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Major Problems of Water Management and Maintenance of on-farm Irrigation Systems in Central Kyrgyzstan

A Case Study from Kara-Suu Village, Naryn Oblast

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List of Acronyms

ARIS	Agency of Development and Investment of Communities
ADB	Asian Development Bank
DWMM	Department of Water Management and Melioration
FAO	Food and Agriculture organization of the United Nations
GDP	Gross Domestic Product
GTC	German Technical Centre
GWP	Global Water Partnership
ISF	Irrigation Service Fee
IWM	Integrated Watershed Management
IWRM	Integrated Water Resources Management
KNU	Kyrgyz National University
NGO	Non-governmental Organization
OWM	Oblast Water Management
RWMD	Rayon Water Management Department
UNDP	United Nations Development Program
USAID	United States Agency for International Development
USSR	Union of Socialistic Soviet Republics
UOS	Management of irrigation systems (today RWMD)
UWU	Union of Canal Water Users
WB	World Bank
WUA	Water User Association
WSS	Water Supply System

Glossary

Ayil Kenesh (kyrgyz)	Council of the deputies of village
Ayil Okmotu (kyrgyz)	Village administration
Ayil Okrug (kyrgyz)	Administrative and territorial unit, community
Aryk (kyrgyz)	Canal, channel
Bay (kyrgyz)	Rich man
Moncho (kyrgyz)	*Sauna (russ. Banya)*
Eginchi (kyrgyz)	Agriculturist, farmer
Hidropost (russ.)	Hydrological recording station
Kiyiz (kyrgyz)	Felt
Kolkhoz (russ.)	Collective farm
Murab (kyrgyz)	Water distributor, water master
Shyrdak (kyrgyz)	Embroidered in two layers ornamented felt
Sovkhoz (russ.)	State farm
Som *(kyrgyz)*	Monetary unit of the Kyrgyz Republic
Suugatchy *(kyrgyz)*	Irrigator

1. Introduction

1.1 Introduction to the Object of Research

Central Asia is one of the oldest centers of irrigated agriculture in the world. The first irrigation canals were built some five to six thousand years ago (HERRFAHRDT et al. 2006:46, MALATESTA et al. 2012:91). Because of the distinctive arid and semi-arid climatic conditions in almost the entire region, irrigation is one of the most essential factors ensuring a steadily and stable agricultural production. For this reason a constantly access to water is of great importance for the nations of Central Asia. Economy and life standard in these countries highly depend on irrigation, as rain-fed agriculture is faced with risks in many places.

Central Asia is a region with an unequal distribution of natural water resources, high water withdrawal and an overexploitation of water resources. The Central Asian republics Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan range among the countries with the highest water consumption worldwide, from 1575 m^3 (Kyrgyzstan) up to 5,952 m^3 per person/year (Turkmenistan) (FAO 2013:41). The agricultural sector in the region is responsible for more than 90 percent of the water consumption. This situation results from the pre-dominance of agricultural irrigation and its massive expansion during the Soviet period.

Set in Soviet economy policies, the former Soviet republics in Central Asia had to specialize in the production of highly water-consuming agricultural products (e.g. cotton) and thus the irrigation area was massively expanded since the early 1960s. The sharing of the water resources between the five Soviet republics in Central Asia was based on master plans for the development of water resources in the Amu Darya and Syr Darya river basins. The orientation towards large-scale irrigation agriculture led to an over-exploration of the regional water resources and inter alia finally to the Aral Sea catastrophe (MICKLIN 1988; LETOLLE and MAINGUET 1996, GLANTZ 1999, OPP 2007). Furthermore, the collapse and dissolution of the Soviet Union and the resulting national independence of Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan, and Turkmenistan in 1991, led to conflicting interests in the cross-border water usage as well as in considerable political, economic and social tensions between upstream and downstream riparian states (ABDOLVAND *et al*. 2014; BICHSEL 2009; ROST 2004; WEGERICH 2004).

The Kyrgyz Republic gained its independence in the aftermath of the dissolution of the Soviet Union in 1991. Agriculture was and still is a significant part of the country´s economy. According to FAO (2013:131), the gross domestic product (GDP) was

4,616 million US-Dollars; in 2010 agriculture contributed 21 percent. Since about 66 percent of the population lives in rural areas (NATSIONAL'NYY STATISTICHESKIY KOMITET KYRGYZSKOY RESPUBLIKI 2012:36), the agricultural sector employs a large part of the working population of Kyrgyzstan.

Because of the mountainous topography, irrigated agriculture in Kyrgyzstan is concentrated to the mountain forelands, the main river valleys, and the eastern surroundings of the Issyk Kul Lake (Figure 1). Only 6.8 percent of the total land area (199,949 km^2), mostly in lowlands and intramontane basins, is used for crop cultivation, whereas animal husbandry remains the most significant part of the agricultural economy in the mountain areas (FAO 2013:131). Subsistence agriculture has become increasingly important since the dissolution of the former state and collective farms in the mid-1990s.

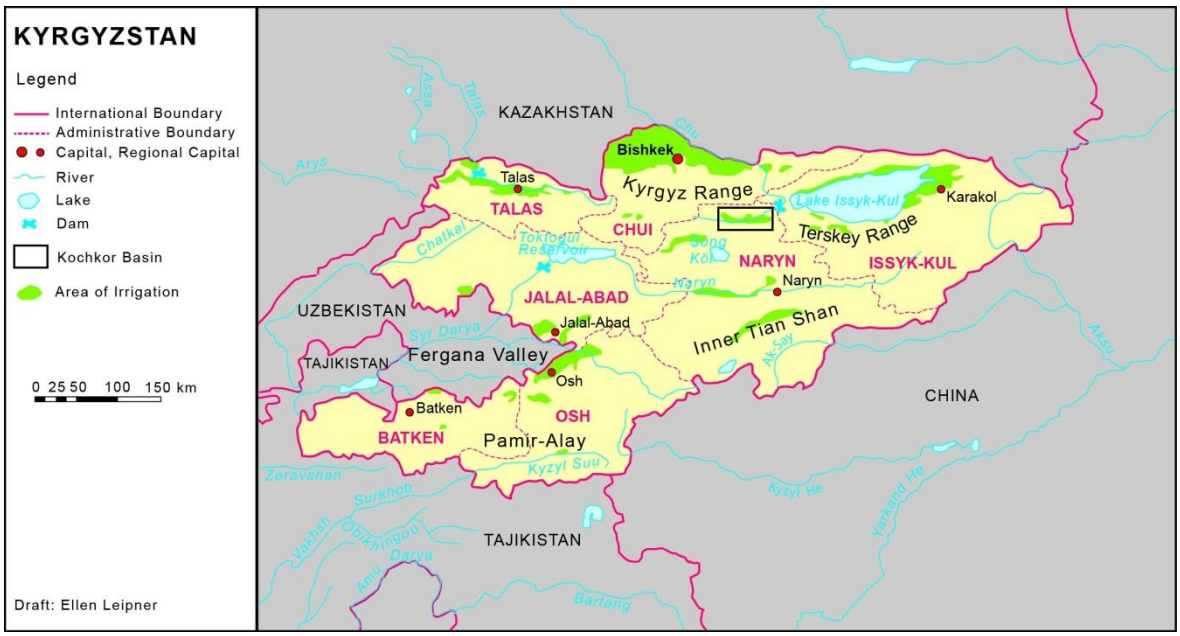

Figure 1: Irrigated areas of the Kyrgyz Republic and the research area in the Kochkor basin (Draft: Leipner, 2014).

Irrigation is of key importance for the agricultural sector. According to KAZBEKOV *et al*. (2009:1259) by efforts from the Soviet administration the area of arable land in Kyrgyzstan increased from 200,000 hectares in 1945 to 1 million hectares in 1990. Cultivated area was extended during the following decade to 1.35 million hectares, with 1.07 million hectares of them (or 80 percent) being irrigated (HERRFAHRDT *et al.* 2006:43).

Since independence in 1991, the Kyrgyz government has carried out various reforms on all levels of society, politics and economy (ABAZOV 1999). One of the major challenges was the so-called “agrarian transition” with the privatization of agricultural land (SPOOR 1995, 2004). In the process of the dissolution of the former Soviet state farms (*sovkhozy*) and collective farms (*kolkhozy*) their arable land was distributed among the

local population. Thus, small peasant farms, cultivating between 0.2 and 0.5 hectares, became the main form of agricultural activities. According to FAO (2013:132) 301,935 farms existed in the Kyrgyz Republic in 2005 of which 300,935 are peasant farms. It soon became evident that the land reform process and the transformation of the former state and collective farms into numerous individual farms also made necessary a water governance reform (HERRFAHRDT *et al*. 2006; SEHRING 2007; ABDULLAEV *et al*. 2009).

During the Soviet period, agricultural irrigation was managed by a two-level system: Main irrigation canals, delivering water from the water source to two or more collective and state farms, had an inter-farm status. These off-farm canals were operated and maintained by the state. Irrigation canals of the lower level transported the water directly to the fields of the collective or state farms, which were responsible for operation and maintenance of these on-farm canals.

After the national independence, the Kyrgyz Republic became responsible for managing, maintaining, and financing the former centralized agricultural irrigations system. However, the land reform process had widely ignored the resulting impacts on the irrigation water management. In particular the on-farm irrigation infrastructure, that was formerly operated and maintained by the sovkhozes and kolkhozes, became obsolete (SEHRING 2005; ABDULLAEV *et al*. 2010). In 1994, the responsibility for the on-farm irrigation network was transferred to the local village administrations (*ayil okmotu*). However, the absence of adequate institutional structures for the on-farm irrigation management as well as the lack of funds and knowledge resulted in unreliability of irrigation management and an increased deterioration of the irrigation infrastructure. In many regions, irrigation channels have not been cleaned or maintained since the late 1980s. As a result, 22,700 kilometer of irrigation canals and other hydraulic engineering constructions remained without service after the independence of Kyrgyzstan (TSENTRAL'NOAZIATSKAYA KONSALTINGOVAYA KOMPANIYA CAICONSULTING 2010:12). Most channels have significant structural damages and mostly missing sluice values (water outlet). The identification of shortcomings in the irrigation management and its reform towards a more efficient and sustainable system is hence one priority in the general reform of water resources management.

To improve the irrigation management on the former collective farm level and to maintain the irrigation infrastructure, the Central Asian states - influenced by international agencies (e.g. World Bank, Asian Development Bank) - started the establishment of so-called Water User Associations (WUAs) in the mid-1990s (e.g. HERRFAHRDT *et al*. 2006, SEHRING 2007; ABDULLAEV *et al*. 2010). Most WUAs are interconnected to international donor activity and have been established in the framework of community development programs. Within the framework of the project "Capacity Building for the Formation and

Management of Water User Associations (1995–1998)", financially supported by the Asian Development Bank, the Kyrgyz government initiated in 1996 the establishment of the first three pilot WUAs (SEHRING 2005:7; TSENTRAL'NOAZIATSKAYA KONSALTINGOVAYA KOMPANIYA CAICONSULTING 2010:14). First results have contributed to the formation of further WUAs in other parts of Kyrgyzstan. According to TSENTRAL'NOAZIATSKAYA KONSALTINGOVAYA KOMPANIYA CAICONSULTING (2010:15), 475 WUAs have been founded nationwide until 2010, serving 736,000 hectare of arable land (73.7 percent of the total irrigation area in Kyrgyzstan).

However, the evaluation of the mainly donor-driven WUAs in Uzbekistan, Kyrgyzstan and Tajikistan shows that such projects often have not been efficient and effective, mainly due to their bureaucratic top-down implementation (UL HASSAN *et al*. 2004; SEHRING 2007; KAZBEKOV *et al*. 2009; ABDULLAEV *et al*. 2010). Many of them have not realized their designed or potential productivity due to an inefficient use of water, problems of equal water distribution and water allocation, or the non-performance of maintenance on the part of the water users. According to SEHRING (2007:288), the local governance often does not provide the necessary conditions and incentives. Furthermore, many WUAs are still dominated by the local elites and are confronted with financial problems. In Central-Kyrgyzstan many of these WUAs only exist on paper or have been dissolved soon after their implementation.

The following research focuses on the water management and maintenance of an on-farm irrigation network in the Kochkor basin (Central-Kyrgyzstan), based on the example of the rural village of Kara-Suu (see Figure 1). In general there exists a lot of scientific research on the Post-Soviet institutional reform of the agricultural irrigation sector and the implementation of WUAs in Kyrgyzstan (e.g. HERRFAHRDT *et al*. 2006; SEHRING 2005, 2007). However, most of the studies are concentrating on areas with a long (Pre-Soviet) irrigation tradition, like in the Fergana basin (e.g. ABDULLAEV *et al*. 2006, 2010; KAZBEKOV *et al*. 2009) or in the Chui Oblast (province) in Northern Kyrgyzstan near the capital of Bishkek (SEHRING 2005). Little research on this topic has been done yet in the mountainous areas of Central Kyrgyzstan (e.g. Naryn Oblast), where the ethnic Kyrgyz population has a rich tradition of nomadic animal husbandry, but no indigenous knowledge of irrigated agriculture.

1.2 Research Questions and Hypotheses

According to HUNT (1989) WUAs are based on an analogy with traditional irrigation communities. The novelty of this present study is to analyze the issues of management and maintenance of an irrigation system in the Kochkor basin (Central Kyrgyzstan), where agricultural farming and irrigation were only implemented during the second period of

Soviet collectivization of agriculture in the 1950s. Due to the traditional nomadic lifestyle in this region there was hardly a compelling need for the construction and management of an agricultural irrigation system in this region prior to the introduction of the large-scale cultivation of fodder crops and the implementation of Soviet collective farms. Thus, on the example of Kara-Suu village this thesis focuses on the following questions:

- What are the characteristic features in the management and maintenance of the irrigation system in the Soviet period?
- What changes did occur in the structure of water distribution and irrigation management after the independence of the Kyrgyz Republic?
- Which circumstances contributed to the deterioration of the local irrigation system?
- Which measures could improve the management of the local on-farm irrigation network?

The research was done within the framework of the Kyrgyz-German project "*Integrated Watershed Management in Central Asia - Implementing an Educational and Research Concept for Capacity Building in Kyrgyzstan*" (ROST 2014). Project partners are the Freie Universität Berlin, the Kyrgyz National University (KNU) in Bishkek and the Albert-Ludwigs-Universität Freiburg. The project is financed by the German Volkswagen Foundation. Its main objectives are to implement a Master-study program on Integrated Watershed Management at the Kyrgyz National University to introduce the Integrated Watershed Management approach in Central Asia. To set-up local teaching capacities, Kyrgyz post-graduates were trained in the catchment of the Ukok river, a small tributary of the upper Chui river (see Figure 1). One of the main objectives was the investigation of problems in the operation, management, and maintenance of on-farm irrigation systems in the Ukok river catchment.

1.3 Research Design

The introduction chapter provides basic information on Kyrgyzstan and the research topic, additionally the research questions are outlined here. In the second chapter the most important facts and information on the concept of Integrated Watershed Management are presented. Furthermore a brief description of the goals and objectives of the project "Integrated Watershed Management in Central Asia - Implementing an Educational and Research Concept for Capacity Building in Kyrgyzstan" is presented. The third chapter is dedicated to the description of the institutional framework of governance in the Kyrgyz water management. The fourth chapter introduces the study area on both physical (natural characteristics) and human (anthropogenic influences and structures) aspects. This chapter describes the features of nature and climate as well as the socio-economic situation in the village of Kara-Suu. The fifth chapter gives an overview on the methods

applied during the field research. Besides it is explained how the needed information was collected, processed and evaluated. The sixth part is the result chapter. The institutional environment and the structures of maintenance and management of irrigation systems in the Kyrgyz Republic on the example of Kara-Suu are described and compared to structures of the Soviet time. In the seventh chapter all results and findings will be discussed and linked to the topic of this thesis. In this chapter summarizes the results of the study, and also gives some recommendations for possible improvements in the management and maintenance of irrigation systems. The eighth chapter is a brief summary of the scientific work. Field survey data for the period from 2010 to 2013 were used in writing this work.

2. The Conceptual Approach: IWRM or IWM?

Over time, water resource management in Central Asia underwent many transformations. Often these transformations have been an expression of social, economic, technological and political changes in the society. The traditional irrigation schemes and the decentralized small-scale irrigation farming systems of the pre-Soviet period were replaced by the large-scale centralized and more production-oriented irrigation system of the Soviet Union (HERRFAHRDT *et al.* 2006; ABDULLAEV and RAKHMATULLAEV 2013). Water management was then characterized by an engineering approach, focused on technical solutions to meet the increased demand for water in the agricultural sector. Furthermore, water management in the former Soviet Union followed a strong hierarchical top-down structure with only limited opportunities for the participation of end-users (HERRFAHRDT *et al*. 2006).

This unsustainable practice led to an inefficient utilization and overexploitation of water resources, with negative environmental consequences. The most famous example in Central Asia is the Aral Sea disaster (MICKLIN 1988; LETOLLE and MAINGUET 1996; GLANTZ 1999). The highly techno-centric water management hardly considered the ecological and socio-economic consequences (HERRFAHRDT *et al*. 2006). It proved to be unsuitable for an efficient and sustainable water resources management. Consequently, it is necessary to adopt new water management strategies in this region. However, there were hardly any efforts to develop watershed management structures in the successor states of the former Soviet Union during the 1990s (ARONSON 1998:251).

After the independence of Kyrgyzstan, overall reforms have become necessary due to various reasons. One major reason for denationalizing the irrigation management in Kyrgyzstan was the state budget crisis. The dissolution of the Soviet Union led to a termination of the state subsidizing of the economy of Kyrgyzstan including the water sector. Another reason was the land reform of the Kyrgyz Republic that resulted in the fragmentation of agricultural land ownership including the on-farm irrigation management structures. The responsibility of the on-farm irrigation was transferred to the water users. In this situation, international donors were willing to finance the irrigation sector as subject to the implementation of Integrated Water Resources Management (IWRM) principles. Thus the Kyrgyz government decided to reform water management according to the principles of IWRM (HERRFAHRDT *et al*. 2006:4).

Promoted by international donor organizations (e.g. World Bank, Asian Development Bank), the concept of Integrated Water Resources Management (IWRM) has been introduced in the Central Asian countries during the last two decades to offer a conceptual

framework of basic principles for a new water management (HERRFAHRDT *et al*. 2006). The IWRM-approach is based on the main principles formulated in the International Conference on Water and the Environment in Dublin 1992, which also contributed to the Agenda 21 recommendations adopted at the UN Conference on Environment and Development (UNCED) in Rio de Janeiro 1992. The four Dublin principles are according to the GLOBAL WATER PARTNERSHIP (2000:13f):

(1) Fresh Water is a finite and vulnerable resource, essential to sustain life, development and the environment.
(2) Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.
(3) Women play a central part in the provision, management and safeguarding of water.
(4) Water has an economic value in all its competing uses and should be recognized as an economic good.

According to an often quoted definition of the Global Water Partnership – Technical Advisory Committee (GWP–TAC) Integrated Water Resources Management is:

"*... a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems*" (GLOBAL WATER PARTNERSHIP 2000:22).

In this regard GLOBAL WATER PARTNERSHIP (2000:14) notes that water is a limited and vulnerable resource (see Dublin Principle No. 1), whose management requires a holistic view of all characteristics of the hydrological cycle as well as its interaction with other natural resources and ecosystems. Furthermore it is recognized, that a holistic management not only requires the management of natural resources, but also a coordination of human activities, which create the water demands, determine the land utilization and generate water-borne waste products (GLOBAL WATER PARTNERSHIP 2000:15).

Although Integrated Water Resources Management (IWRM) has become a popular concept during the last two decades, the approach has been more or less a rediscovery of a more than 60-year old concept (BISWAS 2004: 249). Despite the "new" popularity of this concept, the definition of Integrated Water Resource Management is rather vague or inconsistent, with diverse denominations of the approach (BISWAS 2004, CARDWELL et al. 2006; SARAVANAN *et al*. 2009). The term "Water Resource Management" is imprecise in light of the previously cited definition. It implies rather solely a management of the

resource "water", while according to the definition of the GLOBAL WATER PARTNERSHIP (2000:22) "*IWRM is a process which promotes the co-ordinated development and management of water, land and related resources ...*".

In this respect, the similar approach of Integrated Water*shed* Management (DIXON and EASTER 1991, HEATHCOTE 1998, FFOLLIOTT *et al.* 2003, FÖRCH and SCHÜTT 2004) seems to be more precise. This concept endorses some of the same principles, like the Integrated Water Resources Management (IWRM) approach promoted by the international water community. Integrated Water*shed* Management (IWM) provides an appropriate perspective for a sustainable land and resource utilization on the spatial basis of the open system of a hydrologic watershed or catchment, whose boundaries are determined by topographically delineated water divides (DIXON and EASTER 1991:5; FFOLLIOTT *et al*. 2003:1; FÖRCH and SCHÜTT 2004:122). Early in the mid-1980s EASTER and HUFSCHMIDT (1985:1) defined Integrated Watershed Management as:

"... a *process of formulating and implementing a course of action involving natural, agricultural, and human resources of a watershed, taking into account the social, economic, and institutional factors operating within the watershed and the surrounding river basin and other relevant regions to achieve specific objectives".*

The size of a watershed can range from a few square metres to thousands of square kilometres (TIDEMAN 1996:346, FARRINGTON *et al*. 1999:5, LAL 2000:4). The terms watershed, catchment and river basin are often used interchangeably. However, authors like EASTER and HUFSCHMIDT (1985:1) or FFOLLIOTT *et al.* (2003:1) have pointed out that a watershed is a smaller upstream catchment respectively a drainage subarea of a river basin. This perspective also implies the linkage between uplands and downstream areas.

Regardless of this terminological blurring, a watershed is a spatial ecosystem-based hydrological unit, which involves biophysical interrelationships along with socio-economic and institutional/organizational interrelationships (EASTER and HUFSCHMIDT 1985; DIXON and EASTER 1991, FFOLLIOTT *et al.* 2003, FÖRCH and SCHÜTT 2004). The holistic Integrated Watershed Management (IWM) concept takes into account human interactions (e.g. land use) with the environment. As a development measure the Integrated Watershed Management concept implies the sustainable use of natural resources and serves as a planning tool for rural development projects (EASTER and HUFSCHMIDT 1985, DIXON and EASTER 1991, FÖRCH and SCHÜTT 2004). Consequently, FFOLLIOTT *et al*. (2003:1) state that Watershed Management:

"Organizes and guides the use of land, water, and other natural resources on a watershed to provide the goods and services demanded by society, while ensuring the sustainability of the soil and water resources".

This approach requires the knowledge from various disciplines and a complex cooperation of all stakeholders. External specialists as well as administrations units, organizations, interest group, political decision makers, and the local population need to be involved in the decision-making process (FARRINGTON *et al*. 1999, FÖRCH and SCHÜTT 2004).

On the one hand, the success of the IWM-approach strongly depends on the acceptance of project measures by the local people and relies on their integration and participation in planning, utilization and monitoring processes. On the other hand, the establishment of appropriate management organizations and associations is indispensable (FARRINGTON *et al*. 1999, FÖRCH and SCHÜTT 2004). Participation will help to pursue a balance between a top-down and a bottom-up approach to watershed management.

Overall there are significant substantive similarities between the two concepts Integrated Water Resources Management (IWRM) and Integrated Watershed Management (IWM). According to its designation and its substantive orientation, the main focus of the IWRM-concept lies on the management of water resources. The IWM – approach refers to the water*shed* as a spatial ecosystem-based hydrological unit and emphasizes holistic consideration of biophysical interrelationships along with socio-economic and institutional/organizational interrelationships for a sustainable land use. Both concepts work best, when different scales of river basins are taken into account (EASTER and HUFSCHMIDT 1985; FFOLLIOTT *et al*. 2003). However, although upstream catchment respectively small drainage subunits as basic hydrological units play a critical role within a basin, they are often neglected in river basin management. The application of the IWM-approach is usually focused on managing the upper reaches of river basins (EASTER and HUFSCHMIDT 1985).

In the case of the Ukok river a tributary of the upper Chui river (see Figure 11), the IWM-approach has been applied within the project, as it is an appropriate concept for rural development projects in the planning and implementation of resource management (ROST 2014). However it should be noted, that both concepts are no blueprints. Their contents can not be implemented in practice one to one. They must be adapted to the local natural, socio-economic, cultural and traditional circumstances.

Meanwhile, there are some publications on the post-soviet transformation of the water resources management and the agricultural irrigation management in the Central Asian states. Here, the regional focus is primarily on appropriate investigations in Uzbekistan,

Kyrgyzstan and Tajikistan (WEGERICH 2004, SEHRING 2007, ABDULLAEV and RAKHMATULLAEV 2013). Especially the study of HERRFAHRDT *et al*. (2006) deals with the transformation of water governance in the Kyrgyz agricultural sector. In particular HERRFAHRDT *et al*. (2006) examine in how far the principles of Integrated Water Resources Management (IWRM) approach have been implemented in the first phase of the reorganization of the agricultural irrigation management at national level. Besides the assessment of the status quo of the IWRM implementation process in Kyrgyzstan this reveals existing problems in the transformation of the institutional structure of water management. According to HERRFAHRDT *et al*. (2006:2) the Kyrgyz water management is indeed heading towards IWRM in the initial stage of the reform. Most progress has been achieved in the decentralization of agricultural management, since most on-farm irrigation infrastructure was transferred from the former Soviet state and collective farms to the so-called Water User Associations (WUAs).

In Central Kyrgyzstan many of the WUAs only exist on paper or have been dissolved soon after their implementation. However, there are hardly any detailed, locally based cases that demonstrate why the introduction of WUAs in some communities of Central Kyrgyzstan has not been successful.

3. Institutional Framework of Governance in the Kyrgyz Water Management

3.1 The Post-Soviet Transformation of Water Management

The difficulties and obstacles which Kyrgyzstan´s irrigation management faces are at least partly rooted in the specific institutional environment. At the time when the Russian Empire conquered Turkestan during the 19th century the so-called elders (*aryk-aksakal*) had been in charge of the irrigation management and supervised the water masters (*murab*), who were responsible for an equal distribution of water between the different fields and gardens. These *murabs* were elected by the water users and acted also as mediators in case of any water-related disputes (MIDDENDORF 1882:169, ABDULLAEV and RAKHMATULLAEV 2013:3ff., O'HARA 2000:373). The *murabs* also had to organize the cleaning and repair of canals. *Aryk-aksakals* and *murabs* received a part of the harvested crop as reward for their work. But their remuneration depended on the quality of their service. The farmers decided how much of their harvest was given to the *aryk-aksakals* and *murabs* (MIDDENDORF 1882:169).

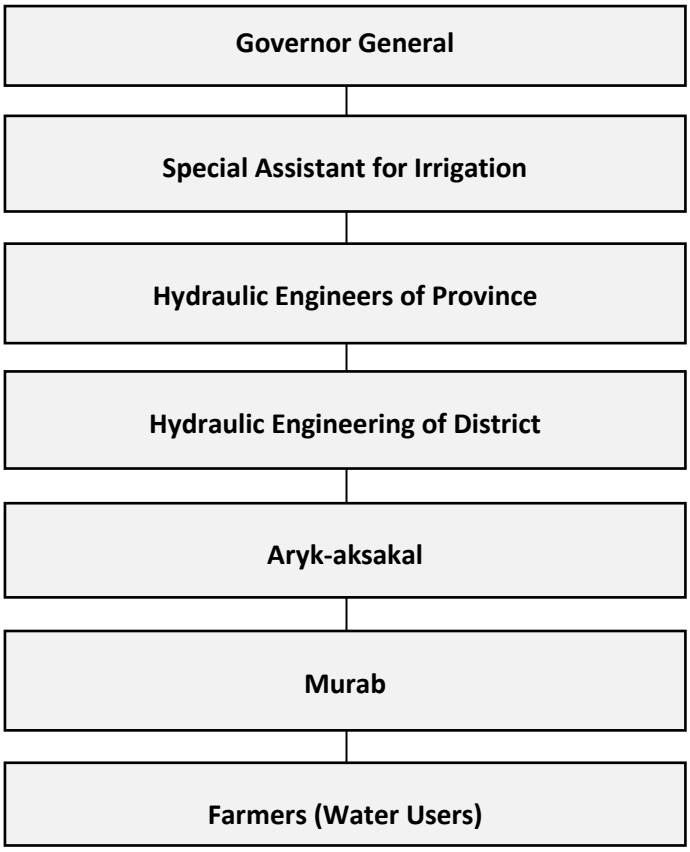

Figure 2: Water management structure in Central Asia in the pre-Soviet period according to the MIRZAEV (2001) (Draft: Kasymov, 2014).

The Russian Tsarist administration recognized this traditional way to manage the water supply as appropriate and, therefore, decided not to cardinally change this local system of governance (MIDDENDORF 1882:169), although the system of management started slightly to change (Figure 2).

A new structure of water resource management emerged in the Soviet period by the end of the 1950s (MIRZAEV 2001:18f.). The main authority involved in water resources management was the Ministry of Melioration and Water Management of the USSR (Figure 3). The competence of this organization was to create laws in the water sector and to define a strategy for the development of the water economy of the USSR. The Ministry comprised departments for research, design and building. The development of major projects in the water sector was carried out and the distribution of water resources was decided here. This ministry controlled the operation of the hydro land reclaiming systems and the protection of the water resources too (MIRZAEV 2001:18f.).

Such ministries worked in all Soviet republics, but were subordinated to the Union Ministry. The Kyrgyz Ministry of Melioration and Water Management was integrated into the action plans developed by the Moscow Ministry. Water resources management on the administrative level of the *oblast* (province) was carried out by the *Oblast Water Management Department* (OblVodKhoz) and on the *rayon* (district) level by the *Rayon Water Management Department* (RayVodKhoz). These subordinate organizations were the main executive bodies responsible for the water management. The *Oblast Water Management Department* was responsible for distribution of irrigation water to the districts and controlled the water management of the several districts, situated in the province. Furthermore the Oblast Water Departments collected data on water allocation and developed plans for water usage. The Rayon Water Departments had to manage irrigation water distribution to secondary and tertiary channels within their districts (MIRZAEV 2001; HERRFAHRDT *et al.* 2006). The lowest level in water management was built by the collective and state farms engaged in water resource management within their territories. Brigade leaders were responsible for determining the water demand for their respective unit on the farm and provided this information to the relevant hydro-technician of the state farm respectively collective farm he collected these requests from the several units and determined the total need of irrigation water for the farm to the higher authorities (HERRFAHRDT *et al.* 2006).

After independence in 1991, water governance in Kyrgyzstan has been fundamentally reorganized several times. The newly founded Kyrgyz Republic was suddenly self-responsible for the irrigation management within its territory. A land reform entailed the dissolution of the former collective and state farms and the privatization of arable land.

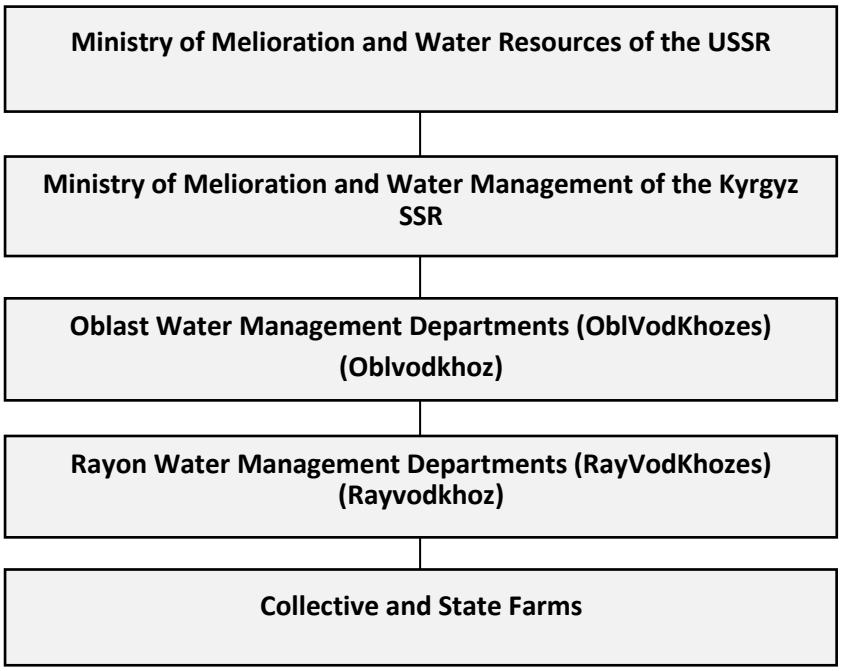

Figure 3: Water management structure in the Kyrgyz SSR during the Soviet period according to MIRZAEV (2001) (Draft: Kasymov, 2014).

Furthermore, this transformation strongly affected the on-farm irrigation management as the former *kolkhozes* and *sovkhozes* were no longer responsible for the operation and maintenance of the on-farm irrigation infrastructure and the water distribution. As a result, a large number of newly established small peasant farms has now to be supplied with water for irrigation. The intention and the economic capacity of these smallholders to jointly operate and maintain their inherited irrigation system was unincisive (UL HASSAN *et al*. 2004, SEHRING 2005), as secondary and tertiary irrigation canals systems had formally be designed for unitary management on *kolkhoz* and *sovkhoz* level. This misfit between the inherited large-scale Soviet water management system and the new private land ownership pattern made inevitable a reform of the water management system in Kyrgyzstan.

The main legal basis on which the water sector has to operate is *The Water Code of the Kyrgyz Republic* adopted in 2005. This legal document emphasizes the economic mechanisms of water management and codifies the legal rights of the various water users to operate and manage the on-farm irrigation system by establishing WUAs. These self-governing associations should allow a group of water users to jointly operate, finance and maintain an irrigation water system. Thereby, the principles of the IWRM – approach should be taken into account (HERRFAHRT *et al*. 2006).

But up to now, still outdated documents from Soviet times, which are in contrary to the provisions of the Kyrgyz New Water Code and the principles of IWRM, regulate the water relations (VALENTINI and OROLBAEV 2010:5). But it does not describe the mechanisms for

the implementation of provisions of the New Water Code. This fact necessitates the development of normative acts to regulate water relations. VALENTINI and OROLBAEV 2010 also note that the reforms have not yet been completed. In this regard, one can observe the contradictions between the laws on the one side and the practical activities on the other side. The current management system which is based on several reforms, still requires improvement. The existing structure of government creates conditions in which the Central Executive body has significant power, which in turn leads to a centralization of all activities. Decisions are mostly made on national level. The national, oblast (province), rayon (district) and local (communal) levels are parts a vertical structure of management (VALENTINI and OROLBAEV 2010:5ff.).

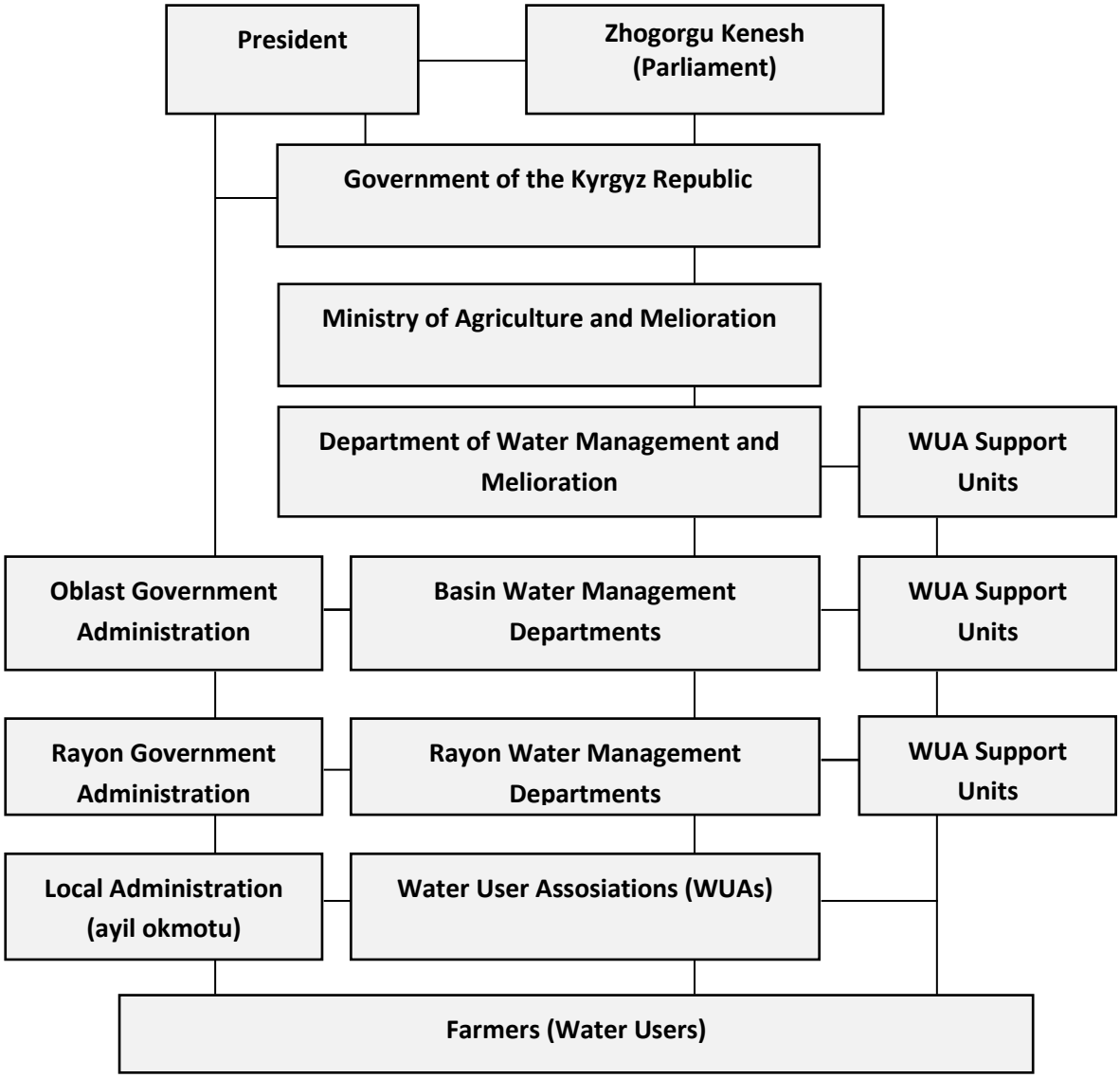

Figure 4: Modern Water Management Structure of the Kyrgyz Republic (Draft: Kasymov, 2014. Data base: UL HASSAN et al. 2004:9, modified).

According to the new Water Code of the Kyrgyz Republic and based on the IWRM principles, the water management, which has previously been based on administrative units (province, district), should take place within the boundaries of the principal hydrological basins (KYRGYZ REPUBLIC 2006), which relate to lake Issyk-Kul and the major rivers of Kyrgyzstan. With two exceptions, the administrative province (oblast) boundaries are more or less congruent with the major hydrological basins (Figure 5). Only the rivers Naryn and Chu cross provincial boundaries in Kyrgyzstan. For the study area, the Ukok river catchment, located in the upper Chu river basin, this means an administrative assignment to Naryn province. However, in hydrological terms this area is part of the Chu river basin.

The national water sector is managed by the *Department of Water Management and Melioration* (*Departament Vodnogo Khozyaystva i Melioratsii*) as executive body (Figure 6). It is part of the Ministry of Agriculture and Melioration, but based on a separate budget. The department has the following tasks: planning, organization and implementation of measures of administrative, economic and legal regulation of water use, operation of water objects, protection of lands in water catchment areas, and regulation of interstate water relations on the use of water resources formed on the territory of the Kyrgyz Republic. In the sphere of irrigation and drainage the department carries out maintenance, technical service, repair, design and construction of new irrigation and drainage systems and other water installations. It also supplies water to water users and takes care for the collection of money for services to supply irrigation water (DEPARTMENT OF WATER MANAGEMENT AND MELIORATION 2014).

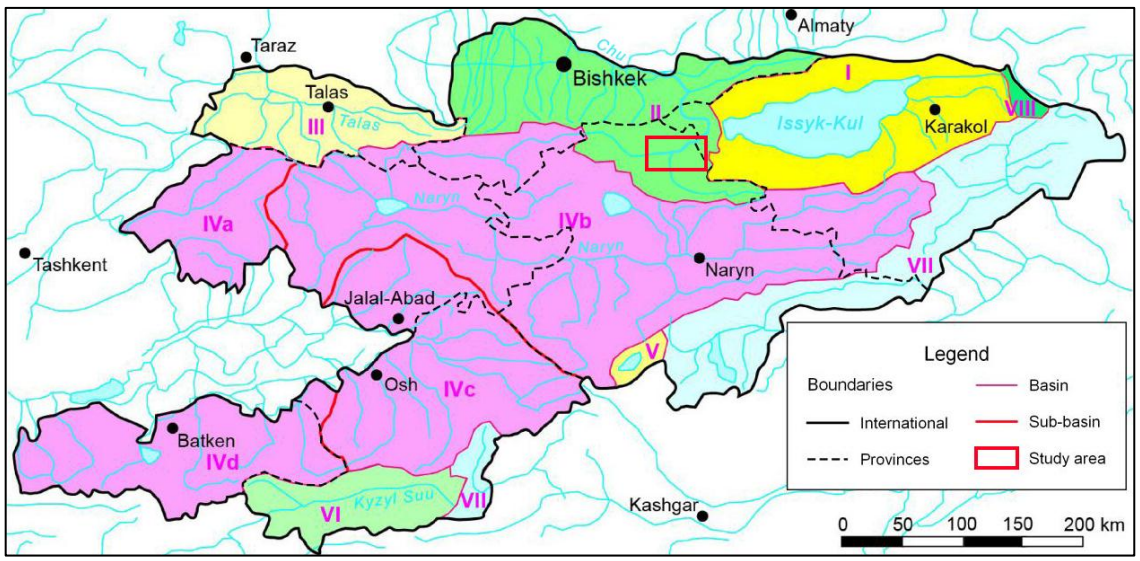

Figure 5: Basic hydrological basins of Kyrgyzstan. Hydrological basins: I – Issyk-Kul basin; II – Chu river basin; III – Talas river basin; IV - Syrdarya river basin (IVa – Rivers the northern part of the Fergana Valley; IVb – Naryn river basin; IVc - Karadarya river basin; IVd - Rivers southern part of the Fergana valley; V – Chatyr-Kul lake basin; VI - Amudarya basin; VII – Tarim river basin; VIII – Balkhash lake basin (according to GOSUDARSTVENNOE AGENTSTVO PO OKHRANE OKRUZHAYUSHCHEY SREDY I LESNOMU KHOZYAYSTVU PRI PRAVITEL'STVE KYRGYZSKOY RESPUBLIKI 2008:134).

The structure in Figure 6 shows that the *Department of Water Management and Melioration* comprises elements from the former Soviet water management organizational structure as well as elements that emerge as a result of the latest reforms. The department has branches of province (oblast) and district (rayon) level. In the seven provinces (oblasti) of Kyrgyzstan, the former Soviet *Oblast Water Management Departments* (OblVodKhozes) were renamed *Basin Water Management Departments* in 1997. This renaming mainly reflects the fact that, according to the new Water Code and the IWRM principles, water management should no longer be organized on the basis of administrative units (e.g. provinces), but on the basis of hydrological basins. However, in fact it is more or less simply a renaming of the pre-existing *Oblast Water management Departments* (HERRFAHRDT *et al*. 2006:67). It is mainly the simple displacement of one institutional arrangement by another one.

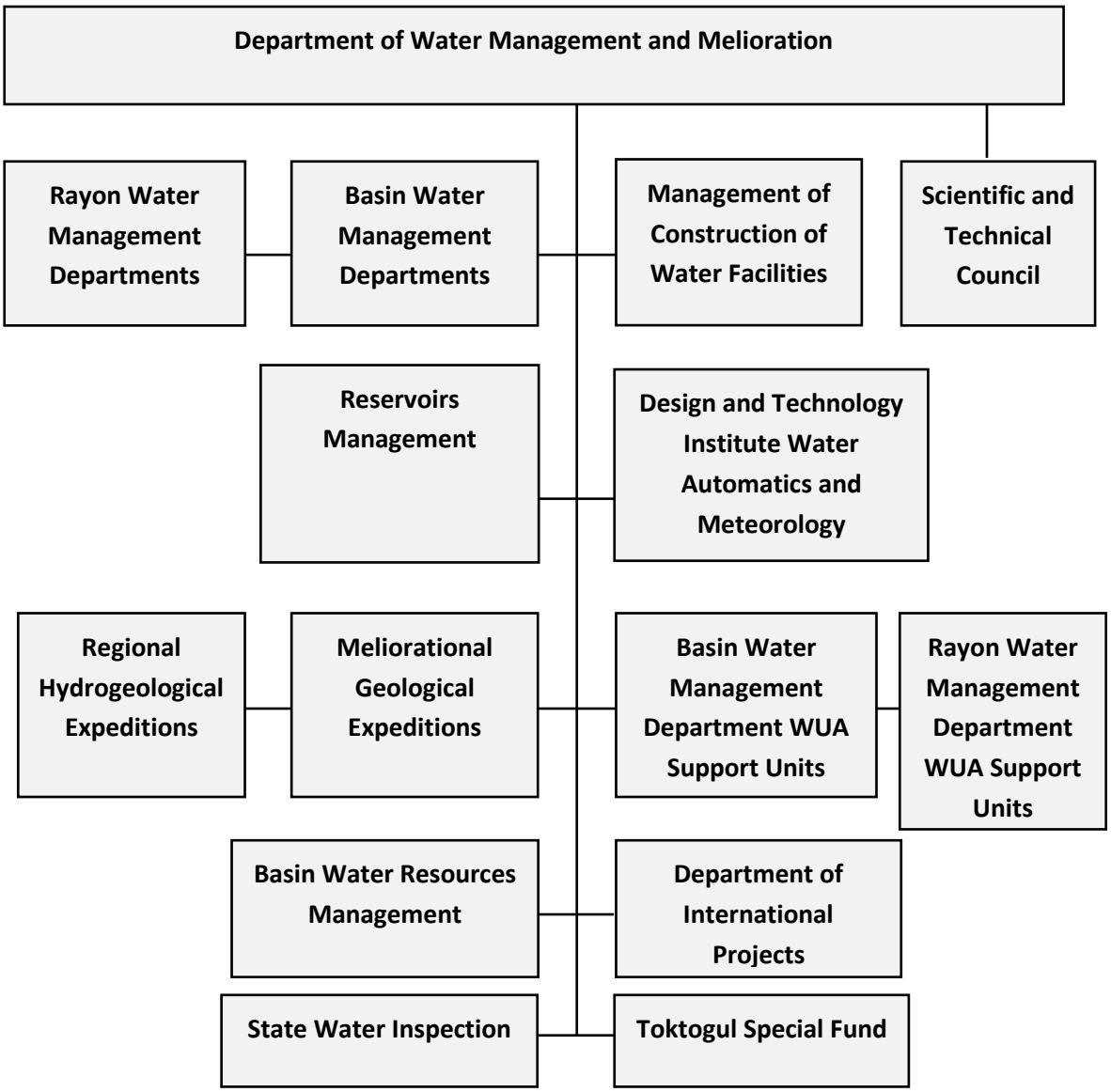

Figure 6: The today's structure of the DWMM (Data base: DEPARTMENT OF WATER MANAGEMENT AND MELIORATION 2014).

Within the framework of the Department of Water Management and Melioration, the Basin Water Management organizations and District (Rayon) Water Management Departments (RayVodKhoz) are the main executive bodies of the irrigation management. Between them there is an administrative hierarchy, where the functions of control, supervision and planning are established in the higher authority, whereas the subordinated District Water Management Departments (RayVodKhoz) are the main implementing authorities, which are formally or directly interacting with water users on irrigation water delivery (UL HASSAN *et al*. 2004:10).

The Basin Water Management Departments implement a unified water policy in operating and construction of irrigation systems in the provinces. They supervise the District Water Management Departments (RayVodKhoz) and collect various data on water usage. In addition, they are responsible for collecting data on financial requirements and costs by the District (Rayon) Water Management Departments. They submit annual reports about the water use in the districts and develop a plan for water use, which is approved by the Department of Water Management and Melioration. The report also deals with the distribution of available water resources between the different districts within the province. The Basin Water Management Departments also employ a construction company for large construction projects in the off-farm irrigation infrastructure (UL HASSAN *et al*. 2004:14).

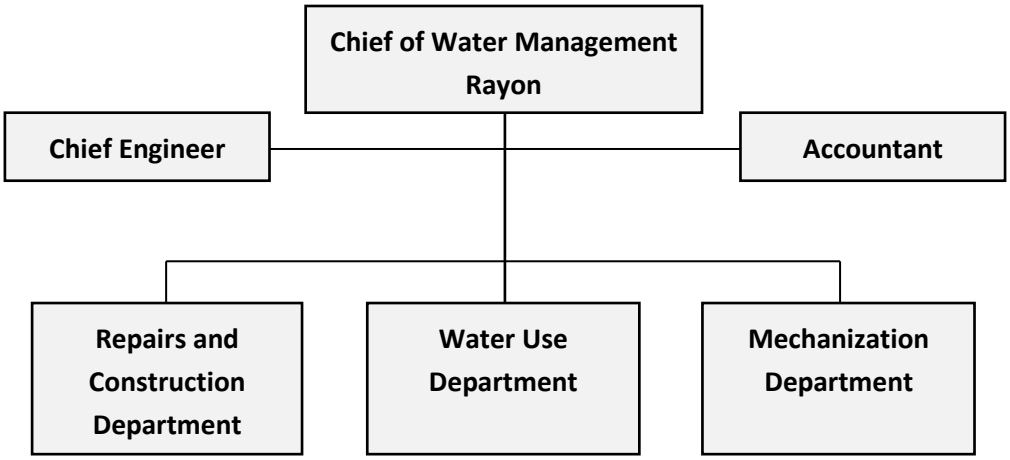

Figure 7: Institution Structure of the Rayon Water Management Department in the district of Kochkor (Naryn Oblast) (Draft: Kasymov 2014).

The District (Rayon) Water Management Departments (RayVodKhoz) are responsible for the operation and maintenance of the off-farm irrigation infrastructure on the district level. They sign contracts with the water users to supply irrigation water during the irrigation season and distribute the water between water users. Furthermore they prepare an annual report on the use of water for the Basin Water Management Department.

Figure 7 shows the organization structure of the District (Rayon) Water Management Department (RayVodKhoz) of Kochkor District (*rayon*) in Naryn Province (*oblast*). The director of the Kochkor Rayon Water Management Department has an assistant in the person of a chief engineer. There exist three departments with specific functions. The *Water Use Department* is responsible for the operation and maintenance of the off-farm irrigation canals as well as the deliverance of water to the on-farm canals. It cooperates with the water users on the basis of annual contracts on water supply. At the beginning of spring, the amount of irrigation water is calculated, although it is difficult to determine in advance the amount of water needed during the irrigation season. Much of the water delivery takes plan on oral agreement between the *District Water Management Department* and the water users.

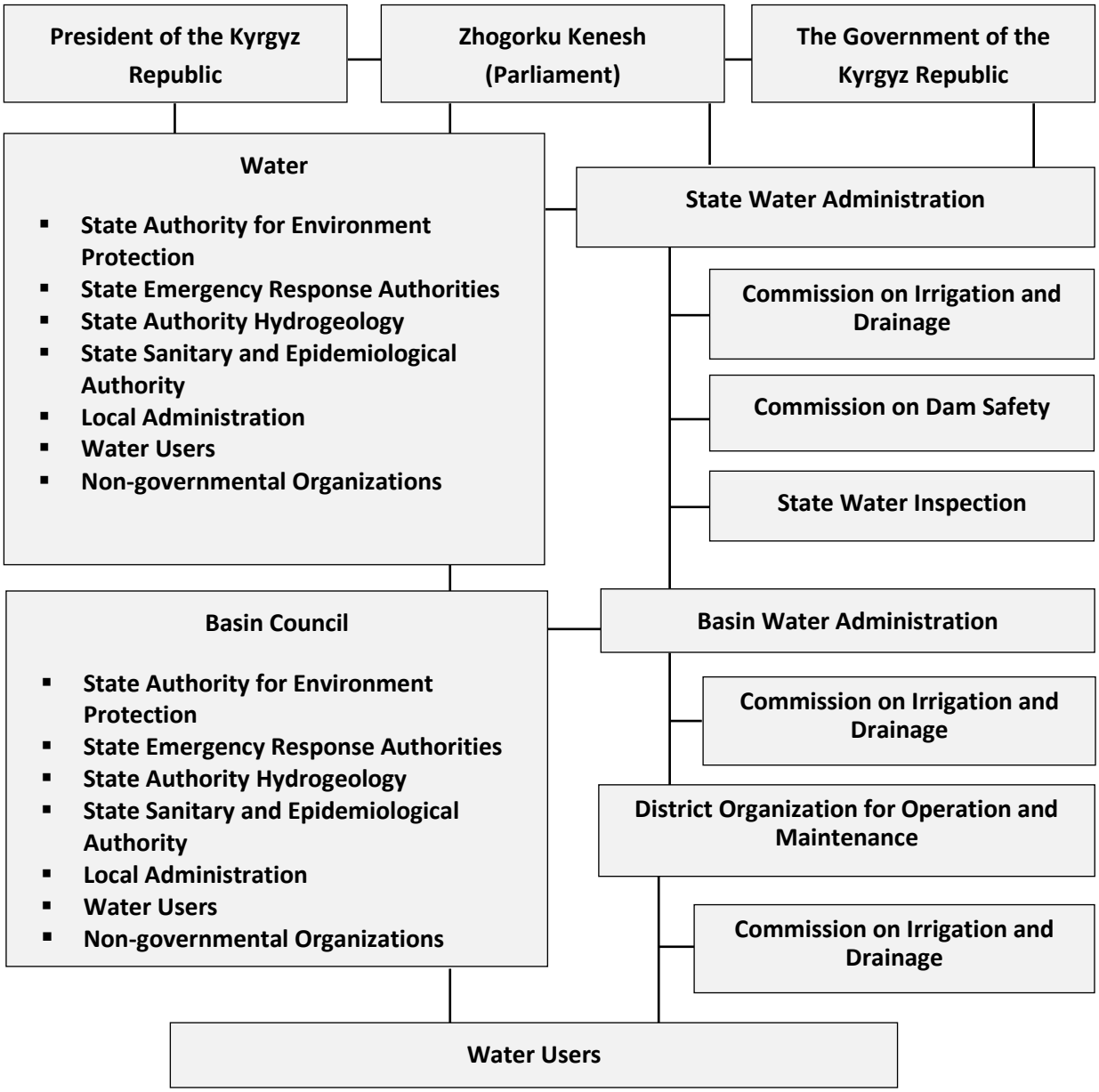

Figure 8: Structure of Water Management as given in the Water Code (Draft: Kaysmov, 2014. Data base: KYRGYZ REPUBLIC 2013)

The *Repair and Construction Department* is responsible for coordinating all repair and construction work of the off-farm irrigation infrastructure in the district of Kochkor. The *Mechanization Department* takes care of all equipment and machinery (e.g. excavators, tractors), which is used for maintenance and repairment of the off-farm irrigation infrastructure. The accountant fulfills all financial operations of the *Rayon Water Management Department*. In addition, there are two departments that are part of the water sector, but is not part of the *District Water Management Department*.

According to the New Water Code, the water management in Kyrgyzstan should be organized as illustrated in Figure 8. The transition to the new structure required the reorganization of the territorial management. At the state and basin level the participation of governmental and non-governmental organizations is required, which in turn requires the preparation of professionals for work in the water sector. However, according to SAKHVAEVA (2012) there is no approved project concerning the hydrographic division of the territory of Kyrgyzstan. The national water strategy was not developed and adopted. The basin plans for development, use and protection of water resources are only available for two pilot basins (Talas river basin and Kugart basin). The *Department of State Water Administration* has not yet been established; so the *Department of Water Management and Melioration* works on those tasks foreseen for the *State Water Administration* SAKHVAEVA (2012).

In future, national as well as basin level should work in the structure of management given by the New Water Code. In the long term, the district level of irrigation management can be abolished in connection with the transfer of the functions of operation and maintenance to water user associations or independent (privatized) water management utilities (AGO 2007:76).

3.2 The Implementation of Water User Associations (WUAs)

Among the institutional reforms in the Kyrgyz water sector, one of the most important was the implementation of Water User Associations (WUAs) for the operation and maintenance of the on-farm irrigation systems. Currently, when the Kyrgyz Republic actively seeks to develop market mechanisms in various spheres of production and life, enabling a WUA to operate within the structures of the water industry best meets the requirements of a market economy and democratic society (SEHRING 2005). A WUA is not a modern invention. For example, among European countries Spain has a long history in the formation of various associations of farmers and water users. Already in the 13th century the process of developing laws concerning the possession and use of water resources began (NAUCHNO-INFORMATSIONNYY TSENTR MEZHGOSUDARSTVENNOY KOORDINATSIONNOY VODOKHOZYAYSTVENNOY KOMISSII TSENTRAL'NOY AZII 1998:8).

Not accidentally similar models have been adopted in different countries of the world, such as *Tennessee Valley Authority* (USA), founded in 1933, *Agence de l'eau* (*Water Agency*, France), established in 1964. Therefore, we can say that Spain is a pioneer in creating the concept of drainage basin as an indivisible body, and in creating the hydrographic confederations of these resources (NAUCHNO-INFORMATSIONNYY TSENTR MEZHGOSUDARSTVENNOY KOORDINATSIONNOY VODOKHOZYAYSTVENNOY KOMISSII TSENTRAL'NOY AZII 1998:12).

Among the principles mentioned in the New Water Code, participation is the most important one for all stakeholders in the planning and decision-making process on water management. The WUAs theoretically meet this requirement best. WUAs are organizations of local water users, which are responsible for the joint use of an on-farm irrigation network. Their main functions are the operation and maintenance of this network, the organization of an equitable distribution of irrigation water, the collection of the irrigation service fee, and the resolution of disputes on water management relations. WUAs allow the development of market mechanisms by regulating demand and supply through service fees for water supply. They should be self-organized and self-financed by their members. WUAs are based on democratic principles through participation of water users in planning and management of on-farm irrigation network (SEHRING 2005, 2007).

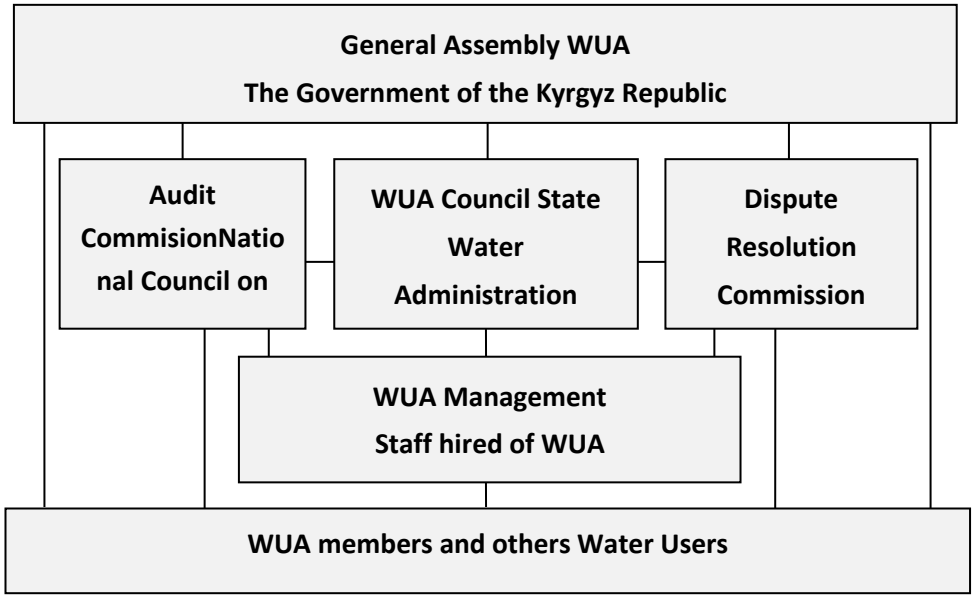

Figure 9: The organizational structure of the WUA (Draft: Kasymov, 2014. Data base: PROEKT IUVR-FERGANA 2003:3).

The development of WUAs in the Kyrgyz Republic started in the mid-1990s. Establishing WUAs throughout the country took place due to the implementation of projects of the World Bank and the Asian Development Bank (SEHRING 2007:285). The process of establishing WUAs was organized by the Kyrgyz Government and international donors. The creation of WUAs applies a top-down approach. It starts with state initiatives and

activities of international organizations and ends on the level of villages (Figure 9). There the village administation (*ayil okmotu*) or leaders of the former collective and state farms often play an active role in the organization. As a result of this top-down approach sometimes parts of the local water users were not aware of the formation of WUAs on their territory (WEGERICH 2000:16). Among the reasons that contributed to the formation of WUAs, specialists also include the access to grants given by international donors. But nevertheless the main reason is that most rural communities are experiencing serious problems in the irrigation sector, caused by difficulties of organization and provision of water (WEGERICH 2000:12).

According to DE AZEVEDO and BALTAR (2007:20f.) the use of pricing mechanisms is an effective means of improving the management of water resources because it stimulates a more efficient use of water. The introduction of adequate water pricing leads to the following changes:

1) It shows the water user the economic value of water resources and thus contributes to a more efficient use;
2) It provides financial resources needed for management, operation and maintenance of the water infrastructure and
3) It contributes to the funding for the management and development of water resources.

In the 1990s, the Kyrgyz government introduced the Irrigation Service Fee (ISF) to cover the costs for operating the off-farm irrigation system. For areas with adverse climatic conditions the rates are three times lower, with 0.01 som per 1 m^3 for irrigation water. This money is supposed to be directed to the operation and maintenance of off-farm irrigation networks. The ISF-tariffs were established by the Kyrgyz Parliament on March 24, 1999 and are valid until today. This indecision of the parliament may be explained by their fear of losing a significant part of the rural electorate, as well as fears of a repeat of political uprisings in 2005 and 2010 (VALENTINI and OROLBAEV 2010:12). However, SEHRING (2007:283) has concluded that the current irrigation service fee is only on a symbolic level.

At the level of on-farm canals in the territories where WUAs exist, the General Assembly of the WUAs decides itselve on how to gather the money for irrigation services and how to use this money for the operation and maintenance of on-farm network. In Kyrgyzstan, the amount of money collected for irrigation services is low (SEHRING 2007:283). Among the different factors for the low level is the unawareness of water users as well as private insolvency as a result of the “de-capitalization” of markets in rural areas. Barter trade is common and 30 percent of the irrigation service fees are paid in the form of goods. Water users can also participate in the repair and cleaning canals as payment for irrigation

service fees. Furthermore impunity of defaulters also contributes to the development of non-payment (SEHRING 2007:284). The poor condition of the canals and the lack of irrigation water do not allow the farmers to determine the volume of incoming water, which also affects the payment (poor quality of services results in low payments).

According to a research conducted by the OECD (2012), the current expenses of farmers for irrigation services range from 0.5 to 2.5 percent of their income. This level is very low compared with other countries (OECD 2012:17). As a result, the Kyrgyz government subsidizes approximately 90 percent of the cost of activities in the irrigation sector. For example 710 million som were charged for supply services in 2010 (SAKHVAEVA 2011:25).

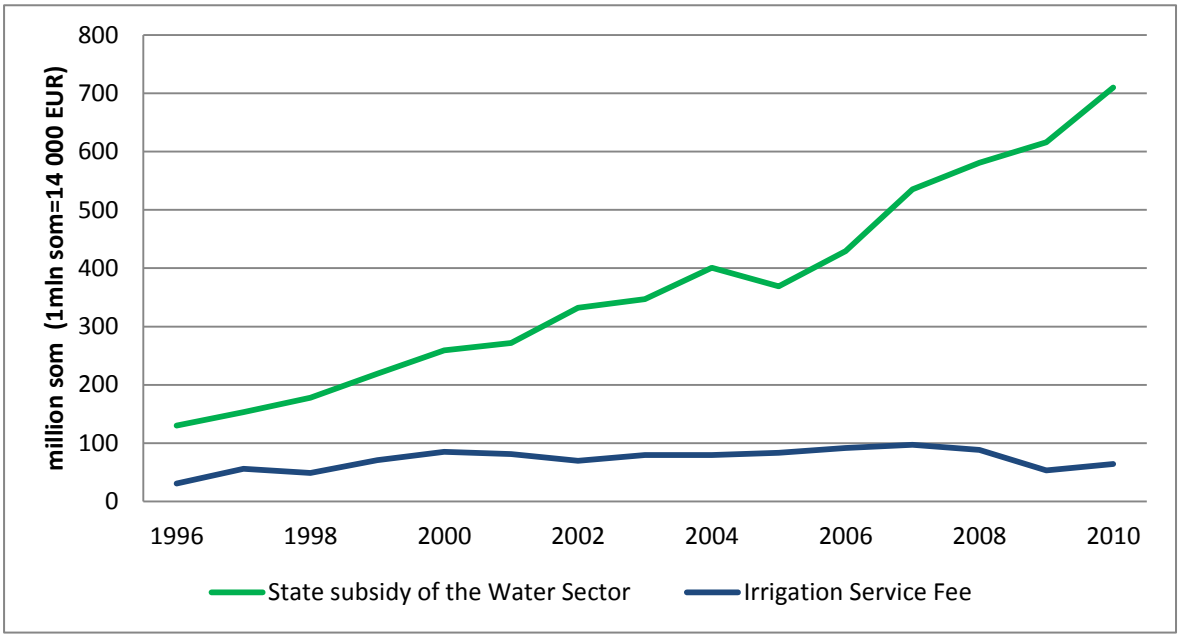

Figure 10: Financing of the Water Sector of the Kyrgyz Republic for the period from 1996 to 2010 (Draft: Kasymov, 2014. Data base: SAKHVAEVA 2011:25).

The graph (Figure 10) shows that the financing of the water management has an increasing dynamics and funding has increased to 710 million som (about 10 million EUR). During the same time (1996 to 2010), the share of charges for irrigation service fee decreased. According to SAKHVAEVA (2011:18) the volume of annual investment in the irrigation sector does not exceed 25 to 30 percent of the required amount. Thus a deterioration of the irrigation infrastructure occurred as the financial budget provided by the state and the ISF collected from farmers are insufficient to maintain the existing infrastructure (OECD 2012:17). About 10 percent of irrigated lands are disadvantaged because of increasing salinity and high groundwater level (SAKHVAEVA 2011:18). Among the factors contributing to these phenomena, which reduce the area of arable lands, the poor condition of the irrigation network as well as violation of the norms of irrigation has to be mentioned. In addition, there is a reduction of irrigated lands in the result of the transformation process (SAKHVAEVA 2011:18).

4. General Characteristics of the Study Area

4.1 Location of the Ukok River Catchment

Following the scientific approach of Integrated Watershed Management (e.g. FFOLLIOTT *et al*. 2003), the investigations are not based on an administrative unit, but on the spatial level of a topographically delineated area drained by a river system. The river catchment examined within the above mentioned project is the Ukok river system in Central Kyrgyzstan. It covers an area of 202.84 km^2 (BECKER 2012:10) and rises from the intramontane Kochkor basin (about 1800 m a.s.l.) up to the glaciers above 3700 m in the Western Terskey Ala-Too Range (Figure 11).

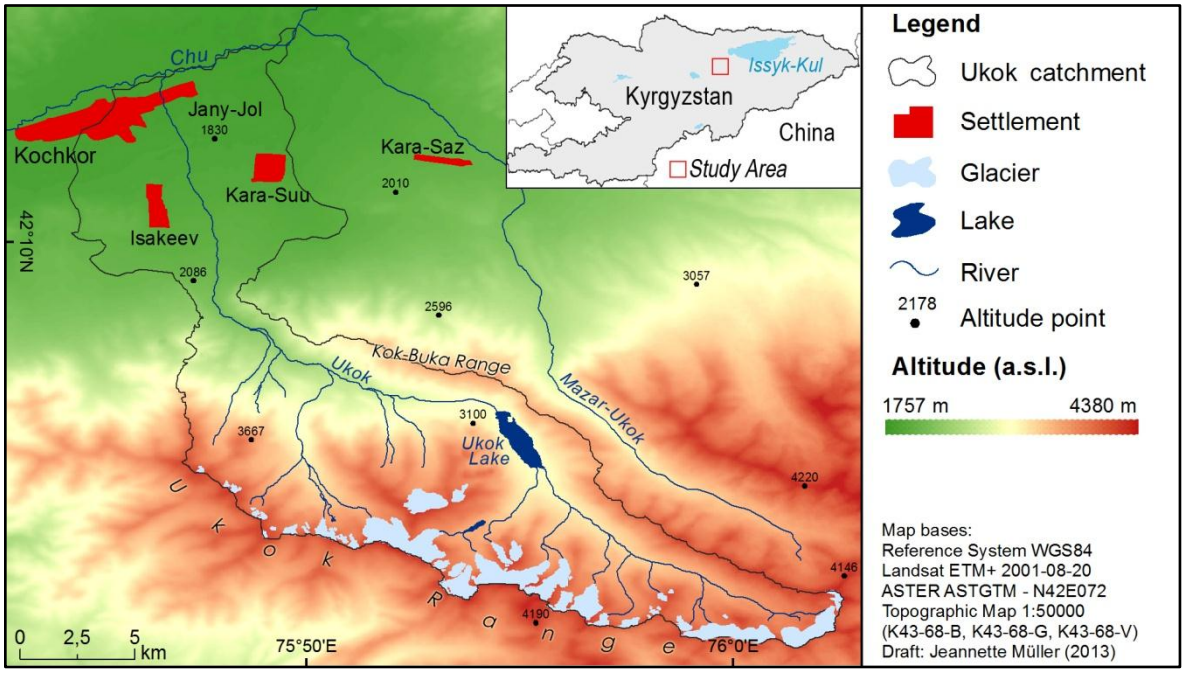

Figure 11: The Ukok river catchment (ROST et al. 2014).

The Ukok is a tributary of the upper Chu (*Чу)* river, which is formed by the confluence of the Kochkor (*Кочкор*) river and the Zhoon Aryk (*Жоон Арык*) near the village of Kochkor. The 1067 km long Chu river (or Chui, Chuy) is of major importance for the agricultural irrigation in the Chu Oblast in Northern Kyrgyzstan and the Shu District in Southern Kazakhstan (see Figure 1). Therefore, the study area is located in the upper Chu river basin, whereas administratively it belongs to the Naryn Province.

4.2 Geological and Geomorphological Characteristics

The approximately 60 km long and up to 20 km wide intermontane Kochkor basin is located in the Inner Tian Shan Range at an altitude of 1700 to 2200 m. It is named after the village of Kochkor, which is the administrative center of the district. The basin is bounded by the >4000 m high peaks of the Kyrgyz Ala-Too Range to the North and the Terskey Ala-Too to the South. The topography is dominated by a continuous process of denudation and a neotectonic development since the late Oligocene (FRANZ 1973:447; MERZLYAKOVA 2002:379). At its southern margin the active South Kochkor fault places the deformed Paleozoic granitic and metasedimentary rock of the Terskey Ala-Too over Neogene and Quaternary sediments of the basin (PARK *et al.* 2003).

Figure 12: Arable land in the Kochkor Basin between the Terskey Ala-Too and the village Kara-Suu (Photo: Kasymov, 2012).

The Kochkor basin is filled with Mesozoic and Cenozoic sediments, with an estimated depth of 2 to 4 km (CHUPAKHIN 1959, PARK *et al*. 2003). Between the edge of the Terskey Ala-Too and the interior of the basin slightly inclined pediments and alluvial fans have been formed. Most of the arable land in the basin is located on these alluvial fans (Figure 12).

At the western edge of Terskey Ala-Too the Ukok valley runs over a length of about 25 km in SE-NW direction. The lower part of the Ukok valley is formed by a deep gorge. The lower mountainous part between 2000 and 2800 m a.s.l. is characterized by

erosional-ravitational processes. The steep slopes are formed by slope erosion and soil denudation. Whereas the steep south-facing slopes of the main valley only have small ravines, small tributary valleys open out at the less steeply inclined north-facing slopes. These side valleys are often affected by mud flows (MÜLLER 2013). Above 2700 m the Ukok valley widens slightly to a more U-shaped valley.

The high-mountain altitudinal belt starts above 3000 m with alpine meadows. Periglacial solifluction lobes occur on the north-facing slopes (MÜLLER 2013). In the main valley, the Ukok landslide deposit (46°6´N/75°54´E) sits on the right-angle bend in 3050 to 3100 m altitude (SANHUEZA-PINO *et al*. 2011:297). These landslide deposits form a 60 to 70 m high debris wall, which dams the 2.75 km long and 0.75 km wide Kol-Ukok Lake (Figure 13). In front of this wall, the hummocky landslide deposits spread down-valley for about 3.2 km and end up in altitudes of around 2730 m. According to SANHUEZA-PINO *et al*. (2011) these landslide deposits are the result from multiple catastrophic rock avalanches during the Holocene.

Figure 13: The high-mountain area in the upper Ukok catchment with the Kol-Ukok Lake and small alpine glaciers, altitude approx. 3050 m (Photo: Kasymov 2010).

Above 3200 m processes of frost weathering dominate. Bedrock, large blockfields, morainic materials, and rock fans cover the bare slopes. Rock glaciers are common above 3250 to 3300 m. Glaciers are located above 3600 m. According to MÜLLER (2013:34) 32 small alpine glaciers existed in the Ukok catchment in 2001. The mean aspect of the glaciers is by 81 percent in northern exposition (N, NE, NW).

Most of them are smaller than 1 km^2 (Figure 13). During the period from 1963 to 2001 the glacier area in the Ukok catchment decreased from 16.5 km^2 to 12.4 km^2 (MÜLLER 2013:35), which corresponds to observations in other Kyrgyz mountain ranges (AIZEN *et al*. 2007; NARAMA *et al*. 2010).

At least nine moraine-dammed glacier lakes exist in the upper Ukok river catchment. There exists a high risk potential of glacier lake outburst (MÜLLER 2013). In August 2010 the outburst of one of these lakes in the Ters-Tor valley, a major tributary to the Ukok, caused a debris flow that heavily damaged the irrigation infrastructure in the lower Ukok catchment (MÜLLER 2013, ROST 2014).

4.3 Climatic and Hydrologic Conditions

The main factors determining the climate in the research area are its location in the lower latitude of the temperate climate zone and its continentality. However, the mountainous relief creates an area with specific climatic features, which affects the local circulation of the air masses. The surrounding mountain ranges detain northwestern and northern humid air masses from ingression.

The climate of the Kochkor basin is quite continental and considerably dry. The characteristic features of the climate are hot summers, cold winters and low rainfall throughout the year (CHUPAKHIN 1959:24). Winds of western and eastern direction are prevailing. Strong winds are typical for the late-autumn, winter, and early spring periods of the year.

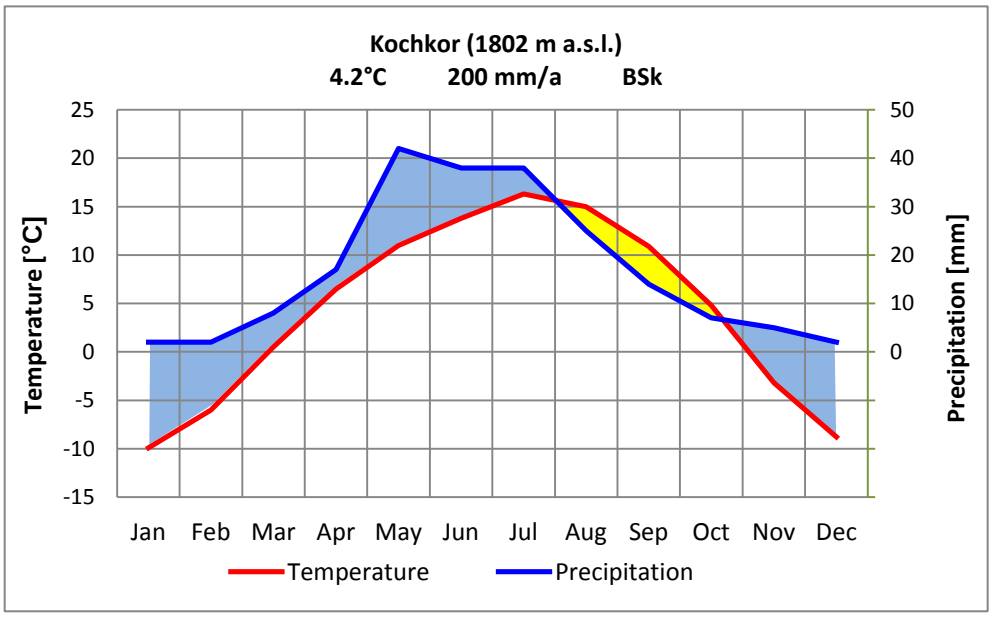

Figure 14: Climate Diagram for the Kochkor meteorological station (Draft: Kasymov, 2014. Data base: KIRGIZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT EKONOMIKI AGROPROMA 1990:7f.).

According to the Kochkor weather station the average annual temperature is 4.2°C (Figure 14). The mean temperature in January is - 8.1°C, and the average temperature in July 17.1°C (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 2009). The frost-free period ranges from 80 to 120 days per year. In order to evaluate the climatic potential for agriculture, the Soviet agro-climatology branch developed a method to measure the quantity of warmth by accumulating all daily mean temperatures exceeding 5°C in one year as a sum. For the Kochkor valley this sum is 2000-2200°K which means that this area has not favorable conditions for plants which need above-average amounts of radiation (CHUPAKHIN 1959:59).

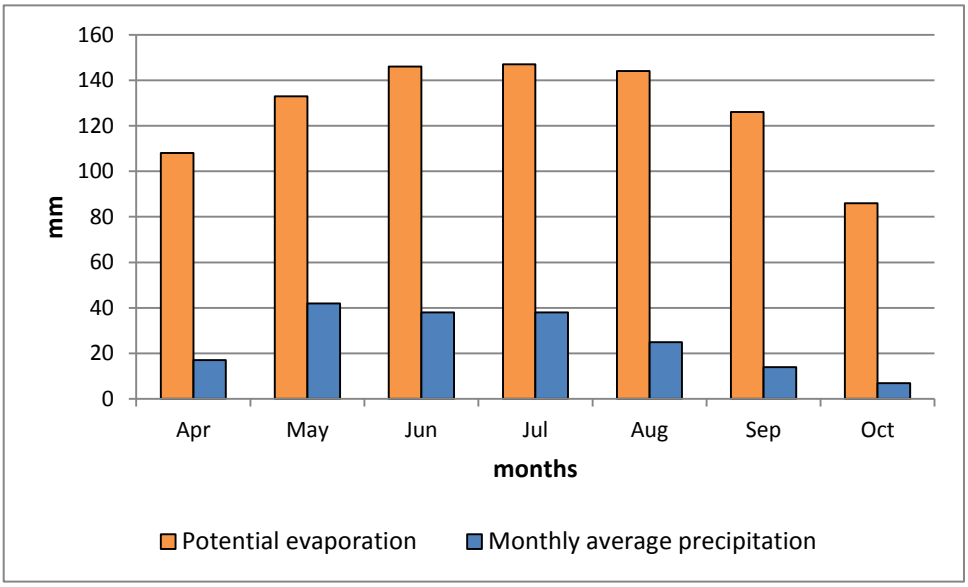

Figure 15: The ratio of average precipitation and evaporation for the Kochkor station (Draft: Kasymov, 2014. Data base: KIRGIZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT EKONOMIKI AGROPROMA 1990:8; SAIPOV 1998:8).

The average annual precipitation amounts to around 200 mm in the interior of the Kochkor basin (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 2009) and 232 mm in Kara-Suu (BÖCKEL and BECKER 2014:72), with a clear maximum in July. During the months May to September precipitation reaches up to 80 percent of the total annual amount (CHUPAKHIN 1959:60). The winter period is characterized by an almost complete lack of snow in the basin (CHUPAKHIN 1959:60).

Humidity plays a very important role in the life of living organisms, including agricultural plants. The average annual air humidity within the Naryn region is 58 to 72 percent (KIRGIZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT EKONOMIKI AGROPROMA 1990:10). But in the summer months, during the vegetation period, humidity is low. Temperature, humidity and wind affect the rates of evaporation from the surface of the earth. Rates of evaporation have necessarily taken into account when determining the irrigation norms (KIRGIZKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT EKONOMIKI AGROPROMA 1990:10). Figure 15 shows that the amount of precipitation during the agricultural season

(seven months) is quite low with about 181 mm whereas the potential evaporation with 890 mm is quite high. Thus an efficient agriculture is only possible with the use of artificial irrigation (KIRGIZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT EKONOMIKI AGROPROMA 1990:10).

In the Terskey Ala-Too Range the climate differs vertically and horizontally. Valley slopes with different aspects (and therefore insolation) have a various micro-climate (MERZLYAKOVA 2002:384). Elevation is the most important factor characterizing the spatial distribution of precipitation, with a higher amount in higher elevations (BÖHNER 2006:290f). According to SUSLOV (1961:537), the cooling of air masses causes a line of maximum precipitation at an altitude of around 3000 m a.s.l. BÖCKEL and BECKER (2014:73) calculate with approximately 660 mm/a in this altitude.

The Ukok river is a typical mountain river which is mainly fed by snow and glacier melt water during the ablation period between May and August. The glaciers and snowfields in the Ukok catchment occur in altitudes above 3500 m. The mean discharge of the lower Ukok river is 0.47 m^3/s (BEUTELL 1997:11). The lowest monthly discharge occurs during the period of October to March, with a minimum of approximately 0.4 m^3/s in January (Figure 16). The discharge starts gradually to increase towards the months between April and August, reaching a maximum of approximately 0.90 m^3/s (BEUTELL 1997:11), respectively of nearly 1.2 m^3/s (KIRGIZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT EKONOMIKI AGROPROMA 1990:28) in August.

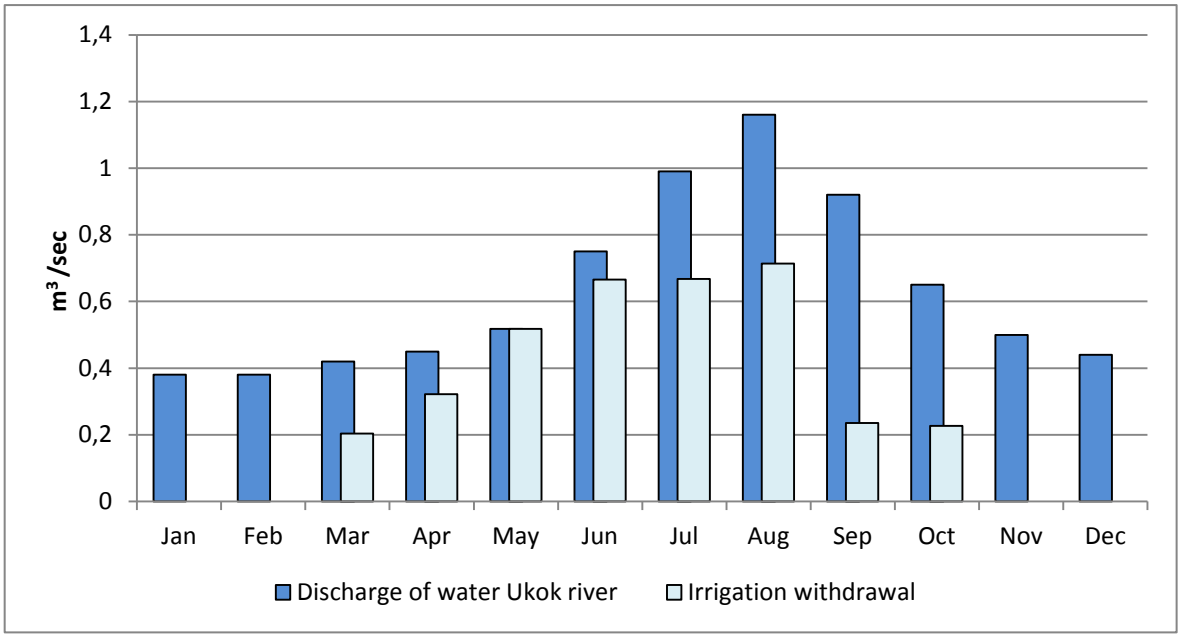

Figure 16: Run-off of the Ukok River at Karaoy (Draft: Kasymov, 2014. Data base: KIRGIZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT EKONOMIKI AGROPROMA 1990:29).

The villages Kara-Suu, Isakeev, and Jany-Jol (Figure 11) gain much of their irrigation water from the Ukok river. As the water discharge is mainly formed by a glacio-nival flow regime, it is assumed that in consequence of global climate change the run-off will be negatively affected by the decrease of the glacier areas in the upper Ukok catchment. This in turn would also affect the agricultural irrigation potential in the lower catchment.

4.4 Soils and Vegetation

Topographic features like elevation, slope exposition, slope angle and the related diversity of climatic conditions are the most determining factors for the development of soils and vegetation in the Ukok catchment (BEUTELL 1997:15; BECKER 2012:23; BÖCKEL and BECKER 2014:72). The amount of rainfall increases in the study area with the altitude. Slope exposure and slope also affect the differentiation of vegetation. On the other hand, the growing season is shortened with increasing height. In the mid-altitudes (2100 to 2800 m) the vegetation period is both interrupted by a winter (temperature-induced) dormancy and by a summer arid phase. According to BEUTELL (1997), BECKER (2012) and BÖCKEL and BECKER (2014) five main geo-ecological units can be observed in the investigation area:

(1) The Kochkor basin (1700 to 2000 m) is dominated by settlements and irrigated arable land. Especially mixed fodder grain (oat, barley, wheat) and green fodder are cultivated, serving as a winter fodder for livestock. During the winter months the harvested fields are used as winter pasture for sheep and goat herds. Light Kastanozeme is the main soil type in the agriculturally used areas between the edge of the mountains and the floodplains of the rivers. Occasionally burozems occur on very dry sites (Figure 17).

(2) On extremely dry and steep south-facing slopes between 1800 and 2400 m altitude a semi-desert like vegetation with dwarf-shrubs dominates. Syrozems and Burozems are the typical soils on these slopes. The degree of vegetation coverage is very low (25 to 50 percent). Nevertheless, these slopes are used as winter pastures.

(3) In the mid-altitudes of the Ukok catchment mainly. *Artemisia-Stipa* dry steppes are widely distributed especially on dry, moderately steep and gentle slopes on 1700-2600 m. *Dracocephalum nodulosum* is typical for the high mountain dry steppe on south-facing slopes of 2800 to 3100 m, whereas *Astragalus nivalis-Festuca alatavica* dry steppes occur on, steep slopes above 3000 m altitude. Light Kastanozems are the dominating soils for these semi-arid and winter cold high mountain steppes, which are mainly used as pastures in spring and early autumn.

(4) The northern exposed slopes between 2600 and 3000 m a.s.l. are covered with short grass steppe vegetation. The dominating species are *Festuca valesiaca*. Vegetation coverage is between 80 and 100 percent. For short grass steppes, dark Kastanozems are the typical soils. These areas are used as summer pastures.

(5) Excellent forage plants (*Kobresia* spp., *Festuca* spp.) are growing on fresh, moist sites above 3100 m, where Mountain-Chernozems are the dominating soils. These sites around the lake Kol-Ukok are the main grounds for summer pastures in the Ukok river catchment.

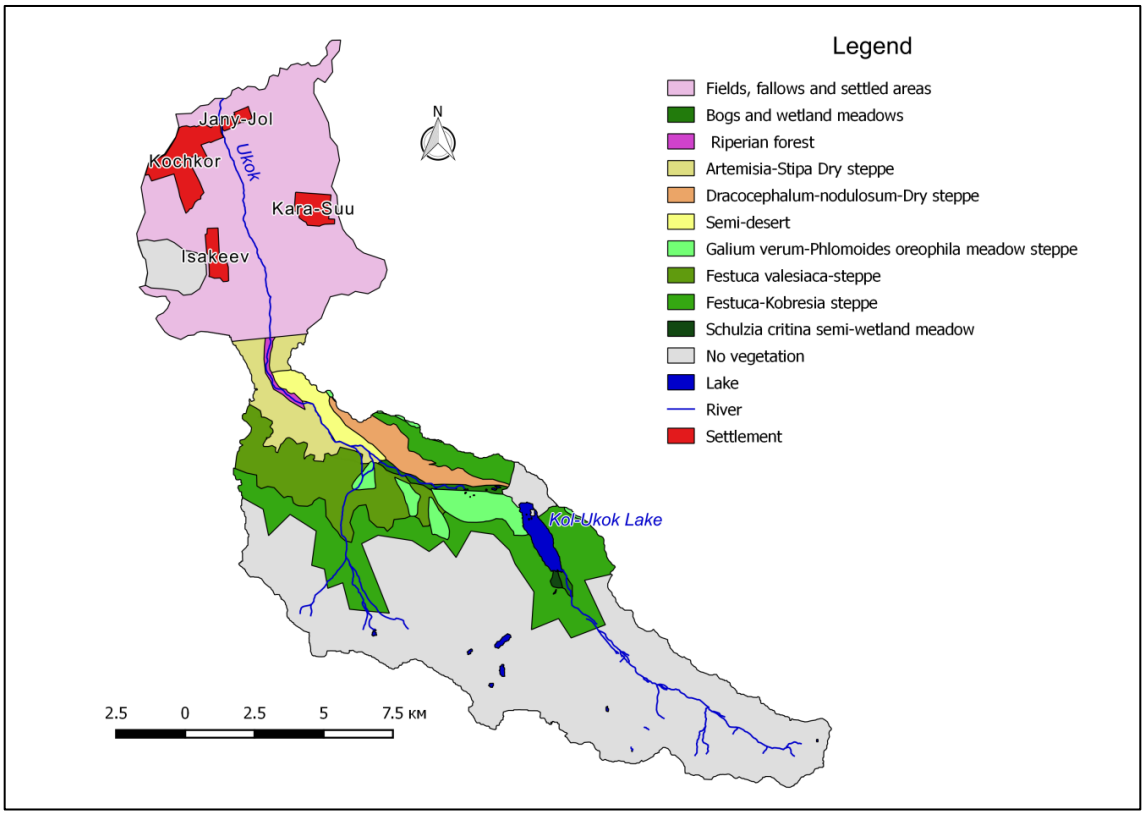

Figure 17: Major ecological units in the Ukok river catchment (Draft: Kasymov, 2015. Data base: BECKER 2012:15).

4.5 The Village of Kara-Suu

The village of Kara-Suu (42°11'N/75°49'E) is located in the Kochkor basin about 45 km southwest of the Lake Issyk-Kul (Figure 11). Situated southeast of the district capital Kochkor, Kara-Suu and the neighboring village Jany-Jol are part of the Ak-Kyya community in the Kochkor Rayon. The Ak-Kyya community comprises an area of 17.6 km^2 and is part of the 202 km^2 large Ukok river catchment (EBERMANN *et al*. 2014:83).

Kara-Suu is a typical Soviet planned kolkhoz village (Figure 18), which was founded in 1951. The village originated by the resettlement of inhabitants of the former small settlements Kara-Suu, Uch-Bulak, Kara-Oy and Alkym (AK-KYYA AYIL OKMOTU 1998).

Almost all objects of social infrastructure (school, culture house, kindergarten, administration building of the collective farm, shop) were built in the second half of the 20th century (PASPORT PERSPEKTIVNOGO NASELENNOGO PUNKTA KARA-SUU KOLKHOZA IMENI ZHDANOVA, AK-KYYANSKOGO SEL'SKOGO SOVETA KOCHKORSKOGO RAYONA NARYNSKOY OBLASTI KIRGIZSKOY SSR 1976). Significant changes occurred in the 1970s, when the construction of engineering infrastructure started in the village, such as the construction of a drinking water supply system by standpipes in the streets and the construction of the agricultural irrigation network (EBERMANN *et al.* 2014; ROST *et al*. 2014).

Figure 18: The village of Kara-Suu (Photo: Kasymov 2012).

Following the national independence the former kolkhoz “Zhdanov” was dissolved in the mid-1990s and the Ak-Kyya community was established (EBERMANN *et al.* 2014:83). Kara-Suu became administrative center of the community. According to the 2011 census, 5672 people lived in the Ak-Kyya community, 2802 of them in the village of Kara-Suu (AK-KYYA AYIL KENESH 2011). Each household consists in average of five family members. The district is characterized by a high birth rate and a natural increase of the population. The rate of natural increase in rural areas in the Naryn region is higher, as in all other areas of Kyrgyzstan. In 2012, the rate of natural increase in rural Naryn region was 18.9 persons per 1,000 inhabitants (NATIONAL STATISTICAL COMMITTEE OF THE KYRGYZ REPUBLIC 2013:110). Indicators like the age structure and labor resources show a predominance of young people. In 2009, the share of persons under working age was around 37 percent, the share of persons in working age was 53 percent and the share of

persons older than the working age amounted up to about 9 percent (NATIONAL STATISTICAL COMMITTEE OF THE KYRGYZ REPUBLIC 2010:162).

According to data for 2009 in the Ak-Kyya community about 58 percent of the population had a secondary education, and 12 percent an incomplete secondary education (AK-KYYA AYIL KENESH 2010). Many of the smallholder households have no permanent income and live more or less from subsistence farming. The level of external and internal migration is insignificant, but is characterized by negative indicators. In the passport of the Ak-Kyya community for 2008 is marked that 50 people left the area while 34 people are redrawn in to the village (AK-KYYA AYIL KENESH 2011). Residents, who leave Ak-Kyya community for the search of work mostly migrate to the Chui Oblast and Bishkek. Others work as immigrant workers in Russia or in Kazakstan, but return after some time.

Like many rural villages in Kyrgyzstan, Kara-Suu has suffered from the decline of all public facilities after the dissolution of the former kolkhoz. The deterioration of social infrastructure has resulted obviously in declining living standards and an aggravation of the socio-economic situation (HEID 2013). Until their dissolution the *kolkhozes* and *sovkhozes* were responsible for building, operating and maintaining the on-farm agricultural irrigation system as well as the drinking water supply systems in rural areas. With the privatization of these systems, the former subsidized water service systems became obsolete and a decentralized water management system was established in rural areas (HERRFAHRDT *et al*. 2006; SEHRING 2007; ABDULLAEV *et al*. 2010; ROST *et al*. 2014). In Kara-Suu, like in many villages in Central Kyrgyzstan, the general poverty as well as the inadequate public funding together with other reasons, which will be discussed later, hampered the effective operation and maintenance of the rural water supply facilities. Consequently, much of the former water supply infrastructure is in need of replacement or has been fallen into complete disrepair (EBERMANN *et al*. 2014; ROST *et al*. 2014).

4.6 Land Use and Agriculture

The peculiarities of land use in the Naryn province, Kochkor district and in Kara-Suu itself are a result of the local structure of the agricultural land. Historically the people in this region were nomads, using a migration system of year-round grazing the herds on pastures in different altitudes (SCHILLHORN VAN VEEN 1995; BÖCKEL and BECKER 2014). During the Soviet period, this traditional system was modified. The nomadic Kyrgyz were settled and their herds were nationalized, with livestock herding and pasture organized into collective and state farm structures. Due to the expansion of the livestock the demand for fodder increased. Therefore, arable land in the Kochkor area was opened up for fodder production. To water the area under cultivation, a centralized irrigation system was constructed. Nowadays approximately 93 percent of all agricultural land in the region is

pastures, whereas arable land only counts for 7 percent (NARYN BASIN WATER MANAGEMENT DEPARTMENT 2011).

During the Soviet period the *kolkhoz* agriculture in the village of Kara-Suu was completely focused on the production of fodder for livestock (BÖCKEL and BECKER 2014). After the country's independence and the associated national land reform, the arable land in Kara-Suu was transferred to the households. During the allocation of the arable land, each household member received 0.39 ha of arable land around the village. Additionally, each family member, including children, was given a cow or a horse and 2.5 sheep. The mountain pasture grounds were excluded from the land privatization and are managed by the community council or the district government (pers. comm. A. Aliaskarov, 05.05.2012).

According to data from 2008, Kyrgyzstan has a total of 326,700 agricultural units, 321,800 of them are managed by small farms (ABDRASULOV 2011:1). In the Kyrgyz Republic the average size of one farm is about 2.7 hectares, including 1.9 hectares irrigated arable land (NATIONAL COUNCIL FOR SUSTAINABLE DEVELOPMENT OF THE KYRGYZ REPUBLIC 2013:86). The farms mainly show features of subsistence farming and produce thus basic goods such as potatoes or wheat on their own (ABDRASULOV 2011:2).

It should be noted that quite a large area (about 400 ha) is not used. This is about 25 percent of the arable land of the village of Kara-Suu. 54 of the surveyed households have additional arable land, which is not used due to a lack of water or remoteness of the fields. On average, one household accounts for about 0.5 ha of unused arable land.

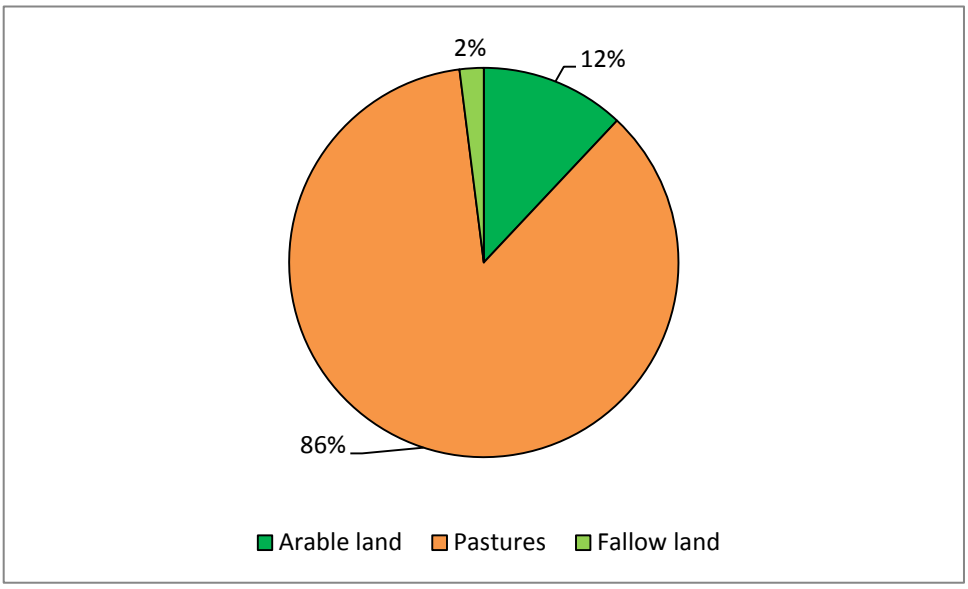

Figure 19: Structure of the agricultural land in the Ak-Kyya community (Draft: Kasymov, 2014. Data base: AK-KYYA AYIL KENESH 2011)

Currently the farmers of the Ak-Kyya community cultivate about 2640 ha of land, including 1587 ha that is cultivated by farmers from Kara-Suu village (AK-KYYA AYIL KENESH 2011; HEID 2013). Besides fodder crops and green fodder, some smallholders plant grain on their fields. Grain crop in 2011 was 20 quintals per hectare (NARYN BASIN WATER MANAGEMENT DEPARTMENT 2011). This is almost two times lower than in Soviet times. The fodder crops are used for winter forage. The decrease of the harvest yields result from the fact that farmers normally do not apply crop rotation. Furthermore the use of fertilizer is very limited, because of financial reasons.

In Kara-Suu, 112 residents were asked for the size of their arable land. The differences were significant, ranging from 0.1 ha to 8 ha. On average, one household has 2 hectares of arable land. Only 12 percent of agricultural land in the Ak-Kyya community is arable land, whereas 86 percent are pastures (Figure 19). Only 17 percent of the surveyed farmers used fertilizer for their agricultural crops.

Irrigating agricultural land is one of the complex actions of farmers. Almost every tenth farm hires special irrigators (*suugatchy*). For watering of 1 ha land farmers pay about 1000 som to the irrigator (about 15 EUR).

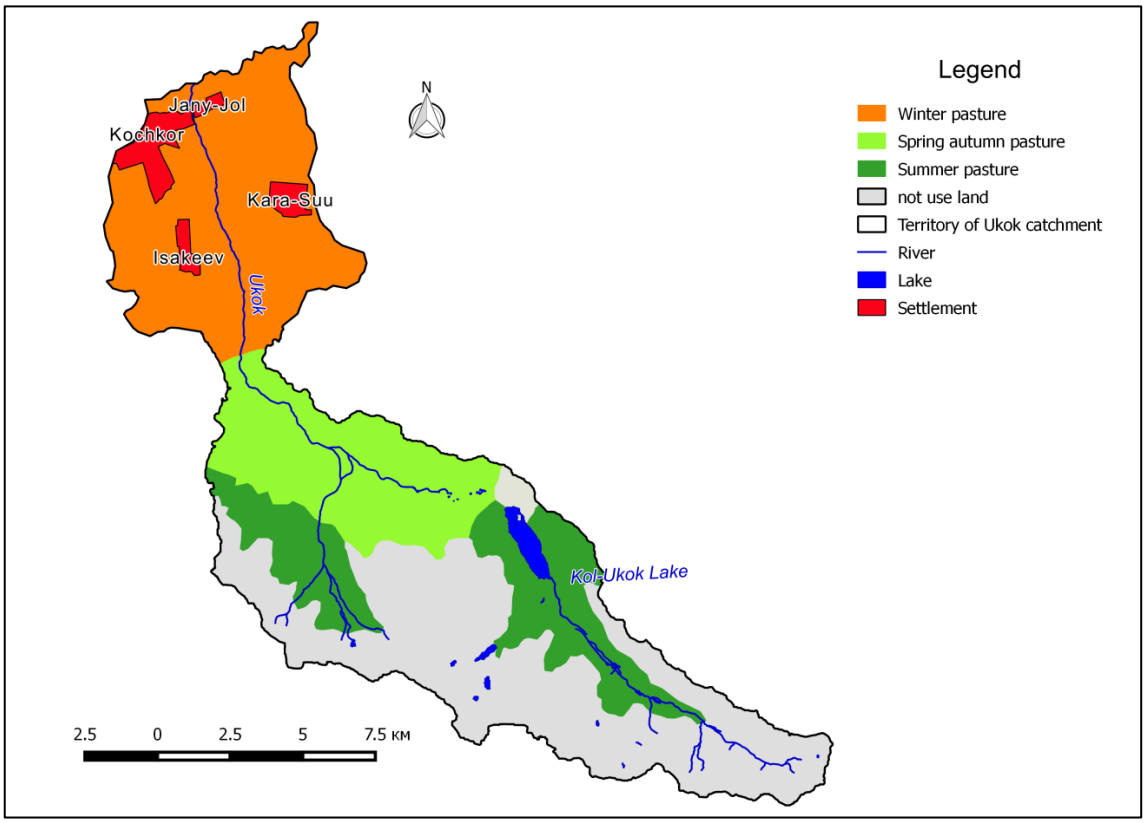

Figure 20: Seasonal used pasture areas of Kara-Suu villagers in the Ukok catchment (Draft: Kasymov, 2014. Data base: BECKER 2012).

The number of livestock units in 2011 has halved compared to 1990 (AK-KYYA AYIL KENESH 2011). The most serious reduction took place on the number of sheep and goats, which reduced to almost a third of their former number. Residents of the village of Kara-Suu have the opportunity to graze their cattle on the pastures in the catchments of the Ukok (Figure 20), in the neighboring valleys Mazar-Ukok, and Kara-Kuzhur as well as on pastures around the lake Son-Kol (BÖCKEL and BECKER 2014).

Most households in the village cultivate additional land in their backyard gardens. The average size of these small garden plots is 0.15 ha. They are mainly used to grow vegetables (e.g. potatoes, cabbage, carrots, onion) or fruits (e.g. apple, apricot). Most smallholders have no permanent monthly income and do more or less live from subsistence. Therefore, some families have started to be engaged in other kinds of individual entrepreneurial activities. For example, some residents opened small shops. Some offer their *moncho* (in Russian: *banya*) for public customers. Others rent their cars for the transport of passengers to Kochkor village. Some families are engaged in crafts, namely the production of Kyrgyz traditional felt products (*shyrdak, kiyiz*). A few number of families are accommodating foreign tourists. There are also small enterprises on processing of agricultural raw materials like small mills and oil mills. According to the AK-KYYA AYIL KENESH (2011), 94 people were unemployed of whom 28 were registered in the employment service in Kochkor village.

5. Methodology

The present study aims to provide an overview of the post-Soviet situation of the agricultural irrigation system in Central Kyrgyzstan. There are numerous publications and project reports for the post-Soviet reform of agricultural irrigation management in Central Asia, but these focus in particular on the traditional irrigation areas, like the Fergana Valley in Uzbekistan, the Vakhsh valley in Tajikistan or the lower Chu river area in northern Kyrgyzstan (eg. HERRFAHRDT *et al*. 2006, SEHRING 2005, 2007, ABDULLAEV *et al*. 2006, 2010, KAZBEKOV *et al*. 2009). In contrast, there are hardly any similar project reports and scientific publications on this topic from the agriculturally used mountainous areas in Central Kyrgyzstan (eg. EBERMANN *et al*. 2014). Own research on the operation and management of the local irrigation system in the Ak-Kyya community (Naryn Oblast) were carried out during 2010 and 2013. During the research various methods were used, which were applied to the part solely and partly in small teams with Kyrgyz or German fellow students.

The empirical data collection included a detailed recording of the geographical features and processes in the Ukok river catchment in small joint teams in August 2010 and August 2011. A major focus of the own investigations was on the mapping of the irrigation infrastructure serving the agricultural irrigation of the Ak-Kyya community. Using GPS, the course of irrigation canals was tracked and pumping stations, reservoirs and other systems of irrigation infrastructure were spatially recorded. Obtained data were analyzed with Quantum GIS. In addition, the condition of the irrigation infrastructure as well as the agricultural use of irrigated land in the vicinity of Kara-Suu village was investigated.

Furthermore standardized interviews on the basis of a questionnaire and open interviews were conducted on the socio-economic situation of private households in the village as well as on various aspects of the local water management (Figure 21). These results were included in an analysis on livelihood strategies (HEID 2013) as well as the investigation on current problems of the local water supply and water resource management.

During the data collection phase, several quantitative and semi-structured interviews with various experts, stakeholders (eg. *murabs*, water users/farmers) and various functionaries (eg. mayor, administration officials) were carried out on the subject of agricultural irrigation, drinking water supply, water management, water quality, etc. Direct and indirect, respectively participating and non-participating observations, combined with photographic documentation, of irrigation practices and the situation in the village contributed to a further gain in knowledge and the assessment of the information obtained through the interviews.

Figure 21: During the interview with the household (Photo: Topbaev 2010)

The applied questionnaire and the questions for the interviews were first designed together with the scientific supervisors, Dr. Tolkunbek Asykulov (Kyrgyz National University) and Prof. Dr. Jörg Stadelbauer (Freiburg University) in German and Russian language and later translated into Kyrgyz language, as many stakeholders in rural Kyrgyzstan do rather speak Kyrgyz than Russian. The questionnaire was pre-tested by interviewing 30 different households in Korumdu village in the Issyk-Kul Oblast (Province) in late July 2010. As in some cases the answers in Korumdu were ambiguous and inaccurate, the questionnaire was revised and the number of questions was reduced to 61 questions (see annex). Most questions were formulated as closed questions.

The revised questionnaire was used during an first survey of 200 households in the Ak-Kyya community in August 2010. During this campaign 80 different interviews were conducted in the village of Jany-Jol and further 120 households were questioned in the village of Kara-Suu. Since Kara-Suu, with a total of 592 households, is the larger village, the focus of the investigation was in this village. The households were chosen randomly to collect a useful variety of data. The interviewed persons were free to choose the place of interview.

Additional interviews with 50 households in Kara-Suu took place in August 2011. These households were identical to a large extent with the households that participated in the survey in the previous year. However, the aim of this survey was to determine the private freshwater consumption in households. Therefore, this questionnaire was different from the previous one and contained only 29 questions. The interviews were conducted by the

doctoral candidates Oktiabr Topbaev and Mukhtar Kasymov, assisted by joint Kyrgyz-German student teams. Preliminary results of these two surveys were presented to the residents and the administration of the village in a public information meeting in April 2012. During this event, the various stakeholders (eg. farmers, administrators, *murabs*) took the opportunity to ask questions and discuss the results.

Additionally several semi-structured expert interviews have been conducted with local farmers, irrigation masters (*murabs*) as well as various employees of the municipal administration (*ayil okmotu*) in Kara-Suu, and of the Kochkor Rayon Water Management Department (RayVodKhoz). Several field campaigns between August 2010 and August 2013 and living with the residents of Kara-Suu for a certain time enabled participatory observations.

The mayor and the administration of the commune Ak-Kyya mainly provided general information on the village (administrative structure, demographic data, information on social and economic condition etc.) and gave an overview of the current problems of water supply and water management, concerning both agricultural irrigation and rural drinking water supply. In particular the discussions with the mayor of the village were of major interest, as he plays an important intermediary role between water users (farmers) and the Kochkor Rayon Water Management Department.

In the district capital Kochkor as well as in Kara-Suu employees of the Kochkor Rayon Water Management Department (RayVodKhoz) were interviewed. The director of *RayVodKhoz* in Kochkor Mr. Duyshon Kyrgyzbaev, provided an overview on the organization structure of the administrative body and answered questions on the water management of the off-farm and on-farm irrigation in the Kochkor district. This administration operates and maintains the off-farm agricultural irrigation system in the district and is in charge of the repair and construction of the off-farm irrigation infrastructure. In addition, the Water User Association Support Unit (WUA Support Unit) of the Kochkor district is situated in this authority. Therefore, an interview with the head of this WUA Support Unit, Saltanat Kozhogulova, was also conducted during the field campaign.

Furthermore a meeting was held with the chief engineer of the Repairs and Construction Department at the Kochkor Rayon Water Management Department, Mr. Talant Asanbaiev, who gave useful information about the irrigation water regulation reservoirs Bel-Saz and Topon-Aryk in the vicinity of Kara-Suu as well as the pump station Kenesh near Isakeev village.

Additional information provided talks with the *murabs* that ensure the irrigation water

supply by the off-farm canals Kairma, Topon-Aryk and Kenesh on behalf of the Kochkor Rayon Water Management Department.

To gain a detailed overview on the current problems in the irrigation water supply management various literary sources and Internet sources in Russian, Kyrgyz and English language on irrigation water management in Kyrgyzstan were studies. In addition, a few publications and project reports in German language were partially translated and analyzed with the help of German colleagues and fellow students.

General statistical data were obtained from the National Statistical Committee in Bishkek. Statistical data for the Kochkor district were gained from the published reports of the district administration (Kochkor Rayon Committee on Statistics). The Department of Water Management and Melioration *(Departament Vodnogo Khozyaystva i Melioratsii*) provides annual reports on the irrigation water management in the Naryn province as well as in the Kochkor district. The Central State Archives of Kyrgyzstan and the State Archive of the Kochkor Rayon were also visited, but their materials referring to irrigation management in the Kochkor basin are rather poor. Statistical data about the population and the social infrastructure of Kara-Suu as well as about the agricultural area and the number of livestock was obtained by the village administration (AK-KYYA AYIL KENESH 2010; AK-KYYA AYIL KENESH 2011).

Possible sources of error in the interviews are certainly due to the willingness and the confidence as well as the credibility of the respondents. The reliability of official statistics is not necessarily guaranteed. Representatives of the authorities also often indulge in official statements. Several field campaigns between August 2010 and 2013 as well as the living with the residents of Kara-Suu enabled participatory observations and the “filtering” of vague impressions and statements.

6. Case Study Kara-Suu: Empirical Results

6.1 Development, Organization, Operation and Maintenance of the Local Irrigation System

6.1.1 Historical Development of the Off-Farm Irrigation System

During a long historical period, the population in the Kochkor basin and the surrounding mountain ranges was engaged in transhumant pasturing as it was typical for most regions of Central Kyrgyzstan (SCHILLHORN VAN VEEN 1995; BÖCKEL and BECKER 2014). This practice had been the main form of (economic) activity of the Kyrgyz people in the pre-Soviet period. Within the Kyrgyz society the prejudice existed, that crop cultivation is only the destiny of poor pastoralists (TURDALIEVA 2009:169). Major agriculturally dominated areas only existed in the Russian-influenced lower Chu river Valley (Northern Kyrgyzstan), the Talas river Valley and the eastern side of Lake Issyk-Kul, as well as in the Uzbek-dominated Eastern Fergana basin around Osh and Jalal-Abad (see Figure 1).

Until the second half of the 19th century, the nomadic or semi-settled families in Central Kyrgyzstan only cultivated small parts of arable land near their summer camps and winter settlements. During their stays on the summer pastures in the high mountains, the pastoralists left their fields in the lower valley and basins in the care of so-called "*eginchi*", who were responsible for the management of small acreages (TURDALIEVA 2009:169).

In the Kochkor basin, irrigation agriculture was introduced by the Russian colonizers, with the Soviet "Land and Water Reform" in 1922, which was linked to a transformation of land utilization in Central Kyrgyzstan. During the Soviet collectivation process, land and livestock from the rich pastoralists (*bay)* were expropriated and redistributed among the poor and landless local population. In the late 1920s the Soviet administration forced the sedentarization of the local population and the formation of collective farms (*kolkhozes*) respectively state farms (*sovkhozes*). In 1933, six small kolkhozes (Kara-Oy, Үch-Bulak, Alkym, Kara-Suu, Jany-Jol and Kyzyl-Dobo) existed in the vicinity of the present village of Kara-Suu (pers. comm. Tolkunbek Asykulov, Aug. 2010). Their economic base continued to be livestock farming and to a smaller extent the cultivation of winter fodder. In 1951 these six collective farms were transformed into one single kolkhoz named "*Zhdanov*" (EBERMANN *et al*. 2014:83). The inhabitants of the small surrounding villages of Kara-Oy, Үch-Bulak and Alkym were resettled to Kara-Suu, as their former villages seemed to be too small for Soviet rural planning criteria.

Expansion of agricultural land was linked to the collectivation in order to enlarge the cultivation of fodder plans in the Kochkor basin. For this purpose, it appeared necessary

to establish an agricultural irrigation system. In the 1930s, the Kochkor Rayon Water Management Department (*Kochkorskoye rayonnoye upravleniye vodnogo khozyaystva*) was established for the building, operation and maintenance of the irrigation network on the territory of the Kochkor district (*rayon*). Water masters (*murabs*) managed the distribution of the irrigation water between the collective farms. The installation of a large-scale irrigation network in the Kochkor area started in 1934, when the Shamen-Alysh irrigation canal was built south of Kochkor village (Figure 22). This open earthen canal, which is actually named "Kenesh", was simply dug into the ground and not lined with any impermeable materials.

This canal is a typical off-farm canal that delivers the water to the on-farm irrigation systems. In case of the "Kenesh" the canal receives its water from the Zhoon-Aryk river southwest of Kochkor, which flows from the Terskey Ala-too upstream of Kochkor into the Upper Chu river (EBERMANN et al. 2014:84). The "Kenesh" provides the arable land south of Kochkor with irrigation water and flows into the lower Mazar-Ukok river (Figure 22). As the "Kenesh" is situated down-slope of Kara-Suu village it only serves a relatively small area cultivated by farmers from this village.

Since 1954, Soviet engineers began to implement a large-scale, demand-orientated irrigation system in the Kochkor area. The most important development in the hydro-technical construction took place in the period between 1970 and the mid-1980s. By this time, 10 small water reservoirs, 8 pumping stations and several main canals were built in the Kochkor basin (KOSHMATOV and DZHAMGYRCHIEV 2008). Due to the implementation of a large-scale irrigation system, the area of irrigated arable land in the Kochkor district increased to 34.246 hectares by 1988, of which cereals occupied 13.689 hectares, clover 11.218 hectares and fodder crops 8.339 hectares (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 1988).

During the 1970s the "Topon-Aryk" canal was built south of Kochkor (Figure 22). This main off-farm irrigation canal also receives its water from the Zhoon-Aryk catchment, but irrigates the arable land south of the two villages Isakeev and Kara-Suu (EBERMANN *et al*. 2014:84). The "Topon-Aryk" has a total length of 11.8 kilometer, all of which have a concrete lining. The maximum flow rate amounts to 1.2 m^3/s. Initially, the canal was designed for irrigation of 1978 hectares of arable land in the ayil okrugs Isakeev, Ay-Kyya (Kara-Suu), Kosh-Dobo and Semiz-Bel of which 899 ha belong to the village of Kara-Suu (pers. comm. M. Mambetaliev, Kochkor RWMD, April 2011). Near Isakeev the "Kenesh Pump Station" pumps water from the "Kenesh" canal into a 1151 m long subsurface pipeline to the upslope "Topon-Aryk Canal" and into a small open reservoir with a storage capacity of 170.000 m^3 (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 2010).

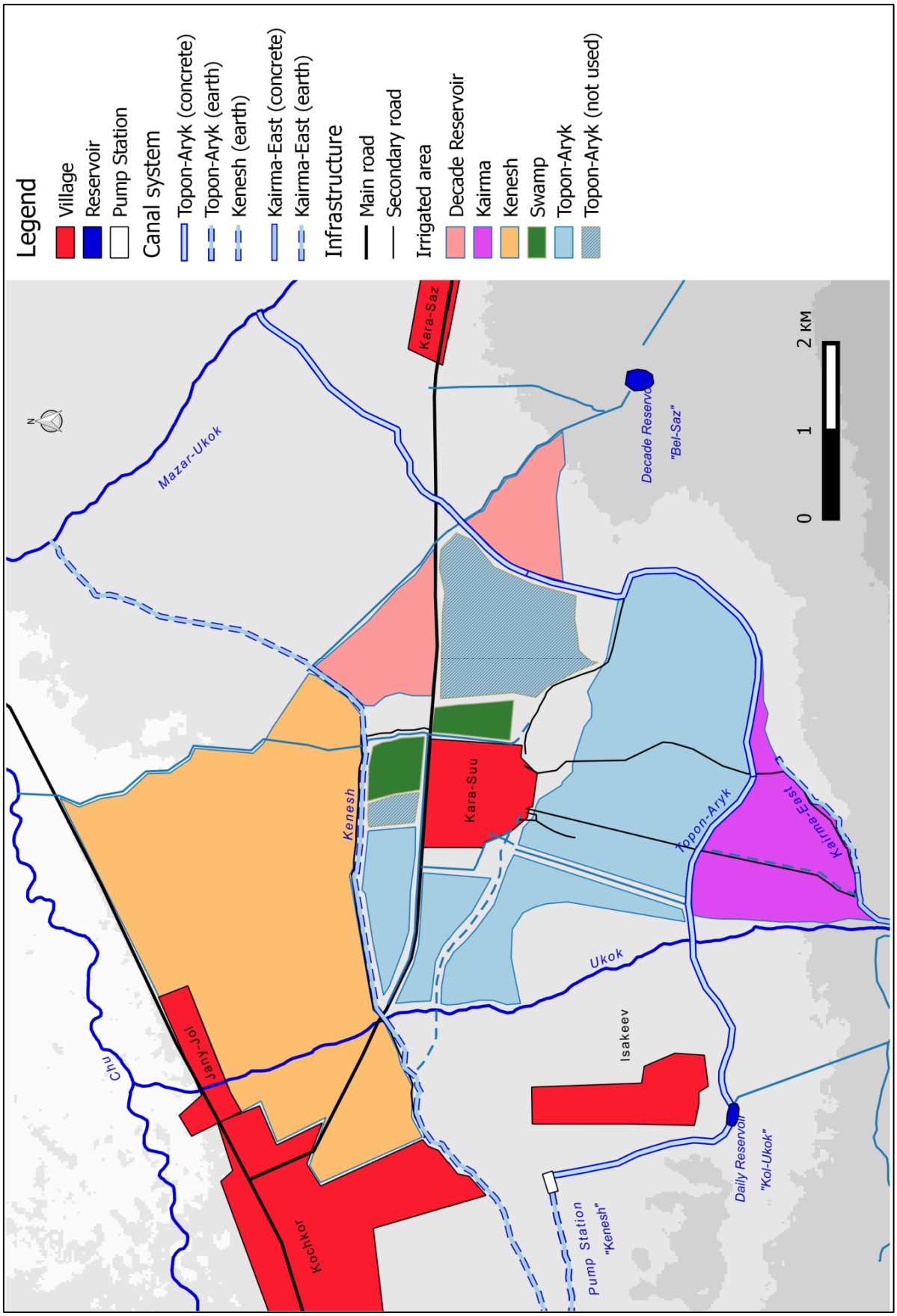

Figure 22: Irrigation agricultural areas Kara-Suu (Draft: Kasymov, 2015. Data base: EBERMANN 2012).

From this reservoir, which has been finished 1979, the canal runs to the east and irrigates an area of about 1045 ha South of Kara-Suu (see Figure 22). In total this major canal supplies about 2200 hectare of cultivated land with irrigation water and is, therefore, the most important off-farm irrigation channel of the Ak-Kyya commune (EBERMANN *et al*. 2014:84).

In 1982 the "Kairma" irrigation canal system has been built to irrigate the arable land between the "Topon-Aryk" and the Kok-Buka Range, the western part of the Terskey Ala-Too mountain system (EBERMANN *et al*. 2014:85). Therefore, water was diverted from the Ukok river into the Kairma canal system. This canal is divided into two branches: The "Kairma East" delivers water for arable land south of Kara-Suu, whereas the "Kairma West" irrigates the fields up-slope of Isakeev Village (see Figure 22). It is important to note that only the "Kairma" canal system receives its water directly through diversion from the Ukok river catchment. The other two irrigation canals, "Topon-Aryk" and "Kenesh", receive their water via long-range transport from the Zhoon-Aryk river catchment.

Up to now, the off-farm irrigation system is based upon a former Soviet irrigation plan. A comparison of the currently irrigated agricultural areas in the vicinity of Kara-Suu (see Appendix) with a copy of the original irrigation plan from 1973 (KIRGIZGIPROZEM 1973) and the map of the irrigation systems in 1993 (KIRGIZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT IRRIGATSII 1993) shows not only the full implementation of the Soviet irrigation plan, but also its still existing validity.

This in turn shows that the agricultural land of the village of Kara Suu currently receives most of its irrigation water from the neighboring Zhoon-Aryk catchment and only a small amount of water from the Ukok river catchment. Since Kara Suu is situated in the Ukok river catchment, this fact complicates the implementation of a natural river catchment based water management according to the approach of Integrated Water Resources Management (IWRM) explained prior in chapter 2.

Since the mid-1990s the main off-farm canals, like the "Kenesh", the "Topon-Aryk" and the "Kairma" are operated by the District Water Management Department (*Rayonnoe urpavleniye vodnogo khozyaystva - RayVodKhoz*) located in Kochkor. All off-farm channels and pumping stations are in their responsibility. This off-farm canal system, that was mainly planned and constructed during the Soviet period, still serves to irrigate the arable land of the villages of Isakeev, Kara-Suu, Jany-Jol and Kara-Saz (see Figure 22). As in the late Soviet period the main canals deliver water from the rivers Zhoon-Aryk, Ukok or Mazar-Ukok into smaller canals for on-farm irrigation. Their water supply is usually based on the demand requested by the water users.

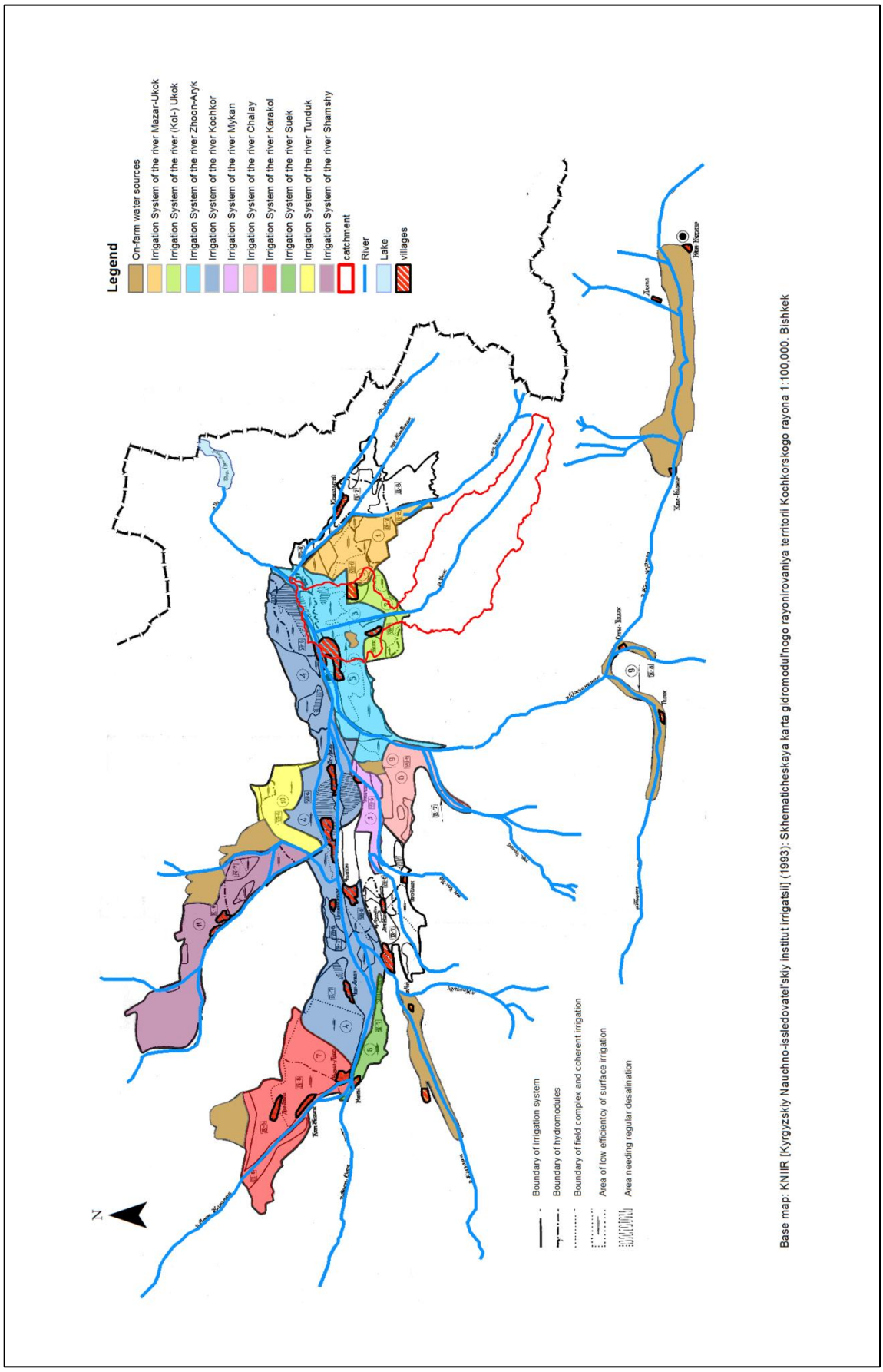

Figure 23: Irrigation system Kochkor basin (Draft: Kasymov, 2015. Data base: KYRGYZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT IRRIGATSII 1993).

In total, the Kochkor Rayon comprehends 9 different irrigation systems, which previously corresponded to the supply areas of off-farm canals (Figure 23). However in 2011, the Kochkor Rayon Water Management Department (RayVodKhoz) operated and maintained only 4 of these irrigation systems. These are the irrigation systems that are provided with water from the rivers Kochkor, Zhoon-Aryk, Ukok and Chalay.

6.1.2 Present Operation of the Off-Farm Irrigation Infrastructure

In 2010 Kara-Suu had an area of 1587 ha of arable land, of which 1578 ha were irrigated and 9 ha were rain fed. As a result of the land reform after independence and the dissolution of the kolkhoz 1480.73 ha of arable land were transferred to the residents of Kara-Suu whereas 106.27 ha remained in the responsibility of the local administration as *FPS* land *(Fond Pereraspredeleniya Sel'skokhozyaystvennykh ugodiy)* (AK-KYYA AYIL KENESH 2010). FPS is land owned by the Kyrgyz State.

Most of the cultivated agricultural land is irrigated by off-farm canals that deliver water from the Zhoon-Arik and Ukok rivers. The operation and maintenance of these canals is performed by the Kochkor Rayon Water Management Department (KRWMD). 985 ha of land is provided with water by the off-farm irrigation system Zhoon-Aryk, of which currently 663 ha are classified as arable land (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 2011). Of this area, around 641 ha were used as agricultural land in 2011. About 371 ha of agricultural land under off-farm irrigation system of the river Ukok were completely used as arable irrigated land (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 2011).

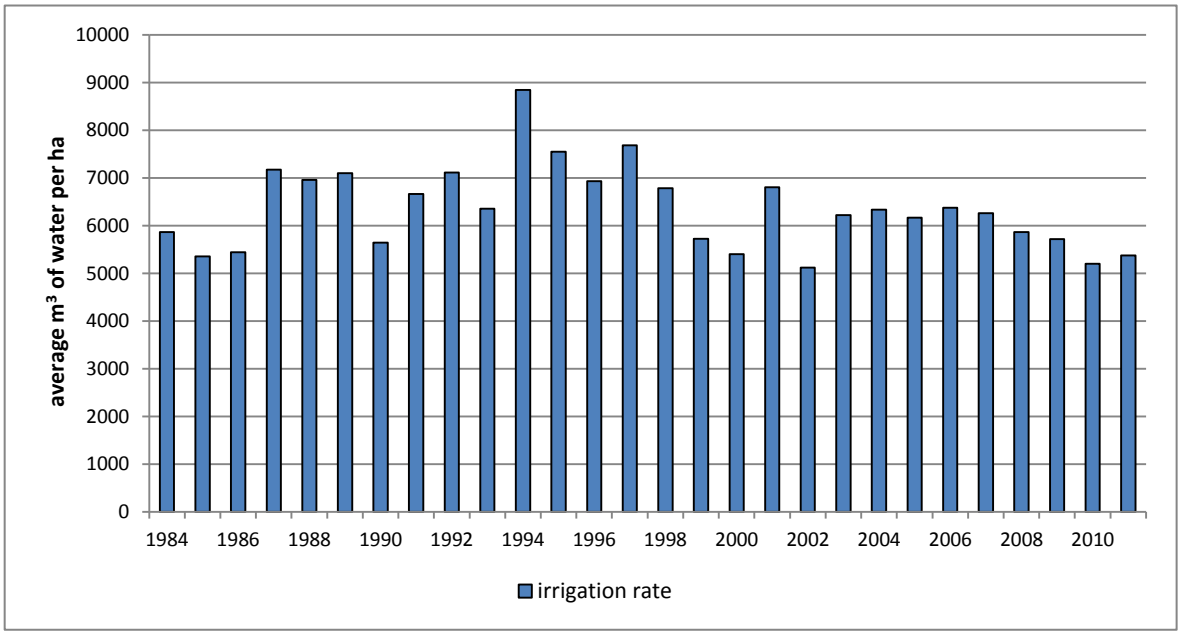

Figure 24: Changing irrigation rate (norms) per season from 1984 to 2011 according to annual reports (Draft: Kasymov, 2015. Data Base: KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 1980, 1988, 1989, 1991, 1996, 1998, 1999, 2001, 2002 & NARYN BASIN WATER MANAGEMENT DEPARTMENT 2007, 2008, 2011).

Most of the off-farm canals, which were built in the 1960s and 1970s, are currently in poor conditions, due to a poor quality of the used materials, the lack of construction or repair works and an incorrect use and service (EBERMANN *et al*. 2014). This status of disrepair causes significant water losses. However, such water losses caused by leakage of irrigation canals and cooperation have been problematic during the Soviet period also. In the 1980s the losses of irrigation water made up about 25 percent of the water intake (Figure 25). In the report on water use, the KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT (1980) admitted that some canals did not meet the standards adopted in the USSR. Especially in earthen canals water losses may reach up to 30 to 40 percent of the water intake (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 1980).

How much water was consumed for irrigation purposes in the Kolkhoz "Zhdanov" in 1991 is reflected in the reports on water use of the Kochkor UOS (*Upravlenie Orositel'nykh Sistem*). The collective farm cultivated 2286 ha of irrigated land, of which about 1587 ha directly belonged to Kara-Suu village. In 1989 an agreement was signed between the Kochkor Rayon Water Management Department (RayVodKhoz) and the Kolkhoz "Zhdanov" in which the Kochkor Rayon Water Management Department assured the delivery of 18,479,000 m^3 water, but finally they delivered approximately 25,458,000 m^3 of water. That means that the actual consumption exceeded by 6,979,000 m^3 the water amount guaranteed in the contract (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 1989).

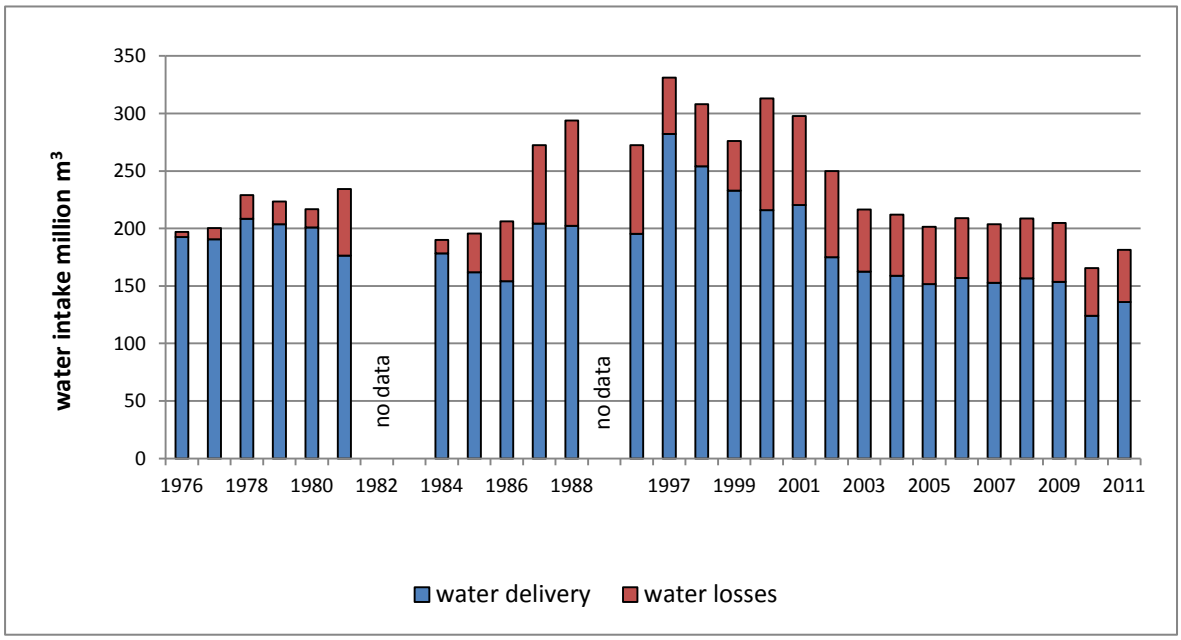

Figure 25: Losses of irrigation water in the Kochkor Rayon from 1976 to 2011 (Draft: Kasymov, 2015. Data base: KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 1980, 1984, 1988, 1998, 2001, 2002, 2004, 2011).

Figure 24 shows that irrigation norms changed between 1984 and 2011. In the Soviet period the Kochkor Rayon was specialized on the cultivation of fodder for livestock farming (wheat, barley and clover). As the crops did not change, it must be assumed that these changes in the irrigation norms were related to weather conditions and water content of the rivers. In the Soviet period, the state water management organizations did not have any government-approved standards for irrigation of crops (KIRGIZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT EKONOMIKI AGROPROMA 1990:30).

KIRGIZSKIY NAUCHNO-ISSLEDOVATEL'SKIY INSTITUT EKONOMIKI AGROPROMA (1990) listed a number of factors which are defined as negative for the irrigated land in the Naryn Oblast:

1) the lack of scientifically justified and approved irrigation regimes;
2) the widespread excess of the actual irrigation norms by 10 to 30 percent above the planned ones;
3) a lack of measurement of water discharge in the on-farm irrigation network. Hydrological measurement facilities are only installed in off-farm canals (main canals), because irrigation water had to be distributed among several collective farms. In irrigation canals collective and state farms had no means of water measurement;
4) a low efficiency of on-farm and inter-farm systems; and
5) the slow progress in the construction of a drainage network and its quality.

In the Soviet period, the Kyrgyz agriculture and irrigation has received substantial financial support from the Central Government (FEDORCHENKO 2001:1). Currently, financing of the water sector by the Kyrgyz Government and international donors is only about 25 to 30 percent of the required amount (SAKHVAEVA 2011:18). This of course has a negative effect on the Kyrgyz water sector. The deterioration of the irrigation infrastructure is a widespread phenomenon, parts of the agricultural land remand unused. Furthermore, the amount of water delivery has decreased in the last decade. In Figure 24 it becomes obvious that the amount of irrigation water has decreased by more than 25 percent compared to 1989.

The result has been a reduction of irrigation norms from 6000 to 7000 m^3 of irrigation water to 1 ha per irrigation season in the late 1980s down to 5000 – 5500 m^3 in 2011. Mainly the reduction of arable lands resulted in a decline in the reasond irrigation norms compared to the Soviet period. The amount of irrigation water received during the vegetation season for 1 ha is the reasond irrigation norm. During the vegetation season crops are watered several times. The number of irrigation procedures usually varies between 2 and 4 times.

Figure 26 shows the amount of water supplied per hectare and irrigation procedure in the Kochkor district in the period 1995 to 2011 (NARYN BASIN WATER MANAGEMENT DEPARTMENT 2011). The quantity of water supplied for irrigation varies from year to year. This can be caused by a variety of reasons among which the most importand are weather changes and – according to these – changes of runoff. As a consequence of changing weather conditions, the intake of water into the canals shows differences.

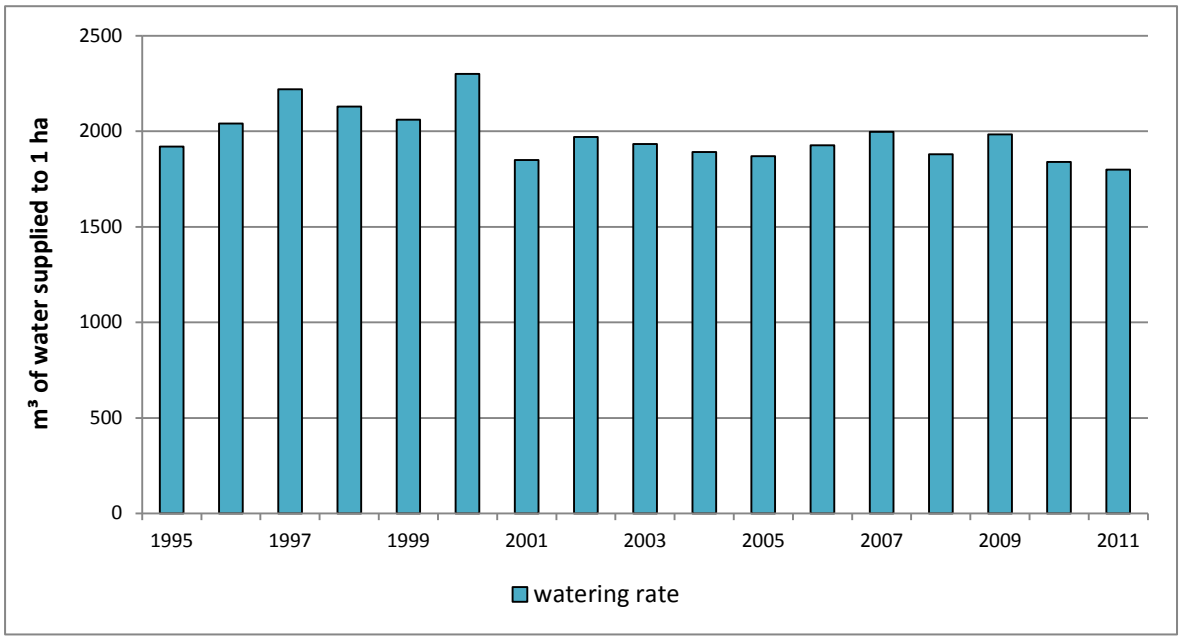

Figure 26: The average irrigation norms for one irrigation (watering) in the Kochkor district from 1995 to 2011 (Draft: Kasymov, 2015. Data base: KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 1996, 1998, 2002 & NARYN BASIN WATER MANAGEMENT DEPARTMENT 2007, 2008, 2011).

6.1.3 Management of the Off-Farm Canals

The off-farm canals play the main role in the irrigation of the arable land in the vicinity of Kara-Suu. These are the above mentioned canals Kenesh, Topon-Aryk and Kairma (East), which have been constructed mainly in the period 1973 to 1985. Only the canal Topon-Aryk is served by the pumping station "Kenesh", in the other canals the water flows by gravity.

In 2011 the state of preservation of the concrete Topon-Aryk canal was investigated and mapped (see Figure 27). The concrete boards of the canal are destroyed in some places, causing additional losses of water. In total this important off-farm canal is in a satisfactory condition of maintenance (Figure 28). However, canal sections, which are closer the mountains and are more affected by debris flows, are generally in poor conditions of maintenance.

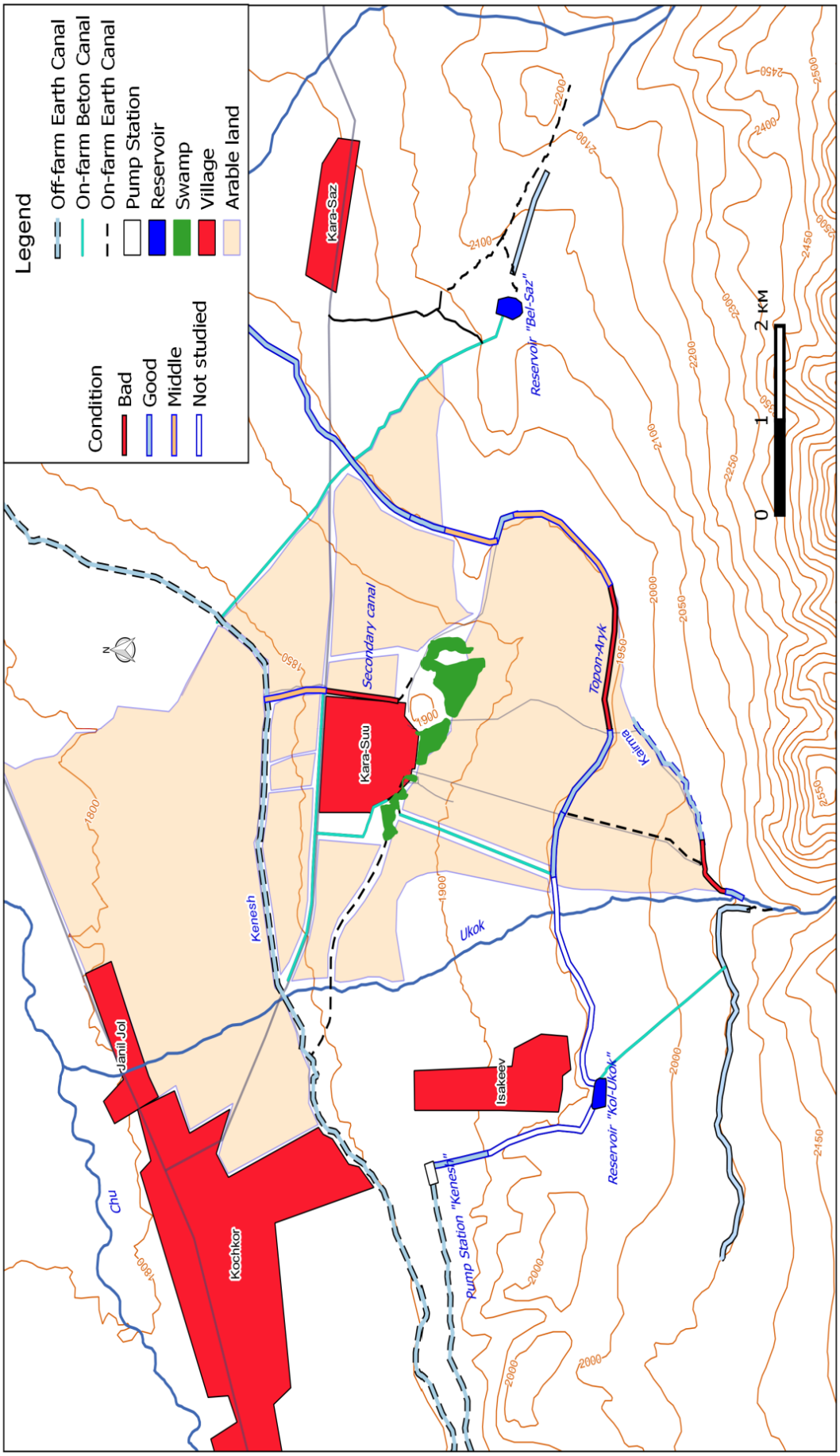

Figure 27: State of maintenance of the Topon-Aryk canal south of Kara-Suu (Draft: Ebermann & Kasymov, 2014. Data base: EBERMANN 2012).

Although the Topon-Aryk canal is an off-farm irrigation channel and, therefore, has to be maintained by the Kochkor Rayon Water Management Department (KRWMD), farmers from Kara-Suu need to clean the canal in early spring (Figure 29). Usually the water users clean those sections in the canal bed, which are located near their own arable land. However, after heavy run-off events sediment and debris is often clogging bridge passages and culverts (Figure 30). The main reason for these jams is often the narrow built culvert.

Farmers who irrigate their arable land with water delivered by the Topon-Aryk often complain that large areas cannot be irrigated. In particular the arable land at the lower Topon-Aryk (Don-Tash) is not irrigated sufficiently for several reasons: First, the pumping station "Kenesh" is not operating at full capacity, because two out of the five electric pumps are inoperative. Second, the pipes in which the water is delivered from the pump station to the upslope reservoir are leaking. Therefore, the water losses are substantially and the quantity of water supplied is not sufficient to irrigate the arable land at the lower end of the Topon-Aryk.

Unlike the two off-farm canals "Topon-Aryk" and "Kenesh", which receive their water from the Zhoon-Aryk river catchment, the Kairma off-farm canal get its water by diversion from the Ukok river (Figure 31 and 32). The weir, where the water is diverted from the Ukok river into the Kairma canal was completely destroyed by a debris flow in August 2010 (EBERMANN *et al.* 2014; ROST 2014). With financial support from the "Community Development and Investment Agency" (ARIS) the weir could be rebuilt in spring 2011. However, the Ak-Kyya community had to pay about one-third of the construction costs. In August 2013, the weir was almost destroyed again by a flood event. These floods and debris flows are caused by heavy rainfall, snow melt and glacier lake outbursts in the rear river catchment (MÜLLER 2013).

To sum up, all these off-farm canals are related to river catchments of Zhoon-Aryk and Ukok and are managed by Kochkor Rayon Water Management Department (KRWMD). Basic maintenance costs are covered at the expense of budgetary funds and funds of donor organizations. Additionally, the water users/farmers, of Kara-Suu village spend about 60,406 som/per year for the rehabilitation of the off-farm irrigation system (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 2011). However, the Kochkor RWMD already has to pay 11,962,690 som just for electricity to operate the 8 pumping stations (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 2011). In general, the operating costs exceed the income payments from the water users significantly. Thus, the off-farm irrigation management is not cost covering, but highly deficient.

Figure 28: The Topon-Aryk canal south of Kara-Suu (Photo: Kasymov, 2010).

Figure 29: Farmers removing sediment from the Topon-Aryk canal section near the mountains (Photo: Kasymov, 2010).

Figure 30: Culvert of Topon-Aryk clogged with sediment (Photo: Topbaev, 2010).

Figure 31: Reconstruktion of the Ukok-Kairma weir after its destruction by a debris flow in August 2010 (Photo: Kasymov, 2010).

Figure 32: The Ukok-Kairma weir in 2013. On the right of the weir are sand bags, which protected the system from a flood event a few days ago (Photo: Kasymov, 2013).

Figure 33: Poorly maintained on-farm canal in the vicinity of Kara-Suu (Photo: Ebermann, 2011).

6.2 The Current On-Farm Irrigation System in Kara-Suu

6.2.1 The Condition of the On-Farm Irrigation Infrastructure

The reform of irrigation management in Kyrgyzstan transfered the responsibility for the on-farm irrigation channels to the water users (eg. farmers); who were respected to be responsible for the operation and maintenance of the on-farm irrigation systems. However, most of the on-farm irrigation infrastructure of the Ak-Kyya community was built by the former Kolkhoz “Zhdanov” in the 1960 and 1970s. The irrigation network of the Ak-Kyya community extends over a length of 22.5 km, of which 16.1 km are made of lined up, reinforced concrete half-pipes (AK-KYYA AYIL KENESH 2011). The remaining 6.4 km of the canals are digged into the earth. During the investigations in 2010 and 2011, most of the on-farm irrigation infrastructure was in a poor state of maintenance. About 8.2 km of the concrete canals and 3.9 km of the earth trenches were in disrepair (Figure 33).

The reasons of their deterioration are various: In the early-1990s with the dissolution of the former kolkhoz, the transfer of agricultural land to rural residents took place. But the on-farm irrigation network, which was formerly operated by the kolkhoz, remained without any service. No institution felt responsible for the maintenance of this network. The intentional destruction of the various irrigation facilities was not controlled.

In 1994, the state transferred the responsibility for the on-farm irrigation system to the local administrations *(ayil okmotu*). But this measure did not lead to an improvement of the maintenance of on-farm infrastructure, because the village administration has neither the financial budget nor the human resources and technical knowledge for the operation and maintenance of the on-farm canals.

Currently the condition of the local on-farm irrigation infrastructure in the vicinity of Kara-Suu is still worse in comparison to the off-farm system. The condition of the on-farm canal at the eastern edge of the village, taking water from the “Swamp №3” and irrigating small areas east and north of the village is poor, because people take concrete sidewalls out of the canal for an easier watering of their domestic livestock on their plots (Figure 34).

East of Kara-Suu, approximately 471 ha arable land, is irrigated with water from the regulation reservoir “Bel-Saz” (cf. Figure 22). This reservoir gets filled with water, diverted from the river Mazar-Ukok. Its catchment neighbors the Ukok catchment to the east. Actually only 329 ha of this land are cultivated, mostly by farmers living in Kara-Saz village. A small number of plots in this area are farmed by residents from Kara-Suu.

Figure 34: Destroyed side wall of an on-farm canal to provide water points for livestock (Photo: Kasymov, 2011).

Unlike Kara-Suu, which is part of the Ak-Kyya community (*ayil okrug*), Kara-Saz is a village of the Kosh-Dobo community. Thus, this farm land is not only located in another administrative unit, but also in a different hydrological catchment than most of the cultivated land around Kara-Suu. Moreover, there is no Water User Association (WUA) currently existing in the Ukok catchment. But the irrigation system in the Mazar-Ukok catchment is operated and maintained by the WUA "Kara-Kungey Ukok Suu" and villagers from Kara-Suu, cultivating plots in the vicinity of Kara-Saz need to be members of this WUA to receive water from the reservoir "Bel-Saz" for irrigation. However, water users complain about the conditions of the water supply infrastructure. The secondary canal, which delivers water from the Mazar-Ukok river into the reservoir "Bel-Saz", is in a poor condition of maintenance. Much of its water is lost by leakage.

The reservoir "Bel-Saz" (Figure 35) was built in 1983 for the storage of water, needed to irrigate the farmland near Kara-Saz and Kara-Suu. Originally it was designed for a storage capacity of about 400,000 m^3. Currently, the reservoir is half-filled up with sediments and its storage capacity is reduced to approximately 200,000 m^3. To dredge this sediment out of the "Bel-Saz" Reservoir would cost about 18 million Kyrgyz som (approx. 300,000 EUR) (KOCHKOR RAYON WATER MANAGEMENT DEPARTMENT 2010). This amount of money cannot be raised by the WUA "Kara-Kungey Ukok-Suu" without the help of a donor. Thus the cleaning of the reservoir did not take place until today.

According to the investigations it can be summarized, that the on-farm irrigation infrastructure in the study area is a poor state of preservation. Mostly built in the 1970s by Soviet planning, the irrigation canals are often interrupted or leak. Much of the infrastructure is destroyed by natural processes (eg. debris flow, rock fall), vandalism and improper maintenance. Reservoirs and canals are often heavily filled with sediment, as they are rarely or never cleaned since the dissolution of the kolkhozes in the early 1990s. Many pumps in pumping stations do not work due to poor maintenance and the lack of repair for years. The lack of money is supposed as the main reason for the current lack of maintenance and repair (EBERMANN *et al.* 2014).

Figure 35: The Bel-Saz Reservoir (WUA Kara-Kungey Ukok Suu) (Photo: Kasymov, 2014).

6.2.2 Management of the Local Irrigation System

The dissolution of kolkhozes and sovkhozes as well as the following national land reform has led to a high number of new smallholder farms in Kyrgyzstan. But the national government was administratively and financially unable to manage the on-farm irrigation of the countless number of small farms. The operation and maintenance of the on-farm irrigation was transferred to the individual farms/water users (SEHRING 2005; HERRFAHRDT *et al*. 2006, EBERMANN *et al*. 2014).

By the land reform, each household in Kara-Suu, whose members were former members of the Kolkhoz “Zhdanov”, received 0.39 hectare of arable land per family member (pers. comm. A. Shakirov, interview: 01.05.2012). Thus the farm sizes depend on the number of

members per household. In 2010 most of the households interviewed in Kara-Suu possessed about 2 hectare of arable land (Figure 36). In addition, the livestock (sheep, goats, horses, cattle) of the former kolkhoz was distributed among the households.

This development has led to a strong fragmentation of the agricultural land into small plots. Meanwhile, some households have leased portions of their arable land to other households. This in turn complicates the irrigation management, because the inherited irrigation infrastructure was originally designed for large Soviet farms, growing fodder crops and forage.

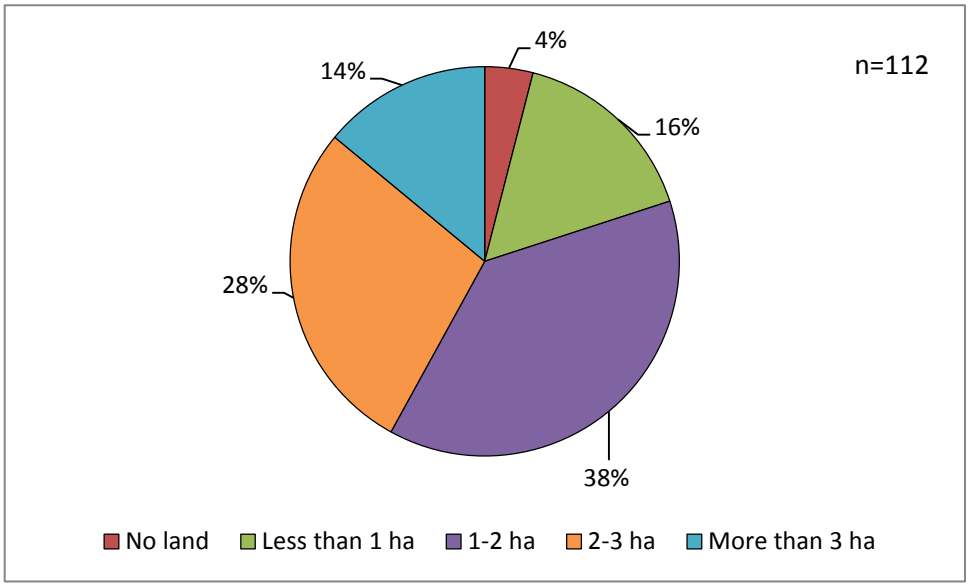

Figure 36: The area of arable land per farm in Kara-Suu (Draft: Kasymov, 2014. Data base: Own investigation 2010).

According to interviews with the village administrators, water masters (*murab*) and farmers the following scheme of functioning of the current irrigation system in Kara-Suu could be identified (Figure 37): The local village administration (*ayil okmotu*) represents the farmers of the village by concluding contracts on irrigation water supply with the Kochkor Rayon Water Management Department (KRWM). At the beginning of the irrigation season in spring, a meeting is held with representatives of the local farmers and the *ayil okmotu* of the Ak-Kyya community among the farmers, a number of well-respected people are proposed as candidates for the position as water masters (*murab*). In a next step, the farmers elect the five water masters, which are in charge of the operation of the irrigation channels and the distribution of the water for the fields. After their election, the five water masters (*murab)* are confirmed by the Kochkor Rayon Water Management Department (KRWM), which pays a regular salary for their work. In 2012, the allowance amounted to 2000 Kyrgyz som (KGS) per month (approx. 35 EUR).

The water masters (*murab)* are responsible for the maintenance of the off-farm (main) canals and the management of the water delivery to the farmers on the basis of an irrigation schedule. Furthermore they collect the irrigation service fee (ISF) from the farmers and transfer it to the Kochkor Rayon Water Management Department (KRWMD). At the beginning of the irrigation season, the *murabs* are contacting the head of the village administration (a*yil okmotu*), in order to organize the cleaning of the off-farm canals from sediments.

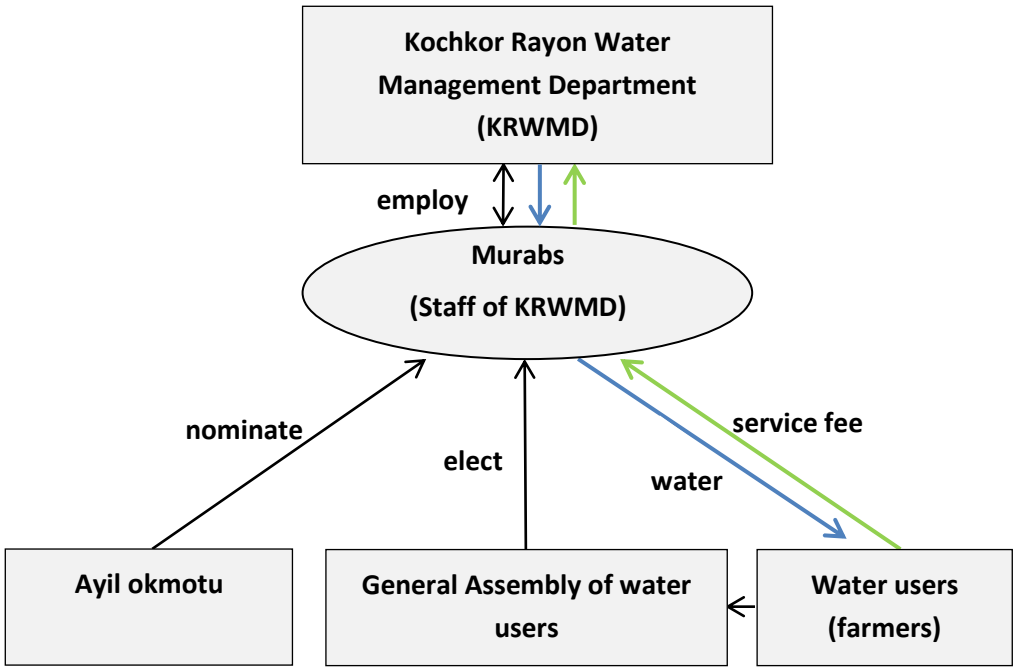

Figure 37: Scheme of interaction between the actors involved in the irrigation management. Blue arrow: Water supply, green arrow: transfer of irrigation service fee (ISF) (Draft: Kasymov, 2014. Data base: Own investigation 2010).

The water masters also carry out minor repairs on the irrigation facilities. Major repairs are reported to the Kochkor Rayon Water Management Department (KRWMD), which carries out these repairs then directly. For this purpose, an unpaid community working day is organized, which is called "*ashar*" in Central Asia ("*subbotnik*" in Russian). Normally, each household has one member who participates in this action for the maintenance and minor rehabilitation work of the irrigation channels and ditches. In case the farmers are not satisfied with the work of a water master, they can complain to the mayor (*ayil okmotu*). The mayor then addresses the complaint to the KRWMD, which can replace the *murab*.

Like almost all farmers in the Kochkor rayon, the smallholders of Kara-Suu mainly use "low-tech" techniques of surface irrigation. Mostly they use flood irrigation (Figure 38) to water the hay meadows and green fodder crops (Figure 39). Furrow irrigation is applied on crops like feed grain or potatoes. However, surface irrigation is a quite unsustainable method that usually needs more water than necessary. Additionally, uncontrolled surface

irrigation can cause salinization of the soils, the rising the groundwater level and the washout of nutrients from soil.

Figure 38: Flood irrigation on a clover field near Kara-Suu (Photo: Kasymov, 2011).

Figure 39: Furrow irrigation on potatoes field near Kara-Suu (Photo: Kasymov, 2011).

6.3 Irrigation Service Fee

Most farmers of Kara-Suu village irrigate their fields and meadows three times per season (Figure 40). Water to irrigate arable land is free of charge. Only those farmers have to pay an “Irrigation Service Fee” (ISF) who receive their water from the district water administration (KWRMD) located in Kochkor. However, most farmers in Kara-Suu receive their water for irrigation directly through the off-farm canals Kenesh, Topon-Aryk and Kairma, which are operated by the Kochkor Rayon Water Management Department (KRWMD).

In Kyrgyzstan the “Irrigation Service Fee” (ISF) was implemented as a market-economic mechanism in 1996 (KOZHOEV 2009:6). Its introduction is based on the Parliament Resolution “On the coordination of tariffs for water supply services operational organizations of the Ministry of Water Management the Kyrgyz Republic” (“*O Soglasovanii Tarifov za Uslugi po Podache Vody Ekspluatatsionnymi Organizatsiyami Ministerstva Vodnogo Khozyaystva Kyrgyzskoy Respubliki”*, № 208 from 26.09.1995) and the Government Resolution “On approval of tariffs for water supply services operational water management organizations of the Ministry of water Management the Kyrgyz Republic“ (“*Ob Utverzhdenii Tarifov za Uslugi po Podache Vody Ekspluatatsionnymi Vodokhozyaystvennymi Organizatsiyami Ministerstva Vodnogo Khozyaystva Kyrgyzskoy Respubliki”*, № 445 from 26.10.1995) (KOZHOEV 2009:6).

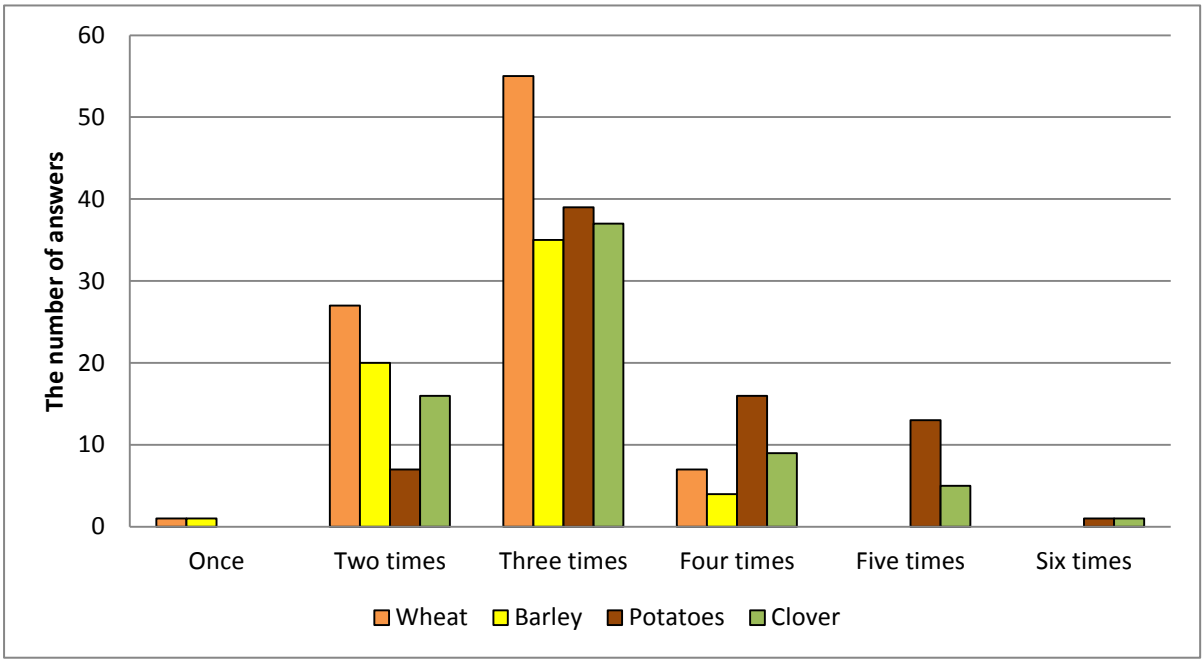

Figure 40: Irrigation of agricultural crops per season in 2010 (Analysis of questionnaire results in 2010) (Draft: Kasymov, 2015. Data base: Own investigation 2010).

A principal aim of the introduction of fees was to achieve a more efficient use of water according to the new National Water Code. However, the ISF is necessary to finance the operation and maintenance of the irrigation system, as the Kyrgyz Government reduced the subsidies from the state budget to the district water management agencies (*RayVodKhoz*) by almost 50 percent (SEHRING 2007:283, VALENTINI 2010:6). On the other hand, the introduction of the ISF increased the financial burden on water users. Particularly affected are small farmers, whose ability to pay the fee is often limited.

The tariff calculation takes into account the seasonal differences (vegetation period/non-vegetation period) and the regional climatic conditions. In 1995, the ISF amounted to 0.015 som/m^3 (approx. 0.00020 EUR) of water during the second and third quarter of the year (April to September) and 0.005 som/m^3 in the fourth respectively the first quarter (October to March). In regions with unfavorable climatic conditions, like in the intramontane Kochkor basin, the amount of the ISF is reduced to 0.005 som/m^3 in the second and third quarter of the year, respectively 0.001 som/m^3 in the first and fourth quarter (KOZHOEV 2009:6).

In 1999, these irrigation service fee (ISF) was raised to 0.03 som/m^3 for irrigation water in the 2nd and 3rd quarters and 0.01 som/m^3 in the 1st and 4th quarters. In regions with so-called unfavorable climatic conditions the fee rate amounted to 0.01 som/ m^3 (3rd and 4th quarter), respectively 0.02 som/m^3 (1st and 4th quarter) (KYRGYZ REPUBLIC 1999; KOZHOEV 2009:6). The ISF is rather symbolic and by no means cost covering.

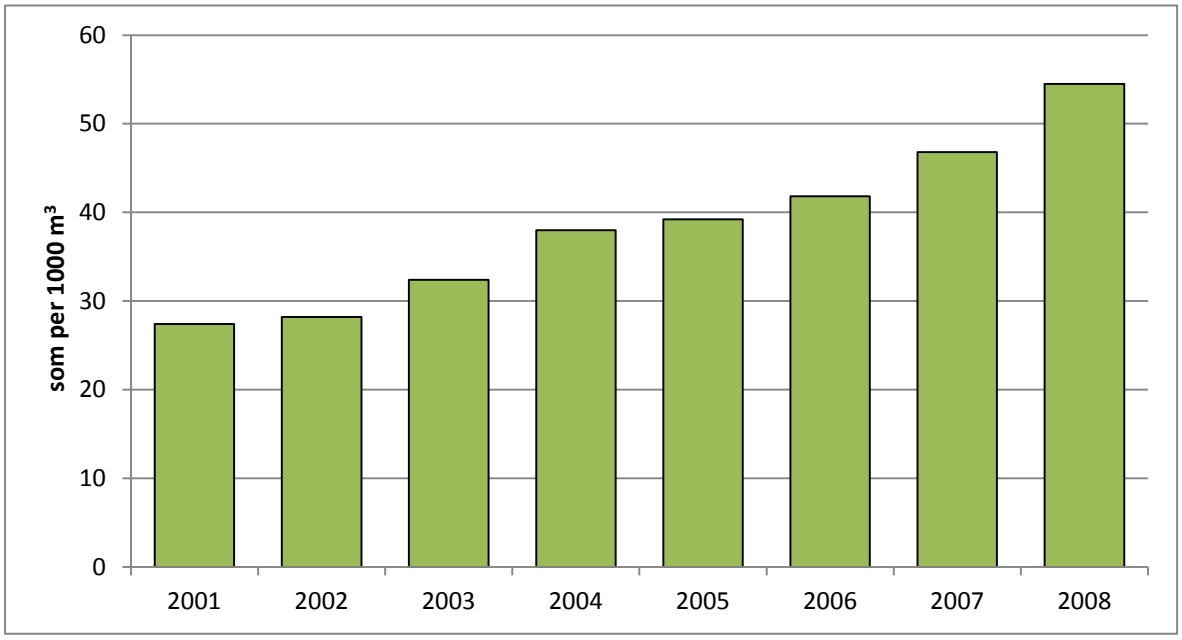

Figure 41: The change in average tariffs for water supply in the Kyrgyz Republic (Draft: Kasymov, 2014. Data base: KOZHOEV 2009:8).

Since 1999, apparently no further adjustment of the ISF by the Kyrgyz Government has taken place (KOZHOEV 2009:7). However, as Figure 41 shows, there has been a gradual increase of the ISF between 2001 and 2008. The fees vary according to the region. In 2008, the national average ISF was 0.054 som/m^3 (KOZHOEV 2009:8). The lowest rate was required in the Naryn Province (Central Kyrgyzstan), with 0.030 som/m^3 on average (KOZHOEV 2009:8).

However, due to the lack of gauging stations at on-farm irrigation level, the ISF are mostly charged according to the size of the irrigated area (per hectare payment) (KOZHOEV 2009:8). This also applies to the case study, the on-farm irrigation of Kara-Suu. There are neither water meters nor other measuring devices at the on-farm canals to register exactly how much water each farmer uses. Due to the lack of water gauges to determine the exact water flow, the *murabs* calculate the water volume by flow velocity. The ISF is calculated according to the land size and not according to actual water use.

According to Mr. A. Aliaskarov, a *murab*, and Mrs. Z. Mamysheva, the main specialist of Water Usage Department of Kochkor Rayon Water Management Department (KRWMD), the ISF is 80 som/ha/year (about 1.10 EUR). Neither the amount of water nor the number of irrigation procedures is relevant for the amount of the ISF. The farmers pay this fee to the water master (*murab*) who passes the money to the District Water Management Department (KRWMD) in Kochkor (Figure 37).

Usually the *ayil okmotu* of the Ak-Kyya community collects information from farmers about the size of their arable land and cultivated crops in early spring. Based on this information, the *ayil okmotu* neogotiates with the Kochkor Rayon Water Management Department (KRWMD) a contract for the annual water delivery. The fee is usually to be payed after harvest in fall. The attitude towards this irrigation service fee (ISF) differs. Some farmers consider the ISF as justified, if the infrastructure is well operated and maintained, while others are reluctant. There are cases of non-payment for water delivery. However, the possibilities for a compulsory fee collection are low. Usually also non-payers get water again in the following irrigation season. During the irrigation period disputes often occur in connection with an impaired watering schedule. In general, farmers on the upper reaches of the channel are better supplied with water than farmers in the lower part of the channel.

The amount of water that is supplied annually by the Kochkor Rayon Water Management Department (KRWMD) through the off-farm canals into the on-farm canals is mainly based on former Soviet calculations. Each year in March the village administration (*ayil okmotu*) signs a contract with the KRWMD for the irrigation water supply. For a total area of 985 hectare of arable land around Kara-Suu, the KRWMD supplied a volume of 6,439,000 m^3 in 2011. For this amount of irrigation water, they charged 60,406 som

(around 1,000 EUR). On the other hand, the KRWMD employs five *murabs*, who receive an annual salary of 24,000 som. Thus, the annual labor costs for these five water masters are twice as high as the revenue from the annual irrigation water supply to the farmers of Kara-Suu.

Table 1: Quantity and price of irrigation water supplied by KRWMD to the community Kara-Suu in 2011 (Data Base: Kochkor Rayon Water Management Department 2011).

	Jan - Mar.	Apr-June	Jul-Sept.	Oct.- Dec.	Total
Irrigation water supply in m^3	79,000	2,685,000	3,256,000	419	6,439,000
Payment ISF in som	1580	26,850	32,560	838	60,406

This example shows clearly the financial dilemma in the on-farm irrigation system. By the more symbolic ISF, it is hardly possible for Kochkor District Water Management Department to cover the costs for the operation, maintenance and repair of the off-farm irrigation infrastructure. The resulting increasing decay of the off-farm irrigation infrastructure causes a deterioration of the on-farm irrigation water supply. This in turn leads to a low acceptance of water fees by the farmers.

Currently, the ISF is not an effective economic mechanism actually affecting the demand and supply of irrigation water to water users and affects the efficiency of water usage negatively. Most other countries with the development of water management use water charging mechanisms, along with a subsidized support the water sector (VALENTINI 2010:6). Based on this experience there should be a systematic and gradual reduction of subsidies from the state budget to increase of water users´ ability to pay the irrigation service fee. This requires an analysis of real income of the water users and their ability to pay the ISF. Currently, most water users/farmers are aware that it is necessary to pay. On the occasion of the interviews in Kara-Suu 2010, 81 percent of the respondents stated that water prices are necessary.

7. Discussion

7.1 Water User Associations as a Panacea?

7.1.1 The Incomplete Implementation of the New Water Code

Following the independence of Kyrgyzstan in 1991, the Kyrgyz government privatized the agricultural land, abolished the former Soviet collective and state farms and distributed their arable land among the local population. Consequently, the inherited centralized state-run irrigation management became obsolete and a decentralized irrigation management system was established (e.g. WEGERICH 2000, SEHRING 2007, ABDULLAEV *et al.* 2010). Another important reason for denationalizing the former highly subsidized irrigation management was the state budget crisis in Kyrgyzstan.

A major step in the reform of irrigation management was the adoption of the New National Water Code in 2005, which regulates the political, institutional, economic and social background of water usage in Kyrgyzstan. In addition, several institutional reforms of the water management were carried out in Kyrgyzstan since 1991. However, the institutional change in water management often just resulted in a simple displacement of one institutional arrangement by another one (cf. chapter 3.1).

UL HASSAN *et al*. (2004), HERRFAHRDT *et al*. (2006) and others recommended the implementation of the IWRM approach in the water management sector. Then it is necessary to link the organization structure not only with the administrative areas (provinve, district), but to hydrologically defined catchments. Thus, the former Province Water Management Departments (*OblVodKhoz*) in Kyrgyzstan were nominally replaced by Basin Water Management Departments to introduce a catchment-based water resources management according to New Water Code and the IWRM-principles (e.g. HERRFAHRDT *et al*. 2006). But in reality, most these renamed authorities are still working on the basis of certain administrative provinces (e.g. HERRFAHRDT *et al*. 2006, SAKHVAEVA 2012).

Summarizing it can be stated that the creation of a new management structure according to the Water Code is incompleted (SAKHVAEVA 2012). The Kyrgyz Government commissioned the Department of Water Management and Melioration with the development of the National Water Strategy, but the project has not yet been completed by this authority so far (SAKHVAEVA 2012:11). There are still various contradictions between the legal framework on the one side and its practical application on the other side. For example, a planned state-controlled water administration has not yet been

created; its functions are at present fulfilled by the Department of Water Management and Melioration (SAKHVAEVA 2012). The national water sector is still characterized by a top–down management, which includes the national, province (*oblast)*, and district (*rayon*) levels. Within this system, the national level plays a central role in decision making processes (VALENTINI and OROLBAEV 2010).

Major problems do not only exist on the level of the remaining state-organized off-farm water management. The reform of the irrigation management in Kyrgyzstan transferred the responsibility of the on-farm irrigation to the water users, particularly the numerous small farmers. They are now faced with the problem to self-responsibly operate and maintain the irrigation infrastructure, which was formerly managed by the *kolkhozes* and *sovkhozes*. Soon it became evident that there were no adequate institutional structures for the on-farm irrigation management. The absence of an incentive system for collective action resulted in decay and destruction of the irrigation infrastructure as well as inequity and unreliability in the water delivery from the District Water Management Departments (RayVodKhoz) to the newly emerged individual farms (e.g. SEHRING 2005, EBERMANN *et al.* 2014).

To improve the irrigation management and to maintain the irrigation infrastructure at the former collective farm level, Central Asian states started the establishment of Water User Associations (WUAs) in the mid-nineties (e.g. SEHRING 2005, WEGERICH 2004, ABDULLAEV 2012). These WUAs are independent member organizations, which are suspected to be responsible for the joint operation and maintenance of an on-farm irrigation infrastructure and the on-farm irrigation water management as well as for the collection of water charges from its members, and the resolution of water related conflicts (cf. chapter 3.2).

In Central Asia, a huge number of WUAs has been established which have to take care for irrigation management on the farm level (ABDULLAEV *et al.* 2010:1042). In Kyrgyzstan, the New Water Code emphasizes economic mechanisms of water resources management. It codifies the right of farmers to establish WUAs in order to jointly manage on-farm irrigation systems. Most of the WUAs in Kyrgyzstan are connected to international donor activities and established by top-down projects.

There are no exact official data on how many WUAs currently exist in Kyrgyzstan. According to VALENTINI and OROLBAEV (2010:8) about 500 WUAs operate nationwide, covering more than 70 percent of the total irrigated area of the Kyrgyz Republic. Although the majority of WUAs took over the operation and maintenance of the on-farm irrigation network, this process is not yet completed. Although a large number of WUAs exists throughout the country, many of them have not reached their goals. The evaluation of WUAs in Kyrgyzstan and in Uzbekistan shows that such projects often have not been

efficient and effective (UL HASSAN *et al.* 2004, SEHRING 2005 KAZBEKOV *et al*. 2009, ABDULLAEV *et al*. 2010). Poor participation of potential members in the foundation process, the lack of technical and business knowledge, financial difficulties and a lack of integration of the WUAs into existing traditional management structures are just some of the many problems. In Central Kyrgyzstan many WUAs only exist in paper. Some have even been dissolved soon after their implementation.

7.1.2 Water User Associations in the Kochkor Basin

The organization of Water User Associations (WUAs) in the Kochkor District is connected with the on-farm irrigation project *Vnutrikhozyaystvennoe Oroshenie-1* (project on-farm irrigation-1; PVO-1), which is supported by the World Bank and the Government of the Kyrgyz Republic (TSENTRAL'NOAZIATSKAYA KONSALTINGOVAYA KOMPANIYA CAICONSULTING 2010:7). Since 2002, eleven WUAs were founded in the Kochkor District (Table 2). The WUA Support Unit of the Kochkor District Water Management Department (KRWMD) organized trainings for the formation and functioning of WUAs and assisted in their legal registration. For this support each member of a WUA has to pay 100 to 300 som per irrigation season to the WUA in Kochkor (pers. comm. Mrs. Saltanat Kozhogulova, interviews: 02/08/2010 and 29/08/2013)

Table 2: Water User Associations in the Kochkor Rayon (Data base: WUA SUPPORT DEPARTMENT OF KOCHKOR RAYON 2010).

№	Name of the WUA	Irrigated area in ha	*ayil okrug* (community)
1	Shish-Choku	1527	Kum-Dobo
2	Senkiltay-Too Bulagy	1078	Semiz-Bel
3	Orton	2010	Kum-Dobo
4	Kara-Kungey Ukok-Suu	2459	Kosh-Dobo
5	Cholpon-Suu	2000	Cholpon
6	Karakol-Sook	4040	Talaa-Bulak
7	Ukok-Kol	2095	Ak-Kyya
8	Teztor	743	Isakeev
9	Baba Dyykan	1936	Kochkor
10	Sarseit	3471	Kara-Suu
11	Raimbek-Baba	817	Tolok

However, according to an interview with Mrs. Saltanat Kozhogulova, the head of the WUA Support Unit of Kochkor Rayon, some of these eleven Water User Associations are not able to organize their work and, therefore, only exist on paper in the reports of the water management organizations of the district and province. The WUAs "Ukok Kol", "Cholpon-Suu", "Teztor", and "Baba Dyykan" in the communities (*ayil okrugs*) Ak-Kyya, Cholpon, Isakeev, and Kochkor only exist on paper. The WUAs "Sarseit" and "Karakol-Sook" were united in 2010 (pers. comm. Mrs. S. Kozhogulova, interviews: 02/08/2010 and 29/08/2013). Thus, of the nominally eleven WUAs in the Kochkor Rayon, only seven exist in practice. With the WUAs "Ukok-Kol" and "Teztor" not working, there is currently no WUA existing in the study area, the Ukok river catchment.

The WUA "Ukok-Kol" was established in 2003. Only two years later, this WUA has ceased activity again. According to the interviews with farmers in Kara-Suu village during the field survey in 2010 and 2011, it seems that most of the WUAs in the Kochkor Rayon were established by top-down projects. Their establishment simply resulted out of the previously mentioned state regulation "*Vnutrikhozyaystvennoe Oroshenie-1"* (project on-farm irrigation-1; PVO-1). It was mainly a systematic implementation of a regulation that was requested by superordinate state authorities.

The implementation of the WUA "Ukok-Kol" was not at all a transparent process for the ordinary farmers, who did not feel ownership and tended to avoid water fee payment. Due to the rushed foundation of the WUA, it was omitted to effectively create awareness about the WUA, its benefits, their organization structure, and role as well as to involve the farmers, local patrons, elders (*aksakal*) and local institutions (e.g. *ayil okmotu*, *ayil kenesh*). Based on the lack of information, the awareness of the water users for the need and benefits of a WUA does still not exist in Kara-Suu village. Furthermore most water users/farmers consider irrigation infrastructure maintenance as the responsibility of the District Water Management Department (KRWMD) in Kochkor and do not understand why they should pay now for something that used to be free of charge during the Soviet time. This experience of the failed implementation of the WUA "Ukok-Kol" in the Ak-Kyya community suggests a high risk of failure, if a WUA is not established through a bottom-up consultive approach.

According to the IWRM-approach and the principles of the Kyrgyz New Water Code a WUA should be managed by a group of water users along a hydrological sub-system (e.g. HERRFAHRDT *et al*. 2006, SAKHVAEVA 2012). However, it is noticeable that the eleven WUAs in the Kochkor District have been assigned to administrative communities, not to hydrological catchments (see Table 2). But such an compliance with the natural hydrographical catchments is not always possible or practical. Another serious problem is

the state of the irrigation infrastructure created in Soviet times. Generally at that time the planning was focused on the technical aspects of irrigation; hydrographic principles were not taken into account during the construction of the irrigation system. As stated above in chapter 6.1.1, the existing irrigation infrastructure in the vicinity of Kara-Suu is based on a former Soviet irrigation management plan which ignores natural hydrographical boundaries. Although the Ak-Kyya community (*ayil okrug*) and thus also the village of Kara-Suu are located in the Ukok river catchment, the majority of farmers in this area receives its irrigation water via the off-farm canals “Kenesh” and “Topon-Aryk” from the Zhoon-Aryk catchment (cf. Figure 22). In addition, a small number of farms receive their water from the "Bel-Saz Reservoir” and thus from the Mazar Ukok river catchment. Only the fields located south of Kara-Suu near the edge of the mountain range, get water from the Ukok river via the Kairma channel. Thus, the farmers from Kara-Suu get their irrigation water through off-farm channels from three different river catchments. The majority of irrigated land is supplied via the channels “Kenesh” and “Topon-Aryk” from the relatively distant Zhoon-Aryk catchment area (cf. Figure 23).

Currently, only those farmers from Kara-Suu are members of a Water User Association (WUA “Kara-Kungey Ukok-Suu”), who get their water from the “Bel-Saz” reservoir. Farmer from Kara-Suu, whose fields are irrigated with water from the three off-farm canals “Kenesh”, “Topon-Aryk” and “Kairma” should also establish so-called channel-bound WUAs. Since the “Kenesh/Topon-Aryk System” has a relatively large catchment (Zhoon-Aryk river), the existence of several WUAs along these two canals could lead to various problems and conflicts. Therefore, it is worth to consider the implementation of so-called *Unions of Canal Water Users* (UWUs) along the main off-farm irrigation canals (cf. ABDULLAEV et al. 2010). Such a Union of Canal Water Users (UWU) may comprise several WUAs that provide residents along an off-farm canal system (e.g. “Topon-Aryk”, “Kenesh”) with irrigation water. A jointly created Canal Water Committee could then be in charge of the management of the main channel (cf. ABDULLAEV *et al.* 2009:325). Experiences on these steps are described by BEKBOLOTOV 2007), ABDULLAEV et al. (2010) and VALENTINI and OROLBAEV (2010).

For resolving water disputes, arising from the distribution of irrigation water from the Kenesh and Topon-Aryk canals, the villages Kara-Suu, Jany-Jol, Isakeev and Kara-Saz should establish a Water Council (*Vodokhozyaystvennyy Sovet*), in which the Kochkor Rayon Water Magement Department (KRWMD), Water User Associations (WUAs), Union of Canal Water Users (UWUs), and the local administration should be represented.

It remains that the institutional change in water management on national, as well as on regional and local level is a complex process. The reforms in the Kyrgyz water sector are

still in an initial stage (HERRFAHRDT *et al.* 2006, SEHRING 2007). Elements of decentralization in the sphere of management are demonstrated by the creation of WUAs, which in long term should take over the functions of the Rayon Water Management Departments. However, WUAs are established as new organizations, based on an inherited irrigation infrastructure as well as in an existing pattern of local institutions of Soviet and partly from pre-Soviet period. The failure of WUA "Ukok-Kol" in the Ak-Kyya community and other mostly poorly functioning WUAs in the Kochkor District shows that the introduction of WUAs in this region has been only partially successful.

Against this background, the proposed dissolution of the District Water Management Departments (RayVodKhoz) makes little sense. Currently, the Kochkor Rayon Water Management Department (KRWMD) rather is a stabilizing element in the local irrigation management. As a large number of WUAs in the Kochkor District are only exist on paper, while others operate only in a limited manner, the existing WUAs are far from being able to take over the tasks of the KRWMD. Instead of implementing new structures, it might be useful to strengthen the capacities and democratic features of traditional local institutions (e.g. *ayil okmotu*, *ayil kenesh*, *aksakals*), as villagers/farmers tend to rather accept their advice or decisions instead of outside experts. State authorities do not really involve the local stakeholders in the reform processes (e.g. SEHRING 2005, 2007, HERRFAHRDT *et al.* 2006). There are at least four essential requirements to made the WUA more acknowledged and more efficient: local stakeholders must be aware of organizational reforms, water users should have the opportunity to participate in all decision concerning "their" water, capacities for organizational management and technical improvements must be created, and water resource have to be considered as evaluated economic goods.

7.2 Awareness and Participation of the Local Water Users

According to HERRFAHRDT *et al.* (2006), SEHRING (2007) and others, one of the main obstacles for reforms in Kyrgyzstan is the lack of compliance among the population with the decisions made by the state authorities. However, one of the most important key components of the concept of Water User Associations (WUAs) is to raise awareness among stakeholders. In Kara-Suu, where the WUA "Ukok-Kol" is not operating, the public awareness among the various stakeholders (water users, *ayil okmotu*; KRWMD) is extremely low. Most residents do not know the legal basis of relations in the water sector. Even the basic laws, governing the activities of the Water Code and the *Law on Water Users Associations* are not available for water users. Therefore, the main principles of water resources management are unknown to them.

Since the beginning of the reforms in the water sector, in the mid-1990, the farmer did not make any progress in the field of water management. When the implementation of the

WUAs started in 2002, in most cases a top-down approach was applied without any training of the farmers by the WUA-Support Unit. Decisions about the structure and organs of the WUA "Ukok-Kol", membership criteria, tenure of representatives, rules for an effective operation and management of the planned WUA has not been discussed with the villagers in consultation meetings.

The hasty implementation only included local administration (*ayil okmotu*) and WUA-Support Unit at the KRWMD. The water users in general did not perceive the WUA "Ukok-Kol" as an independent, self-financed member organization. Even members of local administrative institutions, like the *ayil kenesh*, lacked this awareness. A majority of the individual water users was marginalized in the implementation process of the WUA. The natural reaction was the denial of farmers/water users of Kara-Suu towards the WUA. They considered it a strange organization implemented by state authorities. In such a situation the WUA could not function since its inception to solve problems in the operation and maintenance of irrigation management without the support of water users was impossible. Activities aimed at raising awareness of water users are very rare because of a lack of planning and financing such events (pers. comm. Mrs. S. Kozhogulova, interviews: 02/08/2010 and 29/08/2013).

On one hand the people´s lack of awareness about WUAs and other structural or socio-economic changes is due to the lack of access to information. On the other hand, this lack of awareness is also due to the fact that those transformations do not affect the power relations in their everyday life. Although the villagers/farmers in Kara-Suu often complain that there are no administrative structures that care for village life and on-farm irrigation management, most people seem to expect the communal administration (*ayil okmotu*) to care for everything and to mobilize financial resources. A lack of community awareness and proactiveness as well as a passive response to necessary changes are the consequences.

One of the fundamental principles laid down in the Water Code is participation of the stakeholders in planning and decision-making processes concerning the water management. Participation and involvement of the water users are basic principles; to improve the local governance and the stakeholders´ usage of public water supply (cf. HERRFAHRDT *et al.* 2006), SEHRING 2007). It is necessary to create a common sense of ownership among the water users and to raise the awareness about the necessity to rehabilitate the common drinking water supply system.

A reform according to the concept of Integrated Watershed Management is based on principles of the participation of all stakeholders, the empowering of water users, the accountability of authorities on different levels (e.g. decision-making), and the

transparency of all activities (e.g. FARRINGTON *et al.* 1999, FFOLLIOTT *et al.* 2003). But to what extent can these principles be observed in the study area? Up to now, the principle of participation in decision-making processes has been implemented only to a small extent on the lower levels of water management. Elements of individual water user participation can be found in the election of water masters (*murabs*), who are responsible for off-farm canals. *Ashar*, an unpaid, collective voluntary community works for joint community interests, like major construction work, or the annual repair and cleaning of canals. Ashars (russ. "*subbotniki*") are widespread among poor farmers and water users (cf. BICHSEL 2009, ABDULLAEV and RAKHMATULLAEV 2013).

On the other hand, principles of accountability and transparency in the relationship between water users and water management organizations have not yet really been developed. The farmers can not determine the status of irrigation, due to an institution that would prepare documents on water use and financial matters. Information on the principles of watering orders for arable land or lists of ISF-payment are not available. *Murabs* mentioned in an interview (interviews: 05/2012), that there is a schedule for allocation of the irrigation water, but upon inquiry, they could not show such a schedule. Nevertheless, the majority of the water users do not request this information, due to their previously mentioned passivity.

7.3 Capacity Building for Water Management

In order to implement a fully functioning Water User Association, it is necessary that the stakeholders have appropriate knowledge and skills. Therefore, a major attention must be paid to capacity building activities among water users (STARKLOFF and ZAMAN 1999)**.** The implementation of a WUA should be accompanied by an appropriate program. This should be focused on subjects like water distribution and monitoring, preparing and implementing irrigation infrastructure maintenance plans, the implementation of a business plan, organizational and financial management et cetera.

For such a capacity building program competent and experienced trainers, like the hydro-engineers at the District Water Management Departments and other appropriate experts are required. At the time of the establishment of the WUAs in the district Kochkor, this staff was not available. According to the respondents there has neither been any long-term community awareness raising program in advance nor any capacity training in Kara-Suu. It is also doubtful whether the appropriate personnel is currently available for the WUA-Support Unit in Kochkor. The Ak-Kyya community has by no means the experts with the necessary technical, economic and legal knowledge. The prevailing education is too specialized to meet the current needs of well trained experts, who are able to include ecological and socio-economical aspects into hydro-engineering.

7.4 Water Charges and the Lacking Financial Sustainability

According to SEHRING (2008), primarily technical, institutional and economic deficiencies are responsible for the shortcomings in the Kyrgyz water management. As previously mentioned, a major impediment to the operation, maintenance, modernization and proper functioning of the irrigation system is a shortage of funds. The main reason for the Kyrgyz water reform and the transfer of the on-farm irrigation management to the water users is the ongoing state budget crisis since 1991.

Water as a resource is free of charge, but users, like the farmers in the study area, who receive water from the District (*rayon*) Water Management Departments (*RayVodKhoz*) have to pay an irrigation service fee (ISF). According to the survey in Kara-Suu, the purpose of the ISF is unclear for most water users. Their attitude towards this ISF differs, as some water users consider it justified, if the irrigation infrastructure is well maintained and the water supply is sufficiently and in time. However, some water users are reluctant or even refuse to pay the ISF, mainly because of poverty, bad yields or irregular financial income (see chapter 6.3). This causes budget deficits for the District (*rayon*) Water Management Departments (*RayVodKhoz*). These own observations from the study area in Central Kyrgyzstan match the results of HERRFAHRDT *et al.* (2006) and SEHRING (2008).

To gain financial sustainability, the acceptance of cost recovery principles will have to be accepted by the District Water Management Departments, the rural communities and the water users. The virtual absence of a quantity-based calculation of the amount of irrigation water supplied prevents both fair pricing and an effective water use. Furthermore, the use of the ISF is not transparent to the water users. The *murabs* collect the ISF from farmers and pass the collected money to the District Water Management Department in Kochkor (KRWMD). But this information is not communicated to the farmers. In many cases the farmers simply do not know, which costs have to be covered by the ISF.

Their unwillingness to pay is not simply connected to the “Soviet mentality” and the incorrect assumption that water usage in the Soviet period was actually free of charges. According to our interviews in Kara-Suu, about 80 percent of the respondents indicated that they are aware that service fees for the water supply are necessary. The opposition to the fee payment often simply results out of the lack of information about the proper use of fees paid.

The intake of ISF is also used to maintain the off-farm irrigation infrastructure. Their poor state of preservation requires substantial investments in rehabilitation and maintenance of the irrigation system. But the limited financial ability of the state and the more or less symbolic amount of the ISF do not allow an adequate operation and maintenance of the

off-farm irrigation infrastructure. This results in an unequal water supply, because water users at the lower end of the channel systems often get less water than the upstream riparian's. This in turn leads to a low acceptance of water fees by the farmers since they notice no real improvement in the water supply system, despite their payment of the ISF. It is, therefore, understandable that farmers in Kara-Suu simply distrust in a proper use of fees paid. Without transparency in water pricing, it is difficult for the water users, to judge how adequate decisions and actions really are (STARKLOFF and ZAMAN 1999:7).

The ISF is calculated according to the land size and not the actual water use. According to UL HASSAN *et al.* (2004:39), the more or less rather symbolic ISF should be raised five to seven times higher of its present values. However, only the billing based on actual volumetric water consumption would provide fair pricing and probably allow a more effective use of water (e.g. HERRFAHRDT *et al.* 2006, MIRZAEV and ERGASHEV 2012).

8. Additional Need for the Water Management Reform in Kyrgyzstan

Nearly all reforms in the water sector of Kyrgyzstan and other Central Asian republics tend to change institutional structures. In Kyrgyzstan, the ongoing institutional reform of the water management was conducted to decentralize the inherited Soviet-style system and to make it more efficiently, sustainable, and market-orientated. But the new institutional frame has some fundamental deficits (e.g. HERRFAHRDT *et al.* 2006, SEHRING 2007, 2008, ABDULLAEV *et al.* 2010). According to SEHRING (2007), there is no complete institutional change, but a rather complex recombination of existing institutions and the introduction of new institutional elements and new concepts. On the formal level some new institutions might have been established in the Kyrgyz water management and new laws, like the national water code, have been introduced. However, in some cases prior existing institutions were only renamed or transformed according to the existing institutional logics (cf. chapter 3.1).

Depending on the hierarchical level of water management, different incentives can be important for the various institutions. For the Kyrgyz government and in particular the national Department of Water Management a major incentive was the possibility to transfer the costly on-farm irrigation management to the individual water users. This reduced the financial burden of the government to operate and maintain the on-farm irrigation infrastructure. Major tools of this reformation are the establishment of self-managed Water User Associations (WUA) and the introduction of the irrigation service fee (ISF). Besides, this reform measure is additionally supported by international donors (World Bank, Asian Development Bank) (TSENTRAL'NOAZIATSKAYA KONSALTINGOVAYA KOMPANIYA CAICONSULTING 2010:6f.).

To formally meet the IWRM-principles, the seven former oblast (province) Water Management Departments (OblVodKhoz) were re-named into Basin Water Managemnt Departments. These departments only have little interest to participate in the water reform. Their basic function is to control subordinated water institutions at the *rayon* (district) level, to collect the annual reports of the District Water Management Departments about the water use, and to prepare a general report on water use in the province respectively the hydrological basin for the superordinated National Department of Water Management and Melioration. Thus, the tasks that this authority has to fulfill after the reform do not significantly differ from those they have already in the Soviet period.

With transfer of the on-farm irrigation systems to the individual water users, the District (rayon) Water Management Departments (RayVodKhoz) have experienced the most

comprehensive changes in their structure and range of tasks. Their conventional task is the delivery of irrigation water from the off-farm canals into the on-farm irrigation canals and to maintain the off-farm irrigation infrastructure. Since the mid-1990, the District Water Management Departments sign the annual irrigation water contracts with the individual water users. In the case that functioning WUAs have been set up in the district such water supply contracts are signed between the WUA and the District Water Management Department. For the District Water Management Departments each WUA simplifies the process of concluding irrigation supply contracts and the collection of the ISF.

According to the government resolution of the Kyrgyz Republic № 358 on June 3, 2002 the national Department Water Management and Melioration regulates and controls the activities of the WUAs (TSENTRAL'NOAZIATSKAYA KONSALTINGOVAYA KOMPANIYA CAICONSULTING 2010:18). Consequently, the District Water Management Department, which is part of the water sector, is also responsible for the activities of the WUA. However, the District Water Management Department often is unable to cope with the tasks assigned to them. The main problem is their chronic underfunding: Since the ISF paid by the individual water users, respectively the WUAs, are too low to reach cost recovery, the remaining costs have to be covered by the government budget. Since there are no penalties for non-payers of the ISF, budget deficits of the District Water Management Departments can be significant. This underfunding prevents the effective operation and maintenance of the off-farm irrigation infrastructure.

The own results from the Kochkor district demonstrate that the introduction of WUAs in this region have been only partially successful. The reasons for this are complex and have been described previously by the example of the abandoned WUA "Ukok Kol" in the Ak-Kyya community (Kochkor *rayon*). This case study exemplarily demonstrates, how closely the implementation of a WUA is connected to questions of local politics, inherited irrigation infrastructure, the lack of awareness and the lack of preparation respectively support of water users by the local WUA-Support Units.

Besides the lack of awareness of the farmers for the benefits of a WUA, an additional major problem is the low linkage of these co-operatives in the traditional local institutions and communities structures: WUAs are newly established organizations in an existing institutional pattern directly or indirectly dealing with water issues. With the party donor-driven introduction of WUAs in Kyrgyzstan, the integration of local institutions (e.g. ayil okmotu, ayil kenesh) consciously has been avoided (SEHRING 2005, 2007).

However, farmers are often skeptical about innovations and tend to rather accept an advice of local patrons or elders than the opinions and advice of outside experts. This is especially true in rural and remote regions. During the own investigations in Kochkor

District, the impression arose that a further integration of these local institutions in the on-farm irrigation management would not be counterproductive. It would rather make sense to use their knowledge and experience, to strengthen their capacities and to increase the transparency and participatory awareness of the local institutions, like the *ayil okmotu* or the *ayil kenesh*.

Another obstacle to the implementation of reform measures in the Kyrgyz water management is the lack of regional experts. Especially in rural areas the personnel capacities are limited. Furthermore, the prevailing Soviet-style academic education is too specialized to meet the current needs of interdisciplinary educated experts, being able to include ecological and socio-economical aspects into hydro-engineering (SEHRING 2007, ROST 2014). The implementation of interdisciplinaty IWRM and IWM-master's degree programs at the universities in Almaty and Bishkek might be a possible step towards this capacity building (ABDOLVAND *et al*. 2014, ROST 2014).

Apart from training and capacity building, the sufficient salary is an incentive for the staff of a WUA as well as for *murabs* and WUA-Support Unit employees (SEHRING 2005:39). But due to the fact that farmers set a low price for services of the WUA and the relatively low ISF a difficult financial situation for the existing WUA emerges. As a result, the WUA staff is poorly paid, which negatively affects the quality of work.

The performance of an existing WUA can be improved by monitoring the management activities within an audit commission (PROEKT IUVR – FERGANA 2003:27). So, the WUA activity reduces dependence of the farmers from the District Water Management Departments (RayVodKhoz). But there is another impediment, which prevents the formation of a WUA: the WUA will raise service fees from their members for operation and maintenance of the on-farm irrigation network.

The payment of the ISF was often mentioned by the interviewed experts as a major problem. In the Kochkor district, like in many other regions in Kyrgyzstan, no exact data on the quota of actual ISF payment exist. The case study of Kara-Suu also illustrates the problems in the pricing of irrigation service. As described above, the area-based pricing method dominates in the Kochkor *rayon* to fix the price per hectare for on-farm irrigation water delivery. One disadvantage of this pricing strategy is the lack of an incremental pricing incentive that encourages farmers to use water efficiently.

Volumetric water pricing would encourage a more efficient water use. It recovers all of the costs of providing irrigation services through the price charged per unit of water delivered. However, this method requires volumetric measurement and billing. Appropriate measuring devices are lacking in the irrigation infrastructure. A possible solution to this

problem could be to estimate water deliveries by using water flow rates and delivery times or by reading staff gauges and calculating volumes delivered through carefully constructed delivery canals.

In summary it must be noted that the investigations in the Ak-Kyya community demonstrate exemplary and clear the multifarious problems of the irrigation management in rural Kyrgyzstan. The national irrigation reform is mainly focusing on formal institutional change. The transfer of the on-farm irrigation management to the individual water users is resulting from the land reform. However, the reform was mainly carried out in order to relieve the state financial budget. With the objective to improve irrigation management, to make it more efficient and equitable, the implementation of Water User Association in the Kochkor district must be regarded as largely failed. A large number of WUA registered in 2002 only exist on paper, while others operate rather lean. Nevertheless, these WUAs - even those that now exist only on paper - are still listed by the State authorities in the reports. This method is strongly reminiscent of the apparent plan fulfillment during the Soviet period.

Unfortunately, this practice does not appear to be limited to the Kochkor district, but to be common practice in many parts of the country. Already a result of these procedures, the reform of irrigation management in Kyrgyzstan is doomed to fail. An institutional irrigation management reform needs to develop adequate strategies. Changes cannot be introduced by short-term initiatives and incentives, but only with long-term efforts to change perception patterns and normative attitudes fundamentally (SEHRING 2007:288). The investigated case study "Kara-Suu" clearly shows that the road towards a fundamental reform of the Kyrgyz irrigation management is still very long and laborious.

9. Summary

Transformations of political and socio-economic framework conditions at regional or national level often influence in many ways the structures and scope for action at the local level. The main objective of this work is to investigate the effects of the post-Soviet transformation of water management in Kyrgyzstan on the on-farm irrigation in rural areas. This is done using the example of the Ak-Kyya community in the Kochkor basin (Naryn *oblast*, Central Kyrgyzstan), an area that was characterized by a more or less nomadic pastoral economy in the pre-Soviet era. Irrigated agriculture was first introduced during the Soviet agricultural collectivization in this mountainous region.

Since gaining independence in 1991, the government of the Kyrgyz Republic has carried out various socio-economical reforms, including a radical land reform and a reformation of the water management. A “New Water Code” establishes principles for managing water resources, defines the jurisdiction of state bodies concerning water resources and water management, regulates the usage of and payment for waters, and sets forth measures to protect the national water resources.

The main reason for denationalizing irrigation management was the persistent state budget crisis. With the privatization and dissolution of the former *kolkhozes* and *sovkhozes* thousands of new small farms came into existence. This transformation has also led to the transfer operation and maintenance of the on-farm irrigation from the *kolkhozes* and *sovkhozes* into the responsibility of numerous smallholder farms. The Kyrgyz state is simply no longer in a position to provide financial support for the operation and maintenance of the on-farm irrigation system. This has led to the deterioration of the on-farm network resulting in a heavily decreased efficiency of this network. This problem can be well observed in the case of the irrigation infrastructure in the investigation area, the Ak-Kyya community.

The Kyrgyz government soon realized the necessity for reforms in the water sector on all institutional levels to decentralize the inherited Soviet-style system and to make it more efficiently, sustainable, and market-orientated. Since the mid-1999s, significant changes in the water management sector from the legislative framework to the management structure took place. But the reforms are far from being completed. On the institutional level it is rather a complex recombination of existing institution. In some cases prior existing institutions, like the Oblast Water Management Departments (*OblVodKhoz*), were only renamed or transformed according to the existing institutional logics.

On the local level the water reform process intends the formation of Water User Associations (WUAs) to improve the operation and maintenance of the on-farm irrigation

management. These independent, self-organized associations of water users/farmers are suspected to be responsible for the joint operation and maintenance of an on-farm irrigation infrastructure and water management within a certain hydrological catchment as well as for the collection of water charges from its members.

This study, conducted in the Kochkor district shows that the implementation of WUAs has so far been only partially successful. The eleven WUAs established more or less by a top-down process under presidential decree WUAs were not required to be participatory. Their rapidly set-up paid little attention to social mobilization and institutional development. In most cases an effective operation and maintenance of the on-farm network by the WUAs failed.

Four of the WUAs, registered in 2002 exist only on paper. One of them, the WUA "*Ukok-Kol*", has been implemented for the water users in the community Ak-Kyya. Although this WUA is still officially registered, the local water users/farmers have dissolved it after just one year. The case study exemplarily showed that the reasons for the failure of the WUA "*Ukok-Kol*" are complex and are partly rooted in the specific institutional environment in Kyrgyzstan. The people´s lack of awareness about the WUA´s objectives and benefits is mainly due to the lack of access to information's. Furthermore, broad community awareness is virtually non-existent. As the rural population tends to accept the advice of local patrons and elders instead of outside experts, it is useful to involve more of these persons in the reform process of local water management. It would also useful to strengthen the capacities of the local administrative institutions and to make them transparent and participatory community organizations.

Since the existing irrigation infrastructure was built in the Soviet period, some irrigation systems get water from several watersheds of small rivers (as it is the case in the Ak-Kyya community) and a reconstruction of the existing channel system would be more useful than the conversion to a system based on hydrological basins. Further solutions are e.g. the creation of WUA federations for the operation of inter-farm irrigation networks, or the creation of Water Councils in cases when the irrigation network is used by water users of several villages in different water catchments.

A further obstacle is the acceptance of the ISF. The water users do not see the necessity of ISF, because they do not know for which purpose the fee is used. For most water users to use the ISF by the Kochkor District Water Management Department (*Kochkor RayVodKhoz*) is not transparent. In addition, the Kochkor District Water Management Department is unable to ensure an equitable and timely supply of on-farm irrigation, due to various own financial and personnel difficulties.

Summing up the results of this study it can be stated that answers to the questions which were set at the initial stage of the project were obtained. Data on the current status and operation of the irrigation systems were obtained empirically. To understand the basic concepts and problems of the water sector scientific works of authors from various countries have been used. Studies in this field are relevant, due to the changing conditions in the water sector. It is necessary that in these studies scientists and specialists from various spheres become involved. This will allow looking at problems from different points of view.

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Appendix

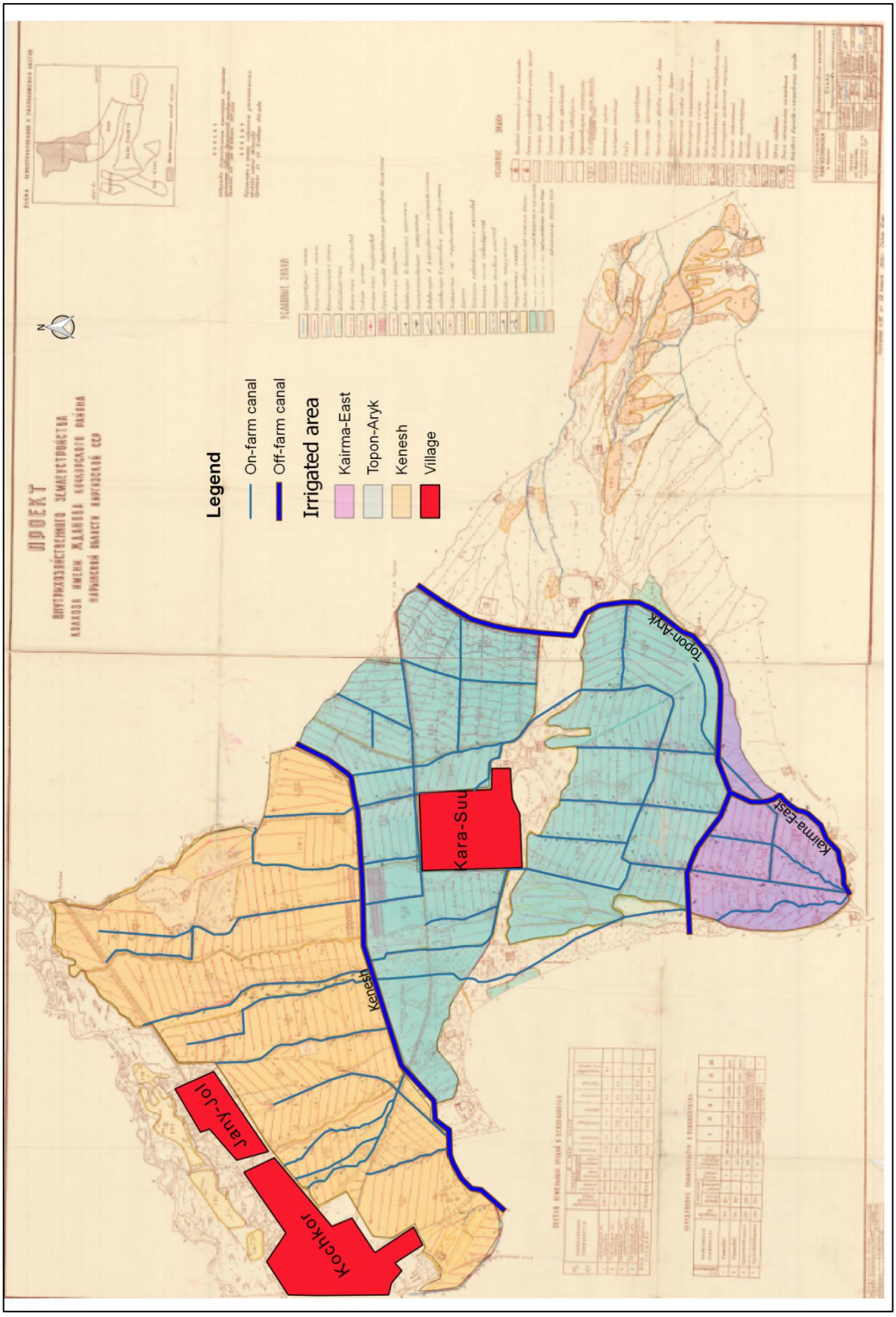

Figure I: Planned project on land management in the collective farm of "Zhdanov" (Draft: Kasymov, 2014. Data base: KIRGIZGIPROZEM 1973).

Questionnaire 2010 (in Kyrgyz)

Кочкор районунун суу бассейнинин жаратылыш ресурстарын интеграциялык башкаруу боюнча

СУРАМЖЫЛОО

(Анкета по интегрированному управлению речным бассейном в Кочкорском районе)
(The Questionnaire on Integrated Watershed Management in Kochkor Rayon)

Урматтуу респондент

Кочкор районунун суу бассейнинин жаратылыш ресурстарын интеграциялык башкаруу боюнча илимий изилдөө проектиси 2010 жылдан башталды. Сиздин аймагыңызда жана үй чарбаңызда суунун пайдалануусу жана суунун абалы боюнча Сиздин ойюңузду билүү биз үчүн кызыктуу. Эгер Сиз төмөнкү суроолорго так жана толук жооп берсеңиз, Сиз келечекте Кочкор аймагынын суу чарбасынын оңолушуна жана бул проектинин ишке ашышына өзүңүздүн салымыңызды кошосуз.
Сурамжылоо суроолордон турат жана Сиздин жообуңуз керектелинет. Сурамжылоо илимий максатта гана колдонулат.
Сурамжылоо аноним түрдө жүргүзүлөт. Сиз өзүңүздүн атыңызды белгилебей деле койсоңуз болот.

Сурамжылоону түзгөндөр:
Касымов М. К.
Топбаев О. А.
проф. Штадельбауер Й.
доц. Асыкулов Т. А.
.

Бишкек–Кочкор 2010

1-бөлүм. Респонденттин демографиялык мүнөздөмөсү

1) А.А.А._____

2) Анкетаны толтурган жер _____

3) жашыңыз_____

4) улутуңуз_____

5) жынысы: *01* аял *02* эркек

6) билимиңиз

01 орто *02* орто кесиптик

03 бүтпөгөн жогорку *04* жогорку

05 башка_____

7) Кесибиңиз_____

8) Азыркы иштеген жериңиз_____

9) Үйбүлөңүз барбы?

01 бар *02* жок

10) Канча балаңыз бар?_____

11) Ата-энеңиз силер менен турабы?

01 ооба *02* жок

12) Пенсия жана жардам аласыңарбы?

01 ооба *02* жок

13) Бир айлык кирешеңиз, айлыгыңыз канча (сом менен)?

01 _____

02 аялыңыздын (күйөөңүздүн)_____

03 балдарыңардын_____

04 үй бүлөнүн башка мүчөлөрү_____

2-бөлүм. Үй чарбанын жалпы мүнөздөмөсү

1) Силердин үйүңөрдө канча киши турат _____

2) Үй чарбаңарда канча жериңиз бар?

01 айдоо жерлер_____ га;

02 короо жай (огород) _____га;

03 жайлоо_____га;

04 башка _____

3) Суу жоктугунан иштетилбеген жер үлүшүңүз барбы?

01 ооба *02* бар болсо, канча_____га *03* жок

4) Кайсы жерлерди арендага аласыңар? Канчага?

01 айдоо жерлер_____га;_____сом

02 чабык аянттары_____га;_____сом

03 жайлоо _____га;_____сом

04 башкалар_____га;_____сом

5) Жерлерди кимден арендага аласыңар?

01 айыл өкмөтүнөн *02* менчик жер ээлөөчүлөрдөн

03 мамлекеттен *04* башкалар_____

6) Жер үлүшүңүздү арендага бересизби? Канчага?

01 ооба (_____сом) *02* жок

7) Короо жайыңарда (огороддо) кандай айыл чарба өсүмдүктөрүн өстүрөсүңөр?_____

_____

8) Айдоо жериңизде эмне өстүрөсүз?

01 буудай *02* арпа *03* картөшкө

04 көп жылдык чөп (беде, эспарцет) *05* башкалары болсо_____

9) Айдоо жериңизден канча түшүм аласыз?

01 буудай_____ *02* арпа_____ *03* картөшкө_____

04 көп жылдык чөп (беде, эспарцет)_____ *05* башкалары болсо_____

10) Түшүмдүн канча бөлүгүн сатасыңар?_____

11) Кандай жер семирткичтерди колдоносунар?

01 кык *02* минералдык *03* колдонбойм

12) Талаа иштеринде ким жардам берет?

01 үй бүлөө *02* туугандар

03 жалдайм *04* айыл өкмөт

13) Менчик унаанын саны

01 жеңил машина_____ *02* жүк ташуучу машина _____

03 трактор _____ *04* прицеп _____

05 араба_____ *06* башкалар_____

14) Малыңыздын саны

01 жылкы_____ *02* уй_____ *03* кой_____

04 эчки_____ *05* эшек_____ *06* тоок _____

07 индюк_____ *08* башкалар_____

15) Кыштан чыкканга өз тоютуңар жетиштүүбү?

01 ооба *02* жок *03* ар кандай

16) Эгерде жетпесе канча сатып аласыңар?

01 жем_____ тонна *02* чөп_____ тонна

03 башка_____ тонна

17) Былтыркыга салыштырмалуу малдын саны кандай өзгөрдү?

01 көбөйдү 02 азайды *03* өзгөргөн жок

18) Өзгөрсө, себеби эмнеде?_____

19) Малды кайсы жерде багасыңар?

Жазында:

01 короодо *02* аңыздарда

03 жаздоодо *04* башка_____

Жайында:

01 короодо *02* аңыздарда

03 жайлоодо *04* башка_____

Күзүндө:

01 короодо *02* аңыздарда

03 күздөөдө *04* башка_____

Кышында:

01 короодо *02* аңыздарда

03 кыштоодо *04* башка_____

20) Жайлоодо малды ким багат?

01 өзүбүз *02* малчыга кошобуз

03 туугандар багат *04* кошпойбуз_____

21) Малды баккан үчүн канча төлөйсүңөр? (бир айда сом менен?)

01 бир уйга_____ *02* бир койго_____

03 бир жылкыга_____ *04* башкаларга_____

22) Туристтерден пайда аласызбы?

01 ооба *02* жок

3-бөлүм. Райондун суу чарбасынын өнүгүү деңгээли боюнча.

3.1 Турмуш-тиричилик жактан суу менен камсыздоо.

1) Турмуш тиричилик жактан суу кайсы жактан аласыз?

01 булактан *02* үйдөгү суу түтүгүнөн

03 арыктын суусунан *04* колонкадан *05* башка _____

2) Үйүңөрдө суутүтүкчөө жок болсо, канча аралыктан суу аласыңар?

01 10 м-ге чейин *02* 10 м-ден 50 м-ге чейин

03 50 м-ден 100 м-ге чейин *04* 100 м-ден ашык

3) Үйүңүздө суу түтүгү жок болсо, үйүңүзгө суу түтүгүн киргизгенге акы төлөгөнгө даярсызбы?

01 ооба *02* жок

4) Айылдагы суу түтүгүндөгү суунун сапатына сиздин ойуңуз.

01 эң жакшы *02* жакшы *03* орточо

04 начар *05* эң начар *06* сиздин ойуңуз_____

5) Суу түтүктөрүн ким тейлейт?

01 жеке ишкана

02 суу чарбасы

03 айыл өкмөту

04 суу пайдаланучуулардын ассоциациясы (АВП)

05 башка уюмдар:_____

6) Кимдин башкаруусунда суу түтүктөрү мыкты иштейт?

01 мамлекеттин көзөмөлүндө

02 жеке ишканалардын башкаруусунда

03 суу пайдаланучуулардын ассоциациясынын (АВП) көзөмөлүндө;

04 башка ойуңуз_____

7) Суу түтүктөрүнөн (колонкадан) пайдаланган сууга айына канча төлөйсүз? _____сом

8) Суу үчүн төлөм акыны өз убагында төлөйсүзбү?

01 ооба *02* жок *03* төлөбөйм

9) Ичүүчү суу сапаты көрсөтүлгөн тарифтерге дал келеби?

01 толук дал келет *02* жарым- жартылай

03 жок *04* билбейм

10) Турмуш-тиричилик керектөөсүнө сиздин үй-бүлөө күнүнө канча суу коротот?
суутүтүгүнүн суусун:

01 1л – 10л *02* 11л – 30л *03* 31л – 50л
04 51л – 100л *05* 101л – 200л *06* 200л-ден көп

арык суусун:

01 1л – 10л *02* 11л – 30л *03* 31л – 50л
04 51л – 100л *05* 101л – 200л *06* 200л-ден көп

11) Совет убагында суу түтүктөр кандай абалда болгон?

01 эң жакшы *02* жакшы *03* орточо;
04 жаман *05* эң жаман *06* сиздин оюңуз_____

12) Суу түтүктөрүнүн азыркы абалы:

01 эң жакшы *02* жакшы *03* орточо;
04 жаман *05* эң жаман *06* сиздин оюңуз_____

13) Аймактагы суунун сапаты аркылуу козголгон оорулар_____

3.2 Сугат суулары

1) Айдоо жумуштарынын алдында жериңизди сөзсүз түрдө сугарасызбы?

01 ооба *02* жок

2) Негизги айыл чарба түшүмүн алыш үчүн айдоо жериңизди сезондо канча жолу сугарасыз?

01 буудай_____ 02 арпа _____ *03* картөшкө_____
04 көп жылдык чөп (беде, эспарцет)_____ *05* башкалар_____

3) Айдоо жериңизди сугарган үчүн кандай төлөйсүз?

01 сезондо бир жолу _____сом
02 ар бир сугарган үчүн_____сом
03 башка _____

4) Короо жай (огород) сугарган үчүн кандай төлөйсүз?

01 сезондо бир жолу _____сом
02 ар бир сугарган үчүн_____сом
03 башка _____

5) Айдоо жерлерди кандай ыкмалар менен сугарасыңар?

01 арык менен *02* башка_____

6) Короо жай участокту кандай ыкмалар менен сугарасыңар?

01 арык менен *02* суутүтүкчөө менен *03* башка_____

7) Айдоо жериңизди ким сугарат?

01 өзүм *02* сугатчы жалдайм *03* башка_____

8) Сууну ким бөлүштүрөт?

01 мураб
02 СЧРБ (суу чарбанын райондук башкаруу)
03 суу пайдалануучулар ассоциациясы (АВП)
04 айыл өкмөтү

9) Мамлекет эгемендүүлүк алганынан бери сугат каналдары узардыбы?

01 ооба *02* жок *03* кыскарды *04* билбейм

10) Сугат каналдарын курууга суроо-талаптар барбы?

реконструкция (кайрадан оңдоп куру боюнча)

01 ооба *02* жок

жаңы куруу (узартуу боюнча)

03 ооба *04* жок

11) Силердин аймакта саз жерлерди кургатууга муктаж жерлер барбы?

01 ооба *02* жок *03* билбейм

12) Сиз сууну экономикалык жактан баалуулук деп эсептейсизби?

01 ооба *02* жарым-жартылай макулмун

03 жок *04* билбейм

13) Сууну пайдаланган үчүн акы төлөш керек деп эсептейсизби?

01 ооба *02* жарым-жартылай макулмун

03 жок *04* билбейм

Чоң рахмат!

Датасы_____

Erklärung

Hiermit erkläre ich, dass ich die Dissertation selbstständig angefertigt und keine anderen als die von mir angegebenen Quellen und Hilfsmittel verwendet habe.

ich erkläre weiterhin, dass die Dissertation bisher nicht in dieser oder anderer Form in einem anderen Prüfungsverfahren vorgelegen hat.

Berlin, 20.03.2015

Mukhtar Kasymov