional arrangement</td>
</tr>
<tr>
<td>Contracting (coordination of individual choices)</td>
<td>Moderate uncertainty, moderate frequency and high assets specificity require more protective governance</td>
<td>Need for protective governance</td>
<td>High uncertainty, high frequency and moderate assets specificity require flexibility of institutional arrangements and need less protective governance</td>
</tr>
<tr>
<td>Competition (rules for benefit sharing and dispute resolution)</td>
<td>Low excludability &amp; high rivalry within WCA leads to high competition and social dilemma</td>
<td>Level and scale of social dilemma</td>
<td>Low excludability &amp; medium rivalry within and between communities create relatively high competition and a social dilemma</td>
</tr>
</tbody>
</table>

Source: Based on Hagedorn (2013) and Thiel et al. (2011).
Thus, we can conclude that the difference of the properties of physical nature-related transaction in irrigation water and pasture use can be related and explain the difference of the key characteristics of two hybrid structures: type of the resources pooled, level and scale of social dilemma, and need for protective government.

5. Discussion and conclusions

In this paper we describe and analyse informal and formal institutions and governance structures in pasture and irrigation water management within the process of transformation in CA. We have relied our analysis on the heuristic framework that details Hagedorn’s (2008) Institutions of Sustainability (IoS), which underlines the importance of physical nature-related transactions for the understanding of institutions and governance structures.

In our empirical research approach, we followed the recommendation of Hagedorn (2013) starting with the analysis of actors’ actions, nature-related transactions and ‘rules in use’ as well as formal institutions and governance structures, concluding about the relationship between physical nature-related transactions and governance structures.

The study demonstrates that there is a strong and complex interrelation between different properties of transactions and governance structures. It presents an empirical application of the nature-related transactions concept.

What we learn from these empirical case studies about the nature of institutions and governance structures in CPR management in Central Asia?

The research results show that there is a high interdependence among actors in use of common pool resources and resource users are involved in multiple interactions with different actors at local, regional and national level. The interaction has been shaped by existing informal as well as new formal institutions and governance structures.

We argue that the difference of the properties of physical nature-related transaction in irrigation water and pasture use can be related and explain the difference of the key characteristics of two hybrid structures: Type of the resources pooled, level and scale of social dilemma, need for protective government.

What we have also observed is an increase of assets specificity of both transactions. Herders/livestock owners fence pasture land to produce fodder, build bars on pasture land. In irrigation system also WCA invest in changing earth to concrete canals and installing water pumps. Probably we can predict that this can affect other properties of transactions decreasing frequency and uncertainty, but increasing excludability.

How this may affect level and scale of social dilemma and need for protective government?

Can we expect that social dilemma will increase, more protective government in pasture and irrigation water management will be required, and formal governance structures such as Pasture Committee and Water Consumers Associations will play a greater role in future?

For future studies, the role of interplay of properties of transactions with characteristics of actors for institutionalisation process needs further research. For example how change of properties of
transactions can affect power relations in pasture use, or how leadership skills of a WCA head can affect or be affected by change of properties of transactions.

Moreover, the interrelation between properties of transactions needs to be specifically addressed, especially how different individual transactions, types of transactions and modules of transactions are related.

Acknowledgments

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## Attachment A. General characteristics of the selected case study in Kyrgyzstan

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Jergetal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>5 420</td>
</tr>
<tr>
<td>Pasture area (ha)</td>
<td></td>
</tr>
<tr>
<td>- Winter</td>
<td>11 643</td>
</tr>
<tr>
<td>- Spring / autumn</td>
<td>24 179</td>
</tr>
<tr>
<td>- Summer</td>
<td>49 278</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td>85 100</td>
</tr>
<tr>
<td>Livestock</td>
<td></td>
</tr>
<tr>
<td>- Horses</td>
<td>2440</td>
</tr>
<tr>
<td>- Sheep &amp; goats</td>
<td>27 706</td>
</tr>
<tr>
<td>- Cattle</td>
<td>2857</td>
</tr>
<tr>
<td>- Camel</td>
<td>41</td>
</tr>
<tr>
<td>- Poultry</td>
<td>2084</td>
</tr>
<tr>
<td>Number of herders providing services</td>
<td>70</td>
</tr>
<tr>
<td>Number of bars on pasture</td>
<td>146</td>
</tr>
<tr>
<td>Date of establishment of PUA/PC</td>
<td>2007, March 2011, April 2012</td>
</tr>
<tr>
<td>Number of PC members</td>
<td>23</td>
</tr>
<tr>
<td>Number of PUA members</td>
<td>104</td>
</tr>
<tr>
<td>Pasture fee (KGS)</td>
<td></td>
</tr>
<tr>
<td>Sheep &amp; goat</td>
<td>7</td>
</tr>
<tr>
<td>Cows</td>
<td>35</td>
</tr>
<tr>
<td>Horses</td>
<td>50</td>
</tr>
<tr>
<td>Young cattle</td>
<td>50</td>
</tr>
<tr>
<td>Yak</td>
<td></td>
</tr>
<tr>
<td>Total budget (KGS)</td>
<td>367 700</td>
</tr>
<tr>
<td>Collected amount (KGS)</td>
<td>108 226</td>
</tr>
<tr>
<td>Pasture fee collection rate</td>
<td>30%</td>
</tr>
</tbody>
</table>

*Source: Communal statistics of Jergetal, 2012.*
**Attachment B. General characteristics of the selected case study in Uzbekistan**

<table>
<thead>
<tr>
<th>Attributes of case</th>
<th>Khalach Kalti</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of ISA</td>
<td>“Kharkhur-Duoba”</td>
</tr>
<tr>
<td>Date of establishment</td>
<td>10.10.2006</td>
</tr>
<tr>
<td>Number of WCA employers</td>
<td>3</td>
</tr>
<tr>
<td>Name of WCA manager</td>
<td>Hasan Azimov</td>
</tr>
<tr>
<td>Name of WCA chief accountant</td>
<td>Rustam Radjabov</td>
</tr>
<tr>
<td>Educational background of WCA manager</td>
<td>Agricultural university (Agronomy)</td>
</tr>
<tr>
<td>Number of members</td>
<td>34</td>
</tr>
<tr>
<td>Membership fee (UZS per ha)</td>
<td>25,000</td>
</tr>
<tr>
<td>Total irrigated area (ha)</td>
<td>2,073</td>
</tr>
<tr>
<td>- Cotton</td>
<td>1,069 (52%)</td>
</tr>
<tr>
<td>- Wheat</td>
<td>627 (30%)</td>
</tr>
<tr>
<td>- Other crops</td>
<td>377 (18%)</td>
</tr>
<tr>
<td>Land quality (average <em>ball bonitet</em>)</td>
<td>45</td>
</tr>
<tr>
<td>Total length of irrigation canals (km)</td>
<td>56</td>
</tr>
<tr>
<td>Total budget for 2011 (UZS)</td>
<td>45.7 mln (with electricity cost included)</td>
</tr>
<tr>
<td>Collected amount in 2011 (UZS)</td>
<td>17.7 mln (in cash)</td>
</tr>
<tr>
<td>ISF rate in 2011</td>
<td>39%</td>
</tr>
<tr>
<td>Total debts by 01.12.2011 (UZS)</td>
<td>28 mln</td>
</tr>
</tbody>
</table>

*Source: Authors field discussion.*