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# Farming systems classification in Zerger watershed, southern Kyrgyzstan: Who grows rice and why?

Master's thesis

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**Supervisor:**

Vladimír Verner

**Author:**

Jakub Skřivan

## Declaration

I hereby declare that presented thesis “Farming systems classification in Zerger watershed, southern Kyrgyzstan: Who grows rice and why?” is my own work and all the sources have been quoted and acknowledged by means of complete references.”

April 22, 2016, Prague Jakub Skřivan

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# Abstract

Rice is a traditional crop in Kyrgyzstan and its cuisine, although it remains rather a minor crop in terms of its volume of consumption when compared to other crops cultivated within the country. The epicentre of rice production in Kyrgyzstan lies in the southern part of the country, in Osh and Jalal-Abad Provinces, that are renowned for their unique local varieties of rice. Production of rice in Kyrgyzstan has kept increasing trend since 1990s, but so has the volume of import, too. The competition raised by the imported rice is one of the threats the local rice growers have to face nowadays and will have to face also in the future. Another problem that keeps growing stronger is lack of water in the locality, that places rice, one of the most freshwater consuming crops, into a very precarious position.

This thesis focuses on farming systems in Zerger watershed, southern Kyrgyzstan. The main aim was to identify the position and role of rice in the locality, as well as to document both local rice growing households and rice varieties they cultivated. Another specific aim was to compare local rice growers and rice non-growers in their resource management, and to obtain future expectations towards local rice agribusiness. To receive the necessary data, a household survey, with usage of interview-administrated, semi-structured questionnaires, was carried out in July 2015 with chosen households in the locality.

The results showed that rice is a very profitable crop in the locality with a price more than five times higher than that of wheat, the main local staple crop. Three varieties, two traditionally local and one originally imported from Uzbekistan, were cultivated by farmers in the sample. The resonance of problems with lack of water and droughts was found present in the locality as well.



**Keywords:** household survey; Osh Province; Uzgen district, rapid appraisal; resource analysis; process analysis

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# List of Abbreviations

| | |
|---|---|
| **ESNA** | European Society for New Methods in Agricultural Research |
| **FAO** | Food and Agriculture Organization of United Nations |
| **FAOSTAT** | FAO – Statistics Division |
| **GDP** | Gross Domestic Product |
| **HDI** | Human Development Index |
| **IMF** | International Monetary Fund |
| **IRRI** | International Rice Research Institute |
| **KGS** | The Kyrgyzstani Som (official currency of the Kyrgyz Republic) |
| **NGO** | Non-Governmental Organization |
| **NSC** | National Statistical Committee of the Kyrgyz Republic |
| **UNDP** | United Nations Development Programme |
| **UNEP** | United Nations Environment Programme |
| **UNESCO** | United Nations Educational, Scientific and Cultural Organization |
| **UNESCO-IHE** | UNESCO – Institute for Water Education |
| **USD** | United States Dollar (official currency of the United States) |
| **USDA** | United States Department of Agriculture |
| **USSR** | The Union of Soviet Socialist Republics (i.e. Soviet Union) |
| **WB** | World Bank |
| **WFP** | United Nations World Food Programme |
| **WUA** | Water User Association |

# 1 Introduction

Rice accounts for one of the globally most spread commodities. According to the last data from FAOSTAT (2016), it keeps position of the most valuable crop within the international market, the third most cultivated crop and, after wheat, the second most cultivated cereal worldwide. Between 1961 and 2010, global production of this crop more than tripled. Moreover, rice is the staple food for the largest amount of people on Earth, providing almost one quarter of all the calories consumed by the world's population (IRRI, 2013), and in most of Asia, rice also constitutes the major economic activity and a key source of employment and income for the rural population (Facon, 2000). Rice is culturally deeply rooted and comprises for an integral ingredient within many local cuisines. That is also typical for the whole region of Central Asia, being highly renowned as a base of paloo (*pilov*) dish (Nesbitt et al., 2010), including Kyrgyzstan, where the local production of rice has been growing sharply since the country regained independence after the USSR break-up in the early 1990s. Yet the country's rice supply is still strongly supported by foreign production import, while the export extent remains negligible (von der Dunk and Schmidt, 2010; FAOSTAT, 2016). Nowadays, farmers in Fergana Valley, an area that has for centuries been considered very fertile for the vast region of Central Asia, providing the best conditions for farming in the region and for that reason taking pride in status of Central Asian oasis (Kreutzmann, 2016), struggle with still increasing water scarcity, which might develop into a problem to redefine their future farming possibilities (Dukhovny et al., 2013). In this context, local production of rice is threatened as one of the most freshwater demanding crops (Barker et al., 1999). Southern Kyrgyzstan is famous for its unique rice varieties of typical taste and appearance (Smanalieva et al., 2015). Such special varieties are usually more expensive compared to rice imported from other parts of Kyrgyzstan or those imported from abroad, but they reflect tradition and often provide better nutrition value. (Giuiliani et al., 2009). However, only a very few studies are available in scientific databases which would focus on household profiles and expectations of families involved in local rice varieties production and value-chains.

# 2 Literature review

## 2.1 Initial information about rice

There are two major species of cultivated rice: *Oryza sativa*, alias Asian rice, and *Oryza glaberrima*, alias African rice (Calpe, 2006; Sharma, 2010). Rice is divided into approximately 120,000 varieties, which makes it the richest gene bank in the plant kingdom, and further classified into several grades. Each particular variety's grains may differ from others by its own texture, colour and other characteristics, which also brings various specifics into the way they are processed (Janick, 2002; Clay, 2004). Especially the Asian rice varies enormously, also regarding the obvious features of the plant itself. There are dwarf varieties that grow up to height of 120 cm, while some other rice plants may grow as tall as 10 m in deep water (Sharma, 2010). Several basic rice types may be distinguished according to two main criteria – according to kernel form and according to grain shape. Kernel form classification points at to what extent the particular rice has been processed. Rough rice provides the least processed grains, staying unhusked and unmilled. The husk is not meant to be eaten, but it may be burned as an energy source. Brown rice has already got its husk removed, yet remains unmilled. However, not all dehusked rice is literally brown in colour. Its colour depends on the outer bran layer of the grain and embryo and may vary from light yellow to red to purplish black. Within the bran and germ, the rice grain contains higher amounts of fibre, vitamins, minerals and other health-related components than in endosperm[1], but also greater amounts of lipid material, which makes brown rice more prone to spoiling. Therefore, the shelf-life of brown rice is shorter in comparison to milled rice. White rice, as the previous text implies, has reached the furthest processing stage, being already freed of its outer bran layer and germ. The other criterion, as written above, represents the grain shape. Three proportional grain shapes are commonly distinguished (see Figure 1): Long grains, being usually approximately three times longer than they are wide, medium grains, usually from 2 to 2.9 times longer than they are wide, and short grains, being less than two times longer than they are wide. (Bergman et al., 2006; Eram et al., 2014)

[1] Endosperm is the white centre of rice grains (Bergman et al., 2006).

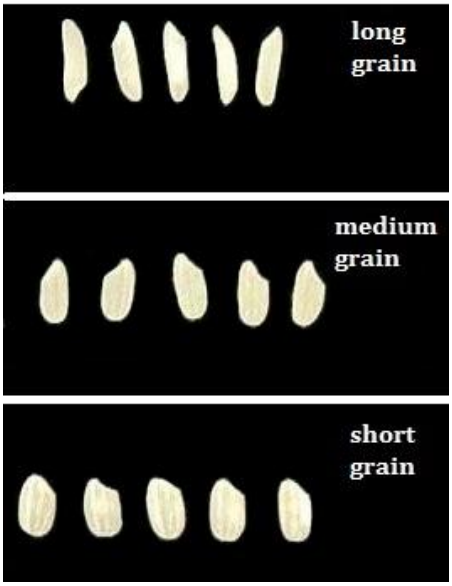


Fig. 1: Long grain, medium grain and short grain rice

Source: Bergman et al., 2006

Rice accounts for the dominant staple food crop in developing countries and developing countries also provide over 95% of the global rice production. This crop's production has increased rapidly at the end of 20th century, even faster than the world population. Rice is most often cultivated on small and frequently also tenanted farms in countries with extreme population pressure on limited land resources (Hossain and Narciso, 2004; FAOSTAT, 2016). Except in the Unites States, Australia, Europe, and parts of South America, rice is predominantly grown on small family farms. In Asia, the average size of a rice farm typically ranges between less than half a hectare and two hectares. Asian farmers usually grow rice to primarily meet family needs, thus the marketed amount is often minor. (Hossain and Narciso, 2004). In 2014, the global annual output of paddy[2] was 745.2 million tonnes, which generated 494.9 million tonnes of milled rice. The total world area of paddy cultivation was estimated to 161.1 million hectares (ha), divided into estimated 250 million farms. The total value of production of rice all around the world was nearly 185,580 million USD in 2012 (Hossain and Fischer, 1995; FAOSTAT, 2016; USDA ERS, 2016). The majority of rice is grown in Asia and only a small part in the rest of the world. Asia itself provided 673.9 million tonnes of paddy,

[2] Paddy is a term for unprocessed rice (Clay, 2004).

thus 90.4% of the overall world production, in 2014. The main producers, as in the previous years, were particularly China, that produced 27.8% of the world production, India with 21% of the world production, Indonesia with 9.8% of the world production, and Bangladesh with 7% of the world production (FAO, 2015).

The nutritional value of rice varies with different varieties and conditions of their growth, e.g. environment, soil quality, fertilizers use, etc. Roughly 90% of the energy in rice comes from carbohydrates, both simple and complex ones. Simple carbohydrates include glucose, fructose, sucrose, and lactose. The complex ones consist of starch and fibres. Rice is also rich in proteins, particularly – which makes it a unique crop – in alkali-soluble proteins and glutelin. Rice contains traces of fats, vitamins (A, B, E), and minerals, namely iron, phosphorus, calcium, potassium, and sodium (Janick, 2002).

## 2.2 Specifications of rice cultivation, processing and trade

Land preparation for cultivating paddy consists of soaking, ploughing and puddling (De Datta, 1981). Rice mostly needs to be grown using extensive irrigation with prolonged periods of flooding. As a result, irrigated rice production is one of the largest consumers of water. It uses 30% of the total freshwater diverted for all uses (Barker et al., 1999). However, only 15–30% of the applied water is actually consumed by a rice crop for transpiration and growth. This reflects the fact that prolonged ponding leads to very high water losses: 10–30% through deep percolation, 30–50% through evaporation, and 10–25% through surface runoff. On average, about 2,500 litres of water need to be supplied, by rainfall and/or irrigation, to a rice field to produce 1 kg of rough rice, but the water demand of particular rice varieties in different environments varies a lot, ranging from around 800 litres to more than 5,000 litres. Such variability has its cause in specific properties and needs of the varieties planted, in crop management, for example in fertilization regime applied or pest and disease control adopted, as well as in weather, and soil properties. The mentioned average 2,500 litres are composed of all the outflows of so called evapotranspiration, seepage, and percolation. In the lump, water inputs to rice fields are averagely 2-3 times higher than those to fields where other

major cereals are cultivated (Chapagain and Hoekstra, 2004; Falkenmark and Rockstrom, 2004). There is evidence in existence that water scarcity already prevails in rice growing areas (Tuong and Bouman, 2001).

Most of the world's rice is still hand-harvested. Around two thirds of the global paddy crop is harvested by sickles, then being foot-threshed or threshed by portable hand-fed power threshers. (Smith and Dilday, 2002; Molden, 2007).The crucial and profit-decisive factors are timing and costs. Timing and duration of the harvest have a direct effect on rice quality, efficiency and, of course, the growers' income. The highest value of rice is achieved in form of intact kernels or whole grain. The maximum whole grain is affected, besides other things, by season appropriateness for harvesting (Smith and Dilday, 2002).Yields of rice range from less than 1 t/ha, when being grown under very poor rainfed conditions, to more than 10 t/ha in intensive irrigated systems (Zeigler and Barclay, 2008).

According to Balasubramanian et al. (2000), up to one quarter of the harvested rice is lost before it reaches the consumers' table. The post-harvest losses in both quantity and quality lead to substantial profit gaps among farmers. To increase profits generated by rice, improved processing and storage are one of the key tools. The usual processing mechanism comprises, in the following order, of cleaning, husking, separating, milling, grading and, finally, bagging/packing. Cleaning is a step when all extraneous objects and impurities, like hay, straw, stones, branches or snail shells, are removed. During husking, all excessive husks are cleaned and rubbed off the rice grain. The remaining husks are subsequently separated from brown rice, being blown from the grain. When husk is removed, rice becomes denser, which makes such grains automatically separate from the still unhusked ones. These are returned to a new process of husking till they become husk-free as well. Within the milling process, the outer bran layer and germ are removed from the grains of brown rice and the bran is further separated by air ventilation. Two to three cycles of this process are usually applied and at the end it results into getting pure white rice (Clay, 2004; Bergman et al., 2006).The milled clean rice is consequently classified into grades, being separated according to its size , wholeness, transparency, colour damage, foreign matter and moisture level. The grading process is usually performed mechanically. The already graded rice is than accordingly separated for storage and bagged at last. Most rice is traded in its raw form after the

husk and bran have been removed. Yet the rice bran, a by-product of processing rice, is sometimes more expensive by weight than the polished rice itself because of its many uses as a medicinal supplement (Smith and Dilday, 2002; Clay, 2004).

According to Calpe (2006), rice is predominantly consumed in the country of its original production. In other words, the international trade in this crop is relatively small. Only five to seven percent of global rice production is traded (Oxfam, 2012). Data from FAOSTAT (2016) then disclose that over 37 million tonnes of rice were traded worldwide in 2013, which proves the trend of its international trade has been increasing. For the record, it passed to this value from 12 million tonnes in the early 1980s (Calpe, 2006). As described by Jason Clay (2004), the market chain of rice involves producers, middlemen, rice mills, brokers, wholesalers, retail shops, and consumers. The international commerce of rice crop is under control of large-scale rice milling facilities.

## 2.3 Agriculture of Kyrgyzstan

Agriculture accounts for an important part of economy of the Kyrgyz Republic**.** It contributes to about 22% of the national GDP and employs up to 35% of the country's workforce. At the same time, only 7% of all Kyrgyz land is arable (Swinnen et al., 2011).The country's agriculture went through noticeable changes as a result of reforms following the 1991 former Soviet Union collapse leading to Kyrgyz independence regain (Abdullaev et al., 2006; Kazbekov et al., 2009). One of the key reforms, redefining the law on private property, was land reform. As a consequence of that, so called kolkhozes and sovkhozes[3], relicts of the Soviet era, were step by step dissolved and replaced by individual farm units. (Wegerich, 2000; Abdullaev and Rakhmatullaev, 2013).

The major problem Kyrgyz agriculture has to face nowadays is still increasing shortage of water, appealing on the farmers to adopt new technologies (Devkota et al., 2013). When the kolkhozes and sovkhozes were dismantled, any institutional structure

[3] Kolkhozes were cooperative farms, sovkhozes were state-owned farms, both in times of former USSR.

responsible for on-farm irrigation was obviously missing in the Kyrgyz agricultural environment, which resulted in chaos and anarchy in water delivery from district water departments to individual farmers (Abdullaev et al., 2006; Yakubov and Ul Hassan, 2007; Johnson and Stoutjesdijk, 2008). In response to this state of things, individual farmers attempted to rectify problems associated with water delivery but, as they lacked on technical and financial resources, these efforts failed. In some cases water users created hydro-services by recruiting former irrigation brigade staff, while other ones formed informal farmers' organizations to address problems they faced as a consequence of their on-farm irrigation insufficient management. These organizations were formed without any technical assistance and were raised on no legal basis to function as participatory farmer organizations. In 1997, the Kyrgyz government passed a bill to encourage establishing so called Water User Associations (WUAs). This bill was later, in 2002, upgraded into a law, which secured a foundation stone for established WUAs to really take over on-farm irrigation water management and infrastructure development (Johnson and Stoutjesdijk, 2008; Kazbekov 2009). A big boom of WUAs took place in years 2003 and 2004. In 2006, 450 WUAs were already registered throughout Kyrgyzstan. They covered land of 710,000 ha, including over 166,000 members (Herrfahrdt et al., 2006). WUAs, till today, play an important role in irrigation water allocation and distribution, as well as in maintenance of the relevant infrastructure and in collection of irrigation service fees. However, the effectiveness of WUAs still stays far below the optimum level, and these associations, thus the local irrigation strategies as well, have to cope with several problems and deficiencies. The main issues include difficult provision of irrigation water to so many water demanding households, ineffective administration within service fees collection (and some small-scale, remote farmers inability to contribute by paying these fees), sustaining crop yields and productivity of irrigation in mostly subsistence farming systems, and last, but not least, problems with running and managing WUAs in a sustainable and efficient way (Abdullaev et al., 2009).

## 2.4 Cultivation of rice in Kyrgyzstan

In Central Asia, rice ranks the second position in popularity among all cereal crops and staple food, being surpassed only by wheat at this level (Devkota et al., 2014; Smanalieva et al., 2015), and is considered highly remunerative, since its local market price is several times higher than that of wheat, and even 2-3 times higher than the standard price of rice at the world market (Christmann et al., 2009). There is given evidence that in Fergana Valley, which includes a part of Kyrgyz territory, Osh region, rice, as well as wheat, was not only present, but at the time widely spread already around the 2nd BC (Nesbitt et al., 2010).Today, rice still holds an important position in food culture of Kyrgyzstan, despite being rather minor product in terms of total volume consumed among Kyrgyz population (Vopenka et al., 2015). Rice production in the Kyrgyz Republic has kept increasing since early 1990s, when the country became independent again (see Figure 2). While the volume of paddy rice production in 1992 was only 2,800 tonnes, the total harvest in 2014 reached 28,230 tonnes (18,632 tonnes of milled basis) and this crop was planted on 8,062 hectares, which results in the average yield of 3.5 tonnes (2.31 tonnes of milled basis) per hectare (FAOSTAT, 2016).

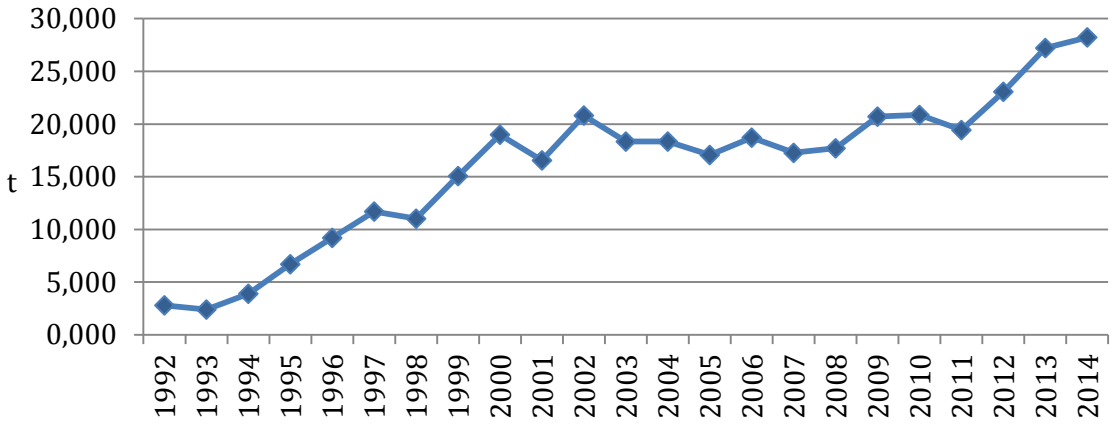


Fig. 2: Quantity of rice production in Kyrgyzstan between 1992 and 2014

Source: FAOSTAT, 2016

Kyrgyz Osh Province is famous for its own and authentic rice varieties of *Oryza sativa* L. that are exceptional by their extraordinary taste (Hauptvogel et al., 2012; Smanalieva et al., 2015). The grains of local varieties also differ from others by red-brown colour and longitudinal brown stripes on the grain body. This anomaly is caused by the region's unique climatic conditions, mineral composition of the soil and by specific farming attitudes.

The post-harvesting processing technology commonly applied in the Uzgen district differs from the standard ones. Rice is usually harvested manually when the grains' moisture content gets to approximately 25%, and is immediately or within several days followed by threshing. Since threshing is mostly carried out by mechanical threshers, paddies have to be dried to achieve moisture content not more than 20% for milling. Rice is almost exclusively produced by smallholder agriculture enterprises in Kyrgyzstan. Typically, it is tied up into bundles, so handling becomes easier, and dried in the field. The rice bundles are then often stored in heap stacks. Under this condition, rice warms up, evaporates superfluous water, and most importantly starts to change its colour towards a red-brown appearance. The stack-storage facilitates subsequent peeling and milling the rice, so that its nutritional profile increases and its texture is changed as required. If the freshly harvested rice, instead of the already enough dried one, was to be cooked, it might be found extremely hard to make it gain the desired texture and it would absorb much more water and fat (Smanalieva et al., 2015). Most of the domestic varieties being traded at Osh Bazaar are grown within Uzgen district (33%) and these are also more expensive on average, compared to varieties imported from other parts of the country or from abroad. Over 15% of rice traded in Osh Bazaar originates from outside of Kyrgyzstan (Vopenka et al., 2015). The traditional local rice varieties in Uzgen district are Ak Uruk  and Kara Kulturuk. Among varieties that were originally imported from Uzbekistan and nowadays are commonly cultivated in Uzgen district belong Kazim, Nazer, and Tokol. Variety Ak Uruk, which was in recent years literally rescued from its disappearance, was recognized very important for future preservation and cultivation, because of its specific and unique characteristics that accurately represent the local rice culture and tradition, and got certified for autochtonity and quality for its use in agriculture and nutrition. (Hauptvogel et al., 2012).

The import of rice into Kyrgyzstan increased rapidly in 2005, as show data provided by FAOSTAT (2016), when the country bought 33,264 tonnes of this crop. Since 1995 till then the rice import volume ranged between 825 tonnes, which was the minimum value of the period recorded in 2001, and 7,387 tonnes, which was the maximum value of the period recorded in 2003. The all-time maximum value of 41,349 tonnes was recorded in 2008. Since then, a decreasing trend has been evident. The last record of FAOSTAT from 2013 indicates 22,905 of paddy imported to Kyrgyzstan. As a rice exporting country, Kyrgyzstan is significantly less active. Again based on FAOSTAT data between 1995 and 2013, the export peak was taken down in 2010 at value of 3,226 tonnes. Before 2008, when the exported amount was 1,185 tonnes, the total export sum remained mostly negligible, sometimes even below 10 tonnes. The last records – 711 tonnes in 2011, 271 tonnes in 2012, and 376 tonnes in 2013 – point at rather decreasing tendency of Kyrgyz export activity. The trends, for comprehensiveness compared with Kyrgyz domestic production volume of rice as well, are demonstrated in the following Figure 3.

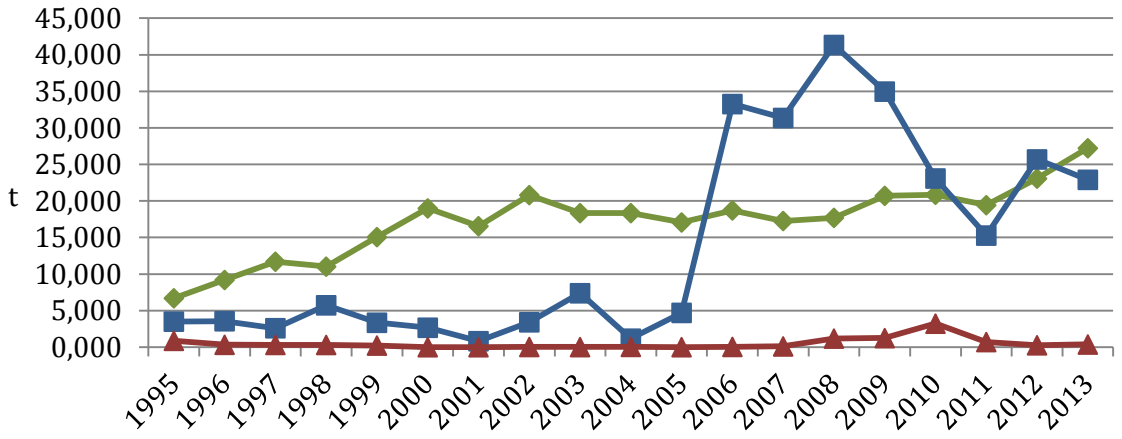


Fig. 3: Comparison of import (blue line), export (red line) and domestic rice production (green line) in Kyrgyzstan 1995 and 2013

Source: FAOSTAT, 2016

### 2.4.1 Future prospects of Kyrgyz rice

Presently, local species are permanently threatened by high-yielding imported cultivars (Barghouti et al., 1993). Nevertheless, they often play an important role in the livelihoods of local communities, even if their share in production trade is small. Their importance is grounded in the local tradition and culture, which they usually reflect very authentically and accurately. These traditional and culturally rooted varieties also frequently offer better nutrition value, but sometimes they suffer from lower yields and less efficient supply-chains (Giuliani et al., 2009). The decline in agricultural biodiversity, which has undeniably been taking place recently, has increased the level of vulnerability among poorer farmers and households. However, many farmers continue to rely on the conventional species and varieties for the nutritional value (Bellon, 2009). In Kyrgyzstan, proceeding from the FAOSTAT data (2016), the competition caused by imported rice seems pretty considerable. Besides that, local rice production is also threatened for the fact that rice is a very freshwater demanding crop (Barker et al., 1999). Because of the increasing water shortage Kyrgyz agriculture has to deal with, the problem of enormous irrigation demands of rice already got onto a level of national topic, and certain political steps aiming on reducing the area of rice crop cultivation are nowadays in consideration within the Kyrgyz executive body. (Devkota et al. 2013; Devkota et al. 2015).

# 3 Aims of the thesis

The aim of the thesis was to understand the role and importance of rice in the locality of Zerger watershed, Osh Province in south-western Kyrgyzstan. Specific objectives were to:

(i) document socio-economic profile of the rice growers and planted varieties;

(ii) compare resource management of the local rice producers and rice non-producers;

(iii) obtain future expectations towards rice agribusiness in the region.

# 4 Methodology

## 4.1 Study area

The study was carried in Zerger wathershed, which is situated in the northern part of Uzgen district,Osh Province, southern Kyrgyzstan, specifically in rural area of Uzgen district. Based on the last census (NSC, 2009), Osh Province is the most populous province country with 1.3 million inhabitants and has the highest population density (Statoids, 2014). However, there is lack of reliable data about population dynamics in the region, after ethnic clashes that Osh oblast went through in June 2010 (Crisis Group, 2012).

Uzgen district, a region with population around 200 thousands people (NSC, 2009), lies at the margin of Fergana Valley, main part of which spreads out in Eastern Uzbekistan. This vast lowland area, that is commonly distinguished by its high soil fertility, is lined by large mountain ranges of Tian Shan from the North and East and Pamir Alay from the South. According to FAO/UNESCO classification, the soils of Fergana Valley are Calcic Xerosols (Fitzherbert, 2000). Köppen-Geiger classification grades the climate in Uzgen district as Dsa and it may be described as cold and temperate, with the average temperature around 11.2 °C and annual precipitation of 510 mm, whereas the precipitation peak is reached during spring months (Figure 4). Slightly decreasing trend in precipitation has been noticeable in the region throughout recent years. The average altitude is assessed to 1022 m (Ilyasov et al., 2013; Climate-Data, 2014). There is 907 ha of arable land in Uzgen district. (FAO, 2016).

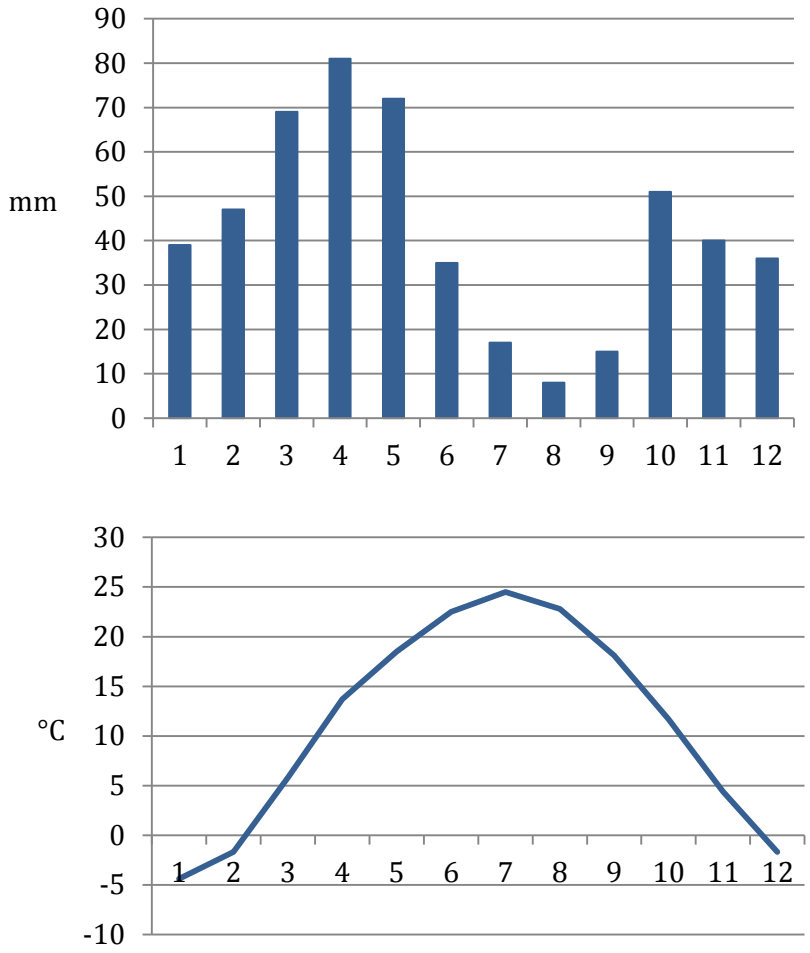


Fig. 4: Annual precipitation (first chart) and temperature (second chart) in Uzgen district

Source: Climate-Data, 2014

According to UNDP (2013), HDI in the locality ranges between 0.595 and 0.606, which ranks the region slightly below the country's mean value of 0.615. Osh oblast contributes into the country's agricultural production by 18.7% of its total. The share of agricultural sector in the oblast is 59.7% in gross regional product and it employs 71.2% of the local workforce. Among export-oriented products produced in Osh oblast belong cotton, tobacco, fruits and vegetables (IMF, 2007). The most popular and grown staple crops in the region are wheat, rice, maize and potatoes. The local farming systems are often strongly livestock-based (Caccavale et al., 2013; Smanalieva et al., 2015).

## 4.2 Data collection

Data were collected in July 2015 in eight villages of Zerger watershed, which is situated at the boundary of Fergana Valley and Fergana range, part of Tian Shan. The villages were namely Tosoy, Ayuu, Dzhany-Ayyl, Zerger, Kayrat, Kuturgan, Nichke-Say, and Toktogul. The map of the study area is pictured in Figure 5.

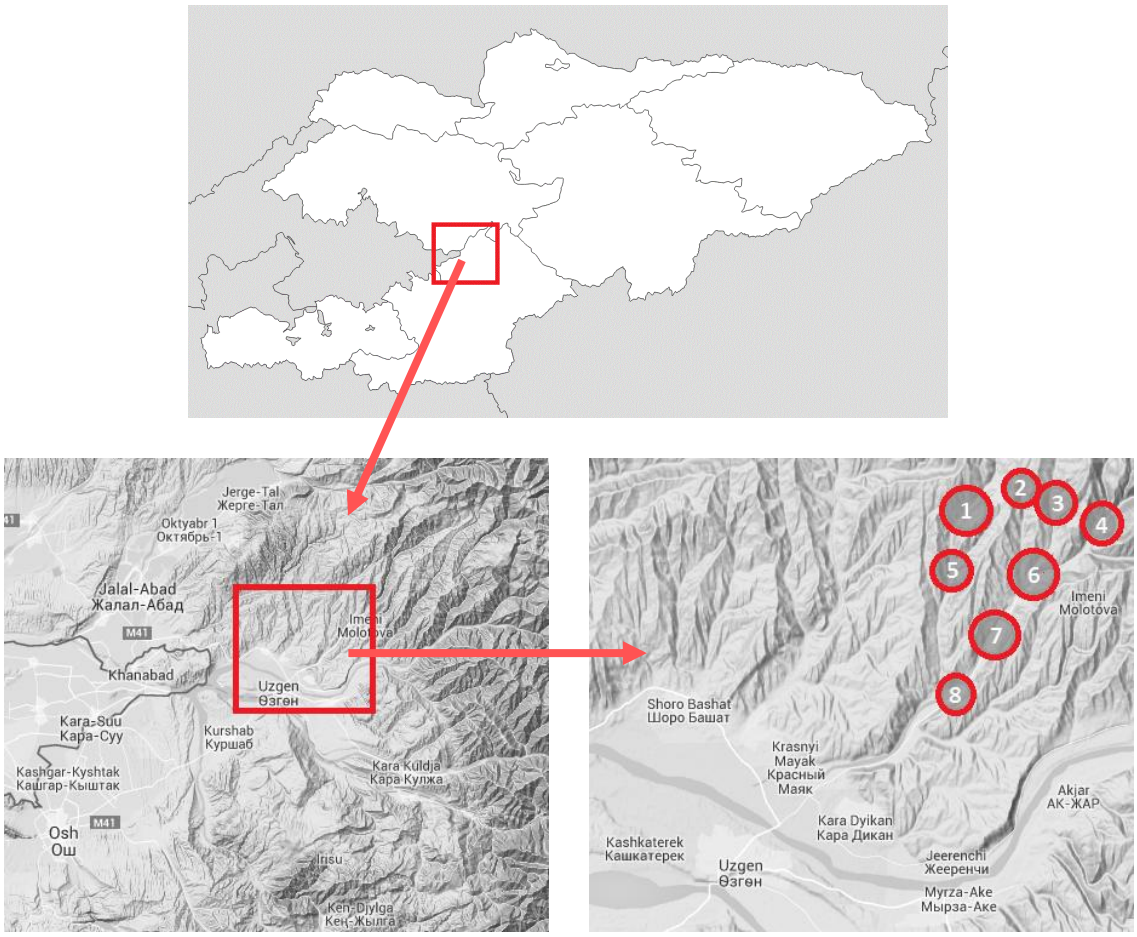


Fig. 5: Map of the study area

1 – Nichke Say (Ничке-Сай), 2 – Kuturgan (Кутурган), 3 – Ayuu (Аюу), 4 – Zerger (Заргер), 5 – Dzhany-Ayyl (Джаны-Айыл), 6 – Tosoy (Тосой), 7 – Kayrat (Кайрат), 8 – Toktogul (Токтогул)

Sources: D-maps.com; Google.com

Prior to the data collection itself, a key-informant from Bishkek-based CAMP Alatoo NGO was contacted with a request for assistance in searching for a suitable representative of rice growers' community, i.e. key-informant, in the desired locality. This way, a key-informant in the study area, an extension agent of CAMP Alatoo, was targeted. He provided community and area insight and enabled logistical support and assistance in identification of potential respondents.

First, transect walks and interviews with local households' representatives were raised up to document main farming systems in the study area and to identify suitable respondents, both rice producers and non-producers.

Secondly, household survey, with usage of interview-administrated, semi-structured questionnaires, was carried out with chosen households in their resources, processes, living standard and future expectations. All in all, fifty households, thirty of whom were rice producers and twenty rice non-producers, were interviewed.

## 4.3 Questionnaire outline

The semi-structured questionnaire included both quantitative and qualitative questions, and was designed to gather relevant data on:

(i) Household resource capacity and use

(ii) Land-use system

(iii) Process analysis of crop production (expenses, yield, market-orientation; variety in case of rice)

(iv) Economic security (crop, livestock, off-farm and other income, credits)

(v) Farmer‘s personal history and prospects

## 4.4 Data analysis

The collected data were transmitted into electronic form using MS Excel 2007, and finally analysed there and via IBM SPSS Statistics 20 software.

Within the analysis itself, descriptive as well as inferential statistics methods, namely t-test and chi-square test, were applied in order to characterise the research sample and to identify the main differences between the two groups of rice producers and rice non-producers. All significance tests provide results within a predefined 95% confidence level.

# 5 Results

The sample group of rice producers (n=30) altogether cultivated three different varieties of rice. The group of rice non-producers (n=20) included fourteen farmers focused primarily on cultivating wheat, three farmers focused mainly on sunflowers' production, and three farmers whose primary cultivated crop was maize. As for data on process analysis, those were gained only for rice grown within the rice producers group (n=30) and for wheat grown within the group of rice non-producers (n=14).

## 5.1 Household resources capacity and use

### 5.1.1 Land resources

The average farm size in the sample was 1.71 hectare (±1.63). The farmers operated on land ranging from 0.2 hectare to 7.8 hectares. Figure 6 shows the households of the sample divided into four groups according to their farm size.

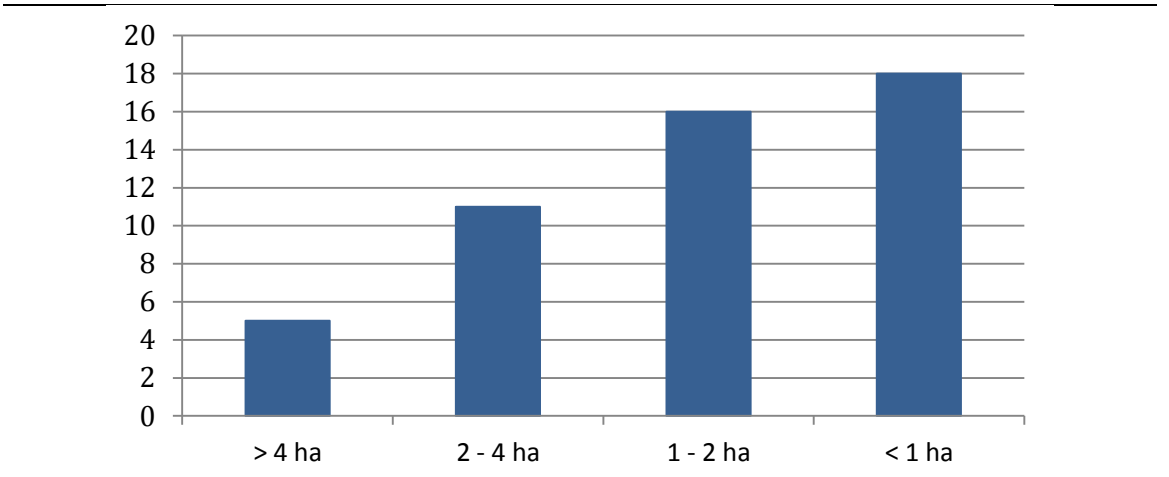


Fig. 6: Farm size of the sample households (n=50)

The average home-garden size within the tested sample was 0.22 hectare (±0.19). The home-garden size ranged from 0.04 ha to 1 ha. The number of fields cultivated ranged between 1 and 4. The mean value was 1.78 (±0.86) fields cultivated. As for the fields' size, the largest field of the sample was 6 ha large, while the smallest one measured 0.1

ha. The average size of a single field was 0.84 ha (±0.9). The mean value of total fields' area of single households was 1.48 ha (±1.51), ranging between 0.1 and 7 ha.

The ownership conditions were also documented within the research. The average owned land size was 1.34 hectare (±1.41). The values ranged between 0.08 ha and 6.5 ha. Expressed as a percentage, out of the total land cultivated by every single household, 78.34% was averagely owned by the cultivator, while 21.66% was either rented or semi-owned. Concerning fields only, on average, the households in the sample owned 1.3 fields (±1.07). Thirteen households did not own any field, the maximum value occurring once was 4 fields. Expressed as a percentage again, the respondents averagely owned 68.17% of the fields they cultivated (70.24% of the cultivated fields' area), 31.83% (29.76% respectively) were rented or semi-owned.

Significant difference between rice-growers and rice non-growers was identified particularly in fields' ownership ratio (p=0.014) and total owned land size (p=0.027). See Table 1.

Table 1: Farm size and land ownership of rice producers and rice non-producers

| | **Rice producers (n=30)** | | **Rice non-producers (n=20)** | | | |
|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | **T-test** | |
| Home-garden area (ha) | 0.15 | 0.14 | 0.32 | 0.22 | 0.055 | * |
| Number of fields | 1.70 | 0.79 | 1.90 | 0.97 | 0.658 | |
| Fields area (ha) | 1.29 | 1.54 | 1.81 | 1.52 | 0.999 | |
| Owned fields | 1.07 | 0.94 | 1.65 | 1.18 | 0.267 | |
| Owned fields (% of the number of fields) | 58.61 | 45.09 | 82.50 | 37.26 | 0.034 | ** |
| Owned fields (% of the fields' area) | 62.06 | 45.93 | 82.50 | 37.26 | 0.014 | ** |
| Farm size (ha) | 1.44 | 1.56 | 2.13 | 1.64 | 0.805 | |
| Owned land (ha) | 0.95 | 0.96 | 1.93 | 1.77 | 0.027 | ** |
| Owned land (% of the farm size) | 73.83 | 32.22 | 85.12 | 31.51 | 0.440 | |

Note: *, ** and *** represent significance level of 90%, 95% and 99% respectively.

The respondents were asked to rate their land and farming conditions in three categories: (i) quality of soil, (ii) problems with erosion, and (iii) water supply. On a scale of 1 to 4, where 1 stood for the best mark and 4 was the worst. The average marks of all respondents for all their land were 1.59 in case of soil quality, 1.28 in case of erosion issues, and 2.26 as for water supply. Within home-garden only, it was 1.64 in soil quality category, 1.08 in case of problems with erosion, and 1.55 as for water supply. Concerning fields only, the mark to soil quality was 1.54, 1.37 was to erosion issues, and 2.62 to water supply.

The main category to differentiate rice growers and rice non-growers was clearly water supply, which was proved statistically significant for home-gardens specifically (p=0.004), for fields specifically (p=0.000), and also in overall (p=0.030). An interesting finding is that in case of fields' water supply, rice non-producers rated significantly better than the other group, while in case of water supply on their home-gardens, rice non-producers rated significantly worse. Moreover, difference between the two groups in rating erosion problems of their home-gardens was identified as significant (p=0.032). See Table 2.

Table 2: Land and farming conditions' rating

| | **Rice producers (n=30)** | | **Rice non-producers (n=20)** | | | |
|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | **T-test** | |
| Home-garden – soil rating | 1.72 | 0.65 | 1.50 | 0.51 | 0.995 | |
| Home-garden – erosion rating | 1.14 | 0.58 | 1.00 | 0.00 | 0.032 | ** |
| Home-garden –water supply rating | 1.76 | 1.19 | 1.25 | 0.79 | 0.004 | *** |
| Fields – soil rating | 1.41 | 0.61 | 1.75 | 0.55 | 0.603 | |
| Fields – erosion rating | 1.41 | 0.65 | 1.30 | 0.47 | 0.375 | |
| Fields – water supply rating | 1.76 | 0.85 | 3.90 | 0.45 | 0.000 | *** |
| Overall soil rating | 1.55 | 0.49 | 1.66 | 0.46 | 0.873 | |
| Overall erosion rating | 1.34 | 0.47 | 1.18 | 0.28 | 0.109 | |
| Overall water supply rating | 1.81 | 0.77 | 2.92 | 0.54 | 0.030 | ** |

Note(s): *, ** and *** represent significance level of 90%, 95% and 99% respectively
Rating scale of 1 to 4 was used, where 1 is the best mark, 4 the worst

The respondents were also given an opportunity to list constraints and problems they have to cope with within their farming activities. The most mentioned point was again the problem with freshwater supply to cover the needs of the farm, which was mentioned 33 times (66%), 14 times by rice producers and 19 times by rice non-producers. Other items mentioned were problems with insects having 9 mentions (18%), 7 of them by rice producers, 2 by rice non-producers, lack of minerals and nutrients in the soil with 9 mentions, 8 of them by rice producers, one by a rice non-producer, struggle with weed having 3 mentions (6%), all by rice producers, landslip issues mentioned by two rice producers (4% of all respondents), lack of labour force mentioned by two rice non-producers, plant diseases mentioned by one rice producer (2% of all respondents), and also too hot and dry weather mentioned by one rice producer.

Among the most frequently cultivated home-garden crops belonged tomatoes (33 households), potatoes (32 households), corn (30 households), cucumbers (23 households), onion (22 households), capsicums (19 households), carrots (13 households), and cabbage (11 households). As for field crops, apart from rice, the most frequently cultivated ones were wheat (30 households), sunflowers (16 households), and alfalfa (11 households). Also corn appeared three times and there were two cases of barley cultivation.

### 5.1.2 Human resources

The households were also tested for their human resources, to identify their farming experience, household sizes[4], number of dependent members, labour force, further diversified into male and female labour force, emerging dependency ratio[5], and the household head's age. Among the respondents, 35 farmers (70%) were of ethnic Kyrgyz origin, 15 farmers (30%) were of a different ethnic origin. The average farm experience was 24.7 years (±10.3). The maximum value was 45 years, the minimum value was 4 years. The average household size of the research sample was 5.98 people (±2.3). The labour force proportion out of this value reached 3.22, the dependent members mean value was measured to 2.76. It gives the average dependency ratio of 85.71%. The average female labour force was 1.5 and the average male labour force was 1.72. The age of the head of household was averagely 50.44 years (±11.17). 49 (98%) of the heads of household were males, while only one (2%) head of household was a female. Significant difference between rice growers and rice non growers was identified in the average number of dependent members (p=0.000). See Table 3.

[4] Household size expresses the total amount of residents of the particular household.
[5] Dependency ratio is calculated as the ratio of dependent members of the household to the household's labour force. All household members of age between 15 and 59 years are considered as labour force, children under 15 years of age and seniors older than 59 years are involved as dependent members. (Sharma, 2007)

Table 3: Human resources of rice producing and rice non-producing households

| | Rice producers (n=30) | | Rice non-producers (n=20) | | | |
|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | **T-test** | |
| Farm experience (years) | 28.17 | 10.02 | 19.50 | 8.55 | 0.150 | |
| HH size (members total) | 6.30 | 2.54 | 5.50 | 1.85 | 0.073 | * |
| Dependent members | 3.17 | 2.44 | 2.15 | 1.09 | 0.000 | *** |
| Labour force | 3.13 | 1.70 | 3.35 | 1.98 | 0.458 | |
| Male labour force | 1.67 | 1.06 | 1.80 | 1.06 | 0.831 | |
| Female labour force | 1.47 | 0.86 | 1.55 | 1.10 | 0.412 | |
| HH head age (years) | 52.83 | 11.13 | 46.85 | 10.49 | 0.972 | |

Note: *, ** and *** represent significance level of 90%, 95% and 99% respectively

## 5.2 Households economics

The respondents were asked to evaluate financial situation of their household. They were given four options: (i) that they were able to pay for everything their household and farm needed, and they even generated surplus, (ii) that their expenditures and revenues were in balance, (iii) that they had difficulties to pay for their needs during a few months, or (iv) that they had difficulties to pay for their needs throughout the whole year. The four answers were substituted by a scale of 1 to 4, where one was the best mark (surplus), 4 the worst (difficulties to pay throughout the year).The average mark counted from all responses was 2.38. The average mark of rice growers was 2.33, the average mark of rice non-growers was 2.45. Those who admitted problems in a part of the year , often identified the problematic period as spring months when they sow, or the following summer time.

The average annual income of households in the sample was 335,780 KGS (±269,125). The lowest recorded value was 116,000 KGS, maximum was 1,820,000 KGS. Twenty-two households (44%) fitted into a short range of annual income between 200,000 and 250,000 KGS[6]. Five households (10%) did not even reach 200,000 KGS. Thirteen households (26%) ranged between 250,000 and 400,000 KGS and seven households (14%) ranged between 400,000 and 700,000 KGS. Three households (6%) exceeded 700,000 KGS.

[6] 1 USD ~ 69.97 KGS as of April 2016 (National Bank of the Kyrgyz republic, 2016)

The highest contribution to the total income was accounted by income from animal husbandry with average 132,660 KGS (37.3%). The value they stated was often indicative, conditioned by the actual need to sell the livestock products. 60,320 KGS was the average income from selling field crops, 64,300 KGS then averagely generated the off-farm activities, 4,380 KGS was the average income received via selling home-garden crops, 2,700 KGS was averagely given to the household by friends or relatives, and an important part of the households' income was usually accounted by other incomes, which were mostly old age pensions, but also child allowances, with their average value of 71,420 KGS. As no one of the respondents had an orchard available, the income from tress was zero in all cases.

Figure 7 shows comparison of households of rice growers and households of rice non-growers stratified into the five income groups listed above.

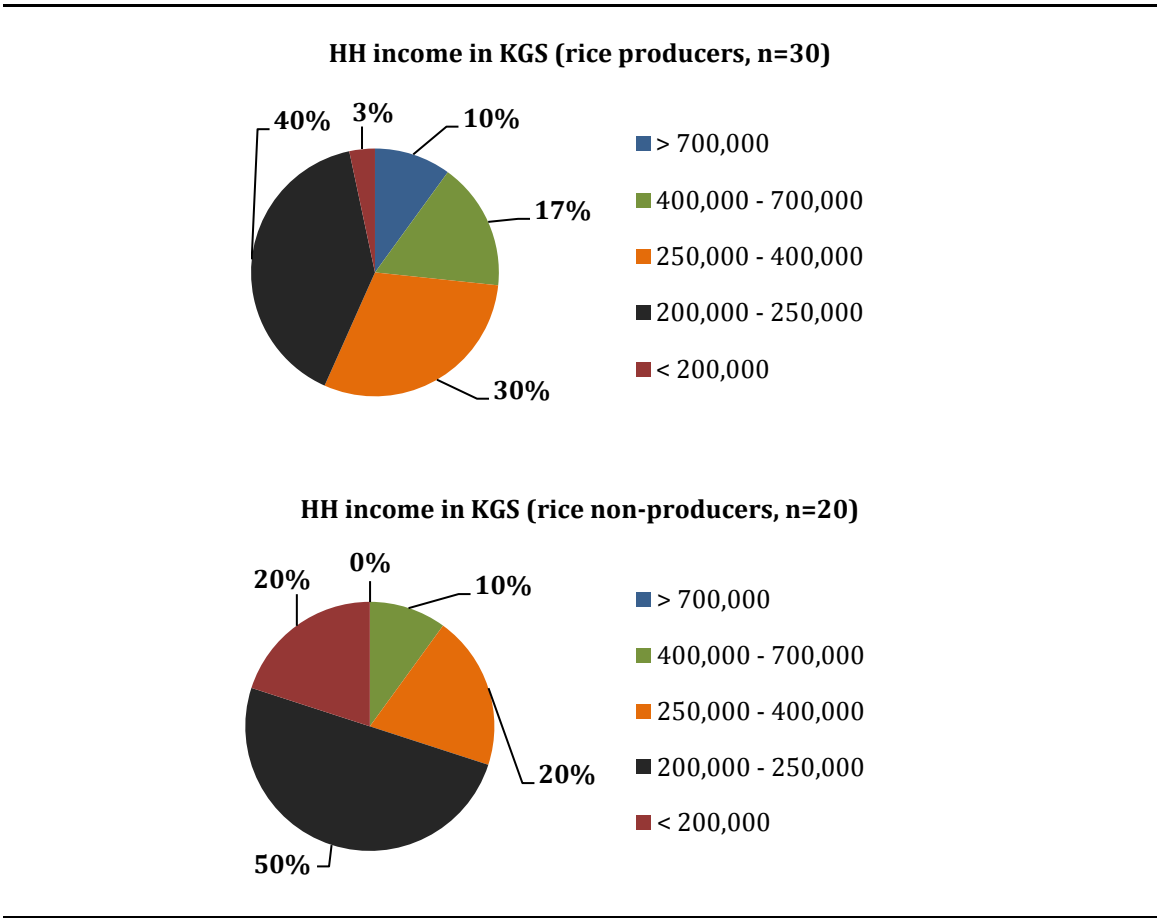


Fig. 7: Rice producers' and rice non-producers' income in KGS

Significant differences between rice growers and rice non-growers were identified in their total annual income (p=0.032), in their field crops income (p=0.039), and in their home-garden income (p=0.035). See Table 4.

Table 4: Income structure of rice producing and rice non-producing households

| | Rice producers (n=30) | | Rice non-producers (n=20) | | | |
|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | **T-test** | |
| Total income | 387,953.33 | 329,399.01 | 257,520.00 | 102,141.27 | 0.032 | ** |
| Field crops | 84,300.00 | 91,845.88 | 24,350.00 | 28,308.96 | 0.039 | ** |
| Home-garden crops | 5,633.33 | 9,271.70 | 2,500.00 | 7,863.98 | 0.035 | ** |
| Animal husbandry | 121,333.33 | 176,869.00 | 149,650.00 | 140,117.72 | 0.900 | |
| Off-farm activities | 81,900.00 | 278,380.83 | 37,900.00 | 65,571.09 | 0.215 | |
| Money from friends/relatives | 2,666.67 | 10,482.61 | 2,750.00 | 8,807.14 | 0.991 | |
| Other incomes | 92,120.00 | 48,885.98 | 40,370.00 | 58,010.54 | 0.396 | |

Note: *, ** and *** represent significance level of 90%, 95% and 99% respectively
All values listed are in KGS

## 5.3 Association or cooperative membership

All the fifty respondents declared they were not members of any association, nor cooperative.

## 5.4 Rice cultivation, cultivators and its economics

### 5.4.1 Rice growing households' resource capacity

The mean value of the thirty rice growers experience in cultivating rice was 21.67 years (±8.95). Their average farming experience was 28.17 years (±9.85). Therefore, rice growers' experience in rice production accounted for 76.9% of their total farming experience. Total farming experience was equal to experience in cultivating rice in case of 15 farmers.

Averagely, rice was cultivated on area of 0.38 ha (±0.38), ranging between 0.1 and 1.7 ha. The average yield of rice was 879 kg (±597) of milled basis, ranging between 200 kg and 3,5 t. In paddy, the average was 1,34 t. These values result into 2.31 t/ha of

milled basis and 3.53 t/ha of paddy. Among the thirty rice growers, there were 33 fields where rice was cultivated in total. One household cultivated two rice fields, one household cultivated three. All of the remaining rice producing households cultivated one rice field each.

17 out of the 33 fields were owned by the rice growers in the sample. On average, rice growers owned 0.15 ha of rice fields' land and 0.57 fields. Expressed as a percentage, they owned 39.5% of the average area of fields under rice cultivation and 51.5% of all the rice fields cultivated. There were two households to own two rice fields. Thirteen of them owned one rice field, fifteen of them owned no rice field.

The average land and farming conditions rating of rice fields was following: 1.12 for soil quality, 1.24 in case of erosion issue, and 1.12 as for water supply. The only constraint the respondents mentioned as for rice fields in particular was weed.

### 5.4.2 Economy of rice growers' households

Nineteen rice growing farmers stated that they sell their rice directly on the local market in Uzgen. Eight farmers reported to usually approach middlemen, who further distributed their produce to markets, and two farmers said they combine both ways. The average price rice growers in the sample sold their produce for was 94.01 KGS/kg, ranging between 60 KGS/kg and 130 KGS/kg. The average price of direct sell was higher (96.23 KGS/kg) than that offered by middlemen (88.33 KGS/kg).

The average annual proportion of income generated by selling rice production was 70,500 KGS. That means 83.6% of the rice growers' income from field crops and 18.2% of their total income. The maximal value was 350,000 KGS and the minimum was 0 KGS, which occurred only once. In case of 26 out of the 30 rice producing households, rice production accounted for the highest field crops income share.

The annual costs spent on rice production ranged between 2,000 KGS and 36,500 KGS. Their mean value was 11,493.75 KGS. These costs were composed of seed expenses, with average value of 2,731.25 KGS, expenses on fertilizers, with average value of 3,881.25 KGS, expenses on pesticides and other crops' protection with average value of

1,343.75 KGS, labour costs, with average value of 687.5 KGS, and mechanization costs, with average value of 2,850 KGS.

### 5.4.3 Rice growers' ethnicity

A significant association was discovered between the farmers' rice production status and their ethnicity (p=0.002). Twenty-six (87%) of the rice cultivating respondents were of Kyrgyz origin, while only nine (45%) of ethnic Kyrgyz farmers occurred among rice non-producers, as presented in Figure 8. The Cramer's V value of 0.445 revealed that the effect of ethnicity on rice production status was moderate, according to classification described by Munro (2005).

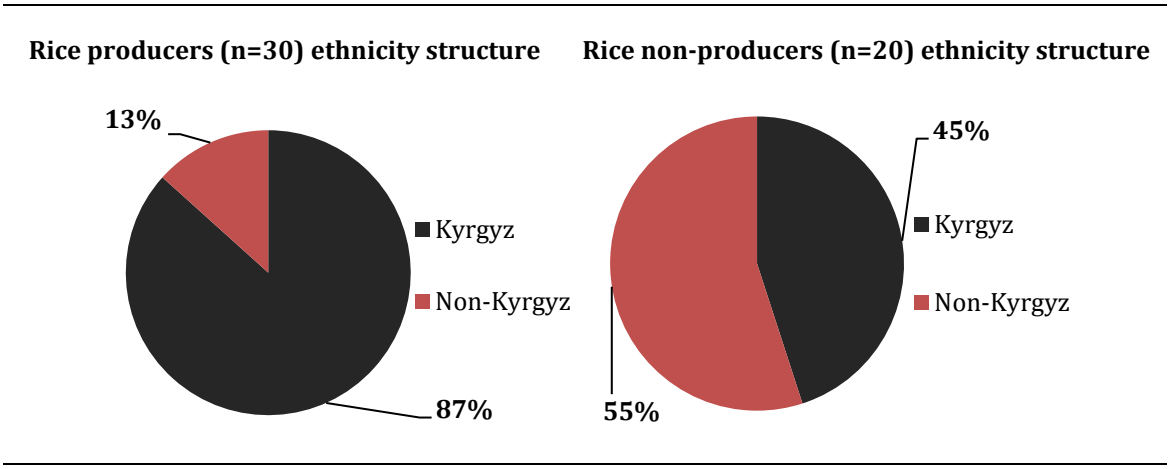


Fig. 8: Ethnicity and rice production correlation

### 5.4.4 Characteristics of the cultivated rice varieties

Three currently cultivated rice varieties were identified among the households of the sample. The most frequently grown rice variety was Kara Kulturuk, mentioned 16 times. Ak Uruk and Kazim followed, both with eight mentions. The results overview is visible in the below Table 5.

Kazim was cultivated on the largest average area of 0.43 hectares, Kara Kulturuk followed with cultivation area of 0.37 hectares. Ak Uruk was, compared to the other two varieties, grown on noticeably smaller average area of 0.24 hectares.

The highest average unit price, 100 KGS per kilogram, was recorded for the most frequently grown variety Kara Kulturuk. Ak Uruk is averagely sold for 90 KGS/kg, while Kazim for 87.5 KGS/kg.

Ak Uruk was most frequently marketed directly, compared to the other two varieties. On average, 87.50% of the total sold amount of this variety was directly marketed, without middleman's assistance. As for variety Kara Kulturuk it was 70.59% and for variety Kazim only 62.50%.

The average yield (milled basis) of Kazim was 937.5 kilograms, 798.13 kilograms was the average harvest of variety Kara Kulturuk, and in case of Ak Uruk there was675 kilograms produced on average. When converted to per hectare yield, variety Ak Uruk appears to be the most high-yielding of the three varieties, with 2,812.5 kilograms of milled basis per hectare, while the per hectare harvest of Kazim was 2.180.23 kilograms, and in case of Kara Kulturuk it was 2,151.11 kg.

Table 5: Characteristics of three rice varieties cultivated within the sample

| | **Unit** | **Kara Kulturuk (n=16)** | **Ak Uruk (n=8)** | **Kazim (n=8)** |
|---|---|---|---|---|
| Area | ha | 0.37 | 0.24 | 0.43 |
| Sold directly on market | % | 70.59 | 87.50 | 62.50 |
| Sold via middleman | % | 29.41 | 12.50 | 37.50 |
| Price per unit | KGS/kg | 100.00 | 90.00 | 87.50 |
| Total harvest (milled basis) | kg | 798.13 | 675.00 | 937.50 |
| Production value | KGS | 79,812.50 | 60,750.00 | 82,031.25 |

## 5.5 Comparison of gross margin and market orientation of rice and wheat

Gross margin was calculated for rice and, to provide a comparison, also for wheat, the second tracked crop, specifically for wheat produced by rice non-growing households (n=14). All the included values are listed in the following Table 6.

The computed production value of rice was 82,635.16 KGS, while in case of wheat it was 38,051.95 KGS. Despite the fact that the total harvest of wheat was much larger,

2,092.86 kg compared to 879 kg of rice harvest, the significant difference in production value was caused by huge gulf between the average price of rice (94.01 KGS/kg) and the average price of wheat (18.18 KGS/kg).

The average annual sum of variable costs related to the crop's production was subtracted from the production value in order to obtain the total gross margin of each of the two crops, and the two results were further divided by the average area of cultivation, labour force value and number of household members, thus the per resource unit gross margins were calculated. All the per resource unit gross margin results were significantly higher in case of rice production.

Table 6: Comparison of rice and wheat gross margin

| | **Unit** | **Rice (n=30)** | **Wheat (n=14)** |
|---|---|---|---|
| Area | hectares | 0.38 | 0.82 |
| Labour force | | 3.13 | 3.79 |
| Number of HH members | | 6.30 | 5.86 |
| Price per unit | KGS/kg | 94.01 | 18.18 |
| Total harvest (milled basis) | kg | 879.00 | 2,092.86 |
| Production value | KGS | 82,635.16 | 38,051.95 |
| Variable costs | KGS | 11,933.33 | 11,557.14 |
| GM | KGS | 70,701.82 | 26,494.81 |
| GM per area unit | KGS | 186,057.43 | 32,310.74 |
| GM per labour force unit | KGS | 22,564.41 | 6,998.63 |
| GM per HH member | KGS | 11,222.51 | 4,523.50 |

Another economical indicator, market orientation, was computed for both rice and wheat production within the research sample. In case of wheat, only rice non-producing households were included again. Market orientation is a share of the amount sold of a particular crop on the total harvest of the same crop, expressed as a percentage.

A noticeable difference between the two crops market orientation was identified. Wheat growers averagely sold only 187.57 kg out of the total harvest of wheat. It results into 6.43% of wheat market orientation. In contrast to that, the average sold amount of the

rice growers' rice production was 745.33 kg, which results into rice crop's market orientation of 76.03%. Analysed further in detail, the numbers are following: While there was only one rice growing household not to sell any of its total rice production, 21 households sold amount between 10% and 90%, and eight even more than 90%, twelve wheat producing households reported not to sell anything of their total production of wheat. The remaining two sold 40% and 50% respectively.

## 5.6 Farmers' history and incentives

In total, 25 farmers (50%) claimed they have always been cultivating identical crops, with no change, since the time they started their farming activity. Sixteen of these farmers were rice producers and 9 of them were rice non-producers. Ten farmers reported to have been growing tobacco in the time of former USSR. Nine of these farmers were current rice producers. There were also nine mentions of former cultivation of sunflower, six mentions of former cultivation of wheat, four mentions former cultivation of pea, two mentions of former cultivation of potatoes, two mentions of former cultivation of barley, and two mentions former cultivation of alfalfa.

Seventy percent (21 farmers) of the rice growing respondents have been growing the same variety or varieties of rice throughout their whole rice growers' past. Thirty percent of the sample (9 farmers) then reported to have stopped growing at least one variety of rice they had used to grow before, and eventually replaced it by a different one. 18 farmers (60% of the sample of rice growers), represented in both of these groups, also revealed that they periodically rotate varieties.

Asked about the reasons and motivation to grow rice, fifteen (50%) of the rice producers stated that their main incentive lies in perceiving rice production as traditional and also because rice is an integral part of their cuisine. Twenty rice producers (66.67%) mentioned high profitability of rice as an important reason for them to grow this crop.

## 5.7 Farmers' evaluation, future expectations, and threats

Another question to the rice producing farmers was aiming on the advantages of varieties they currently grew. The most frequently mentioned quality of a particular variety was its taste, mentioned nineteen times (63.33%). In seven cases (23.33%), selected varieties' popularity on the local market and the demand for them in general were highlighted. Six rice growers (20%) praised a variety for being originally local and traditional. Further, six rice growers appreciated proportions of some of their varieties' grains. There were also six mentions on appearance of selected varieties. High yields were pointed out by five cultivators (16.67%). Then there were four cases (13.33%) of appreciating a variety for being hardy and also four cases of appreciating low freshwater demands. Three times (10%), the farmers emphasized a variety's suitability for the local climatic conditions, and three farmers praised a variety for its selling price. Table 7 shows how the mentioned advantages were perceived on particular varieties.

Table 7: Advantages of particular rice varieties according to their cultivators

| | **All varieties' cultivators (n=30)** | **Kara Kulturuk (n=16)** | **Ak Uruk (n=8)** | **Kazim (n=8)** |
|---|---|---|---|---|
| Taste | 19 | 11 | 4 | 4 |
| Local market demand | 7 | 4 | 1 | 2 |
| Tradition and originality | 6 | 2 | 4 | 0 |
| Grains' proportions | 6 | 1 | 3 | 2 |
| Appearance | 6 | 3 | 0 | 3 |
| High yields | 5 | 0 | 5 | 0 |
| Hardiness | 4 | 1 | 1 | 2 |
| Low freshwater demands | 4 | 4 | 0 | 0 |
| Suitability for local climate | 3 | 0 | 2 | 1 |
| Selling price | 2 | 2 | 0 | 0 |

Further, rice producers were asked about their willingness to adopt different varieties of rice and about their eventual plan of extending their rice cultivation area. Thirteen of them (43.33%) proclaimed to be definitely willing to adopt varieties different from

those they grow now, if they discover some considerably good, or are recommended some by fellow rice producers from the locality. Two of these thirteen farmers mentioned particularly Kara Kulturuk as a variety they consider to adopt. Ten rice producers (33.33%) answered that they would be possibly open to adopt a new variety of rice, under the condition of being sure that variety provides high quality. Only seven rice growers (23.33%) completely refused the option of adopting new varieties, since they felt fully satisfied with those they currently cultivated. The main determinants of the rice growers' possible willingness to adopt new varieties were usually yields and demand on the local market The results are visible in Figure 9.

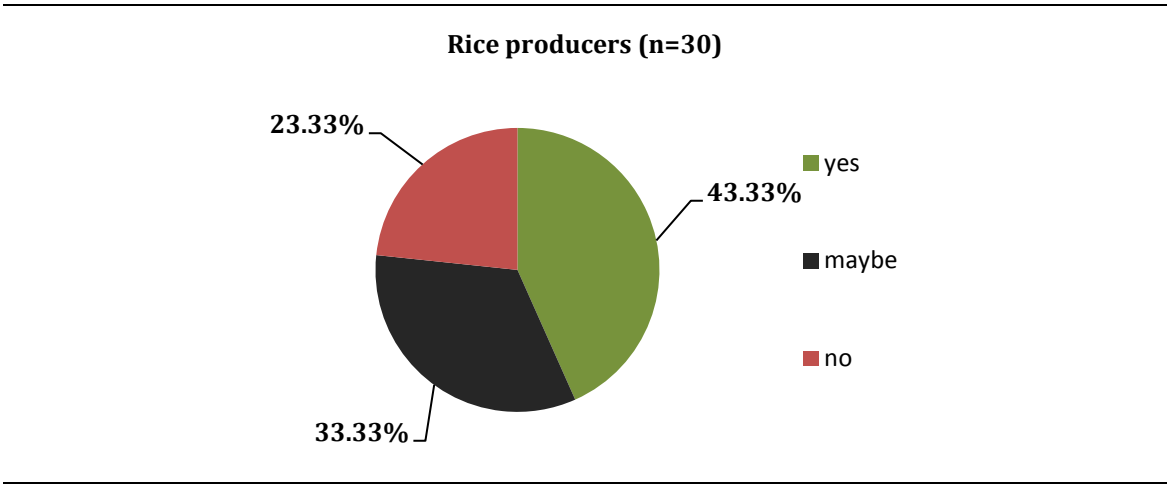


Fig. 9: Are you willing to adopt new varieties of rice in the next years?

Concerning the extension of rice production, only three farmers (10%) stated that they surely wanted to extend the rice cultivation area, nine farmers (30%) said that they will maybe consider certain extension in rice production in the future, and eighteen farmers (60%) ruled out such possibility, mostly saying that they did not have land to allow them to realize it and that they even did not expect this situation would change in the future.

Queried about their happiness with current source of livelihood and emerging living standard, all fifty farmers, hence both rice producers and rice non-producers, assessed it as satisfying enough.

The last question was designed to investigate the future threats which the respondents were worried about. Fifteen farmers (30%) responded that there were actually no threats

to worry them. The most frequently mentioned threat were droughts, in other words too hot and dry weather. Seventeen respondents (34%) were sharing this threat. Related and escalating problem with lack of water was mentioned fourteen times (28%). Seven farmers (14%) admitted that also lack of labour force loomed large within their households and poses a future threat to them. Five farmers (50%) confided that they were worried of not having income sufficient to pay for their household's needs in the future. Four farmers (8%) said that they felt possible decrease in local market's price of the crops they cultivate as a threat to them. Two farmers (4%) mentioned floods as a threat, two farmers pointed at potentially lowering demand on their crop, two farmers felt threatened by possible increase of costs on their agricultural production, which might, as they presented it, exceed their revenues and make their farming activity unprofitable, and two farmers mentioned plant diseases and vermin danger. The results are displayed in Table 8.

Table 8: Future threats

| | **All respondents (n=50)** | **Rice growers (n=30)** | **Rice non-growers (n=14)** |
|---|---|---|---|
| No threats | 15 | 12 | 3 |
| Droughts | 17 | 8 | 9 |
| Lack of water | 14 | 5 | 9 |
| Lack of labour force | 7 | 0 | 7 |
| Insufficient income | 5 | 1 | 4 |
| Decrease in price of crops | 4 | 4 | 0 |
| Floods | 2 | 2 | 0 |
| Decrease in demand on crops | 2 | 2 | 0 |
| Increase of costs | 2 | 2 | 0 |
| Plant diseases and vermin | 2 | 0 | 2 |

# 6 Discussion

The results show that the targeted households had larger farm size with their average size of 1.71 ha, compared to the national average of 1.3 ha (Guadagni and Fileccia, 2009). In particular, rice growers in the sample averagely cultivated 1.44 ha of land, thus less than rice non-growers in the sample, who cultivated 2.13 ha on average. However, this difference between rice producers and rice non producers in the sample was not proved statistically significant. Land under rice cultivation usually accounted only for a minor part of the rice growers' farm size, averaging at 0.38 ha. That corresponds with words of Hossain and Narciso (2004), who claim that in most of Asian countries, rice is usually grown on small family farms, ranging between less than half a hectare and two hectares in size. They also state that a huge proportion of world's land under rice cultivation is tenanted. The case of the research sample is no different, since rice growers averagely own only 51.5% of the rice fields they cultivate. As a relic of the past, 99-years land tenures provided by state still existed in the study area, despite the fact they were originally only a provisional solution within the agrarian reform taking place in 1990s, and most of the arable land in Kyrgyzstan has already been privatised by today (Lerman and Sedik, 2009). However, nine farmers in the sample, eight of whom were rice growers, rented a field from state on 99-years lease.

Consistently with words of Kienzler et al. (2011), both rain-fed and irrigated farming systems were identified in the study area, where the problem of water scarcity, that currently and still more intensively resonates in the region of Central Asia (Devkota et al., 2013), was obviously actual. When rating their land and farming conditions in three categories – soil quality, erosion, and water supply – the farmers were obviously far most concerned about their options to secure sufficient amount of freshwater to irrigate the land they cultivated, in the context of low precipitation in the ongoing season. As presented in results, they averagely rated 2.26 on a scale of 1 to 4, where 1 was the best mark, and 33 farmers (66%) also listed water supply among main constraints and problems they needed to cope with. Moreover, a significant difference was identified between rice growers and rice non-growers in their rating of water supply. The average mark of rice growers concerning their fields' water supply was 1.76, and for their rice

fields specifically it was 1.12, while rice non-growers averagely rated 3.9 on their fields. These results reveal certain competition for scarce water in the locality, loading in favour of rice fields, that were mostly situated along the Zerger stream, which is described by Tuong and Bouman (2001) as a phenomenon of numerous regions worldwide where rice is cultivated. They state that there is evidence of prevailing water scarcity in rice growing areas in general. Also, another important finding is that while rice fields in the sample were all irrigated from nearby river or brook, wheat, corn, alfalfa and sunflower fields were usually rain-fed only. That was often the reason of the poor mark rated by rice non-producers, since the ongoing season was, as they described it, too dry. As a follow-up, farmers in the sample, predominantly rice non-producers, often termed hot weather, drought, and lack of water the main future threats they were worried about.

In Kyrgyzstan very usual practice of rice-wheat rotation, referred by Devkota et al. (2014), did not take place among rice growers in the sample. None of them reported to rotate rice even with any other crop. However, crop rotation was practiced, by both rice growers and non-growers, on fields where rice was not cultivated.

The average household size in Osh Province was 5.9 people in 2009, which ranked it the highest one among all Kyrgyz provinces (NSC, 2009). Household size computed for the research sample, which was 5.98 people, thus matched this value. All differences between rice growers and rice growers were proved insignificant as for their human resources, except for the number of dependent members, that was higher in case of rice producers.

While, emerging from the results of this study, wheat mostly served as a food-crop in the locality with only 6.4% of its produce being marketed on average, rice growers averagely sold 76% of their rice production, hence rice rather stood in the position of a cash-crop. This finding is contradictory to proposition of Hossain and Narciso (2004) that smallholders in Asia mostly grow rice as a food-crop, to meet family needs, and sell only a small amount of this crop. Such inconsistency might be rationalized by cognizance of the same authors that in most Asian countries, where rice is being produced in profusion, it is the unrivalled main staple crop. In Kyrgyzstan the situation is different, since the first place in staple crops clearly belongs to wheat (Smanalieva et al., 2015) and wheat is often cultivated by rice growers as well (Devkota et al., 2014).

Despite the fact that farmers in the sample did not rotate wheat and rice, which is a common practice of rice producing households in Kyrgyzstan described by Devkota et al., sixteen of them grew both crops separately. Another reason of the high market orientation of rice crop in the study area very probably lies in the local market price of this crop. Smanalieva et al. (2015) state that rice is very remunerative in the whole Central Asia, with local market price several times higher than that of wheat. This statement was confirmed within this research, since price of rice was averagely found more than five times higher than price of wheat. The price difference between rice and wheat was also well reflected in comparison of gross margin, since gross margin per area unit, per labour force unite, and per household member were all noticeably higher in case of rice. Smanalieva et al. further add that price of rice on Kyrgyz market even exceeds the world market price of this crop, being even two or three times higher. On the world commodity market, price of rice was 0.36 USD/kg as for July 2015 (WB, 2016), while the average price of rice the farmers in the sample sold their produce for was 94.01 KGS/kg, which equals 1.34 USD/kg according to exchange rate provided by National Bank of the Kyrgyz republic (2016). Therefore, the second mentioned statement was confirmed, too.

Direct marketing, which Balasubramanian et al. (2000) mention as one of the means for farmers to increase their profits, was proved more favourable and also frequented way for rice growers in the sample to sell their produce, since the average price they sold their rice on the local market was averagely 7.9 KGS/kg (8.2%) higher than that of middleman assisted trade.

Averagely, the highest contribution to the sample households' income was related to animal husbandry, which accounted for 37.2% (132,660 KGS/year) of the households' total income. Fourty-three of the fifty households bred some livestock. That confirms Steimann's (2011) words, that Kyrgyz farming systems are still strongly livestock based, and that animal husbandry usually serves as an important source of income for their households.

Field crops generated 18% of the total income on average. While livestock production was found almost equally important source of income for both rice producers and rice non-producers, a significant difference between the two groups was identified in how much they received from selling field crops. Rice growers incomes from selling field

crops were averagely more than three times higher than those of rice non-growers. Rice trade that accounted for 83.6% of rice growers' total income from selling field crops. The difference in field crops income proportion considerably contributed to a difference between the two groups' total income, which was also identified significantly higher in case of rice producing households. This reveals how specific the position of rice is in Kyrgyz farming systems. Steimann's study, although based on observations in parts of Kyrgyzstan different to this thesis' study area, describes incomes from field crops as a negligible part of the households' total income and identifies crops production to be subsistence oriented in overwhelming majority. That would be in accordance with rice non-producing households in the sample, where this constituent of income was averagely only 9.5%, but not so much with the sample rice producing household, where it accounted for almost 22%.

Steimann further continues in his study pointing at social support, that is old-age pensions and child allowances, and also at regular salaried jobs of some household members as other major sources of income to average rural Kyrgyz households, apart from mentioned animal husbandry. In case of sample households presented in this study, social support and off-farm activities were also, together with animal husbandry, the major constituents of household total income on average. However, incomes from off-farm activities varied a lot among the households, and were zero in 36 of them. The still noticeable average value resulted from a very high average value of the 14 households' off-farm income, which was 229,643 KGS/year.

Another important finding was that there did not exist any Water User Association in the study area, although it was afflicted by the problem of shortage of water, and therefore some systematized, cooperative, and institutional way of water management planning appeared to be desirable, in the manner of many other rural communities of the country (Abdullaev et al., 2009). No of the respondents was a member of a cooperative either. However, establishing cooperatives might assist farmers in post-harvest processing (Balasubramanian et al., 2000) and facilitate their access to market (Lerman, 2013).

The three rice varieties discovered among rice growers in the sample were Ak Uruk, Kara Kulturuk, and Kazim. Ak Uruk and Kara Kulturuk are traditional local varieties in Uzgen district, while Kazim is a variety originally imported from Uzbekistan

(Hauptvogel et al., 2012). There is a slight reflection of this fact included in results of this study, since four farmers mentioned tradition and originality in case of variety Ak Uruk and two farmers in case of variety Kara Kulturuk as qualities they value these varieties for, while no one of the respondents mentioned that as for variety Kazim. The most cultivated variety out of the three, Kara Kulturuk, was the one with the highest average unit price, 100 KGS/kg. Variety Ak Uruk was, on the other hand, the most high-yielding variety of the three, providing averagely 2.8 t/ha of milled basis, which also corresponded with the fact that only in case of this variety farmers highlighted its yields as a crucial quality. Apart from originality and high yields, farmers mentioned appearance, grains' proportions, local market demands, and far most often taste among qualities of the cultivated varieties.

Farmers' willingness to adopt new varieties then mainly related to the varieties' eventual high yields and demand on the local market. Study performed by Li et al. (2010) in Sichuan Province in China also revealed potential new varieties' high yields as a decisive factor in rice growers' willingness to adopt them. The examined willingness of rice growers in the research sample of this thesis was in general quite considerable, since 77% of them were more or less likely willing to adoption of new varieties. Yet, only 30% of rice growers in the sample already had certain experience with new varieties adoption.

The average per hectare yield of all the three varieties was 2.31 t/ha of milled basis and 3.5 t/ha of paddy. That accurately matches the value of the average per hectare yield of rice in Kyrgyzstan, derived from FAOSTAT database (2016). The same database also shows the value of the world's average per hectare yield of rice, which is 4.6 t/ha of paddy and 3 t/ha of milled basis. Therefore, on average, rice growers in the sample, as well as Kyrgyz rice producers in general, do not reach the world's average in yield of this crop.

A noteworthy feature of rice growers in the sample was revealed within this study, that is their ethnicity composition. There were 35 ethnic Kyrgyz in the sample, 74% of them cultivated rice and accounted for 87% of rice growers included in the sample, thus a considerable majority. The main propulsion powers to grow rice, according to its producers' words, were tendency to follow local tradition, mentioned by 50% of rice growers in the sample, and mainly its profitability (66.67%), referring to the crop's high

value and demand on the local market. These results again point at the important traditional value of rice in the locality, as Nesbitt et al. (2010) describe it, and also at its profitability, that is discussed by Smanalieva et al. (2015).

In the future, rice agribusiness in Kyrgyzstan will probably face still very competitive volume of import, possibly accompanied by certain political regulations on domestic rice production reacting to increasing water scarcity (Devkota et al., 2015). That might affect all rice producers throughout Kyrgyzstan, both by being forced to reduce the area of rice cultivation as a consequence of such political restrictions and by decrease in ability to compete with favoured imported rice on the market. However, the traditional value of rice in Kyrgyzstan remains noticeable, and there are no suggestions that the trend of consumption, which has been increasing since the 1990s (FAOSTAT, 2016), although still being rather minor, should turn out to be decreasing in the near future.

One of the possible scenarios in future development of rice production described by Hossain and Narciso (2004) predicted possible rice producers' decrease of interest in rice farming, following new incentives to make them move their labour, land and water out of rice to other economic activities. The farmers in the sample also dealt with a threat of lacking on labour force to run their farm in the future, and although this threat was mentioned only by rice non-producers, such situation can easily meet the households of rice producers, if rice cultivation happend to be hardly sustainable and less profitable because of the pressure of water scarcity and its potential consequences described above. Farmers from the study area will very probably need to find some common solutions in order to be able to face the threats that remain on horizon.

## 6.1 Limitations of the research

The results of this study are based on rapid appraisal method. Therefore, only 50 households were interviewed, 30 of whom were focused on production of rice. Because of that, the results might differ from results that would be gathered in different parts of the province and therefore cannot be generalized for the whole region.

The survey also faced a problem with poor keeping records by the respondents who were often hardly able to estimate their production, costs and incomes. Therefore, the

results are often based only on what the farmers were able to remember. Also, in some cases the farmers obviously felt not comfortable answering some of the questions and therefore they could possibly slightly false the provided answers. It might have possibly resulted into certain inaccuracy and bias in the collected data.

## 6.2 Suggestions for further research

To learn more about rice-oriented farming systems and rice producing households in the area, it would be appropriate within another study to more comprehensively document these households' human resources, as for their education and labour force characteristics, and also to focus on the local consumer preferences with emphasis on the position of rice and its locally available varieties.

Concerning the farmers subjected to this research, it seems to be suitable for them to receive certain assistance with records keeping related to their households' economics via some specialized extension services. That might help them increase their economic efficiency. Furthermore, certain extension services oriented on finding common solution towards the water supply problem would be very helpful as well.

# 7 Conclusion

Rice was identified as a valuable tradition bearer in the study area, being a part of local cuisine in a position of an integral ingredient and being mostly cultivated by ethnic Kyrgyz.

The local market price of rice, that was more than five times higher than that of wheat, makes rice very profitable for the farmers, and therefore it mostly served as a cash-crop to them. Although its contribution to the incomes of rice producing households was usually lower than incomes generated by marketing animal husbandry, it still made a significant difference between its producers and non-producers in their incomes from field crops and their total incomes as well.

Rice non-producers averagely cultivated and also owned bigger land and – although it was not proved significant – had slightly more labour force available, but their incomes were lower than incomes of rice producing households.

In total, three varieties of rice were discovered in the study area, two of them were traditionally local, while one of them was originally brought from neighbour Uzbekistan. These varieties differed in their market price, as well as in their average yields.

Rice agribusiness in the Kyrgyzstan is now endangered by still more actual problem of water scarcity, since rice belongs among the most freshwater consuming crops. It will be probably unavoidable for the farmers in the study area to try to look for common solutions to be able to face future threats and strengthen their access to the market, where the competence with imported varieties will be considerable.

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# APPENDICES

# List of Appendices

## Appendix 1: Questionnaire

### 1. Members of the household

| Household members number | Age of decision maker | Children (0-14 y) | Female 15-59 | Male 15-59 | Female 60+ | Male 60+ | Ethnicity | Experience | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Farm | Rice |
| | | | | | | | | | |

### 2. Land use system

| Land type | Area size | Culture | Locality | Ownership | Soil quality (1-4) | Erosion (1-4) | Water (1-4) | Years | Constraint | Rotation |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |

Source(s) of water:

### 3. Rice varieties

| The variety of rice / other cultures for comparison | Area | Yield | Personal consumption | Amount sold | Direct / intermediary trade |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| **Price** | **Expenses for seeds** | **Expenditure on fertilizers** | **Expenses on pests, protection against diseases, etc.** | **Labour costs** | **Mechanization (fuel or services)** |
| | | | | | |
| | | | | | |

### 4. Annual income in KGS from the specific activities listed below

| Crops from the field | Trees | Garden | Livestock | Off-farm activities | Money from relatives, friends, etc. | Other sources |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |

**Financial situation description:**

□ I can pay for everything my household and farm needs, and even my household generates surplus
□ Revenues and expenditures are in balance (equilibrium)
□ I have difficulties to pay for my needs during a few months (which ones and why?)
□ I have difficulties to pay for my needs throughout the year (why?)

**Credit:**

□ No
□ Yes Sum: Interest rate: Term of return: Source (from whom?):

**Association / cooperative membership:**

□ No □ Yes If yes, how many years?

1. Going back through your personal history as a farmer, have you always grown (only) the crop(s) you grow now?

    a. (If *no*) Which crops did you use to grow before?

    b. (If *no*) Why and when did you decide to change?

2. *(rice growers only)* Compared to other crops being grown in this region, where do you find the main advantage(s) of growing rice? Why do you grow rice?

3. *(rice growers only)* Have you always grown the same variety(/varieties) of rice?

    a. (If *no*) Which one(s) did you use to grow in the past?

    b. (If *no*) Why and when did you decide to change?

4. *(rice growers only)* Compared to other varieties being grown in this region, where do you find the main advantage(s) of growing your chosen one(s)? Why do you prefer this/these one(s)?

5. In general, are you happy with growing the crops mentioned as a source of your livelihood?

    a. (If *no*) Would you like a change? For what crops and when?

6. *(rice growers only)* Are you willing to adopt new variety(/varieties) in the next years?

    a. (If *yes*) When and why would you like to do it?

    b. (If yes) Are you planning to extend your rice production, or just change the variety(/varieties)?

    c. (If *yes*) Which variety(/varieties) do you consider as the suitable new one(s)?

7. Are you worried of any possible future threat(s)?

    a. (If *yes*) Which one(s)?

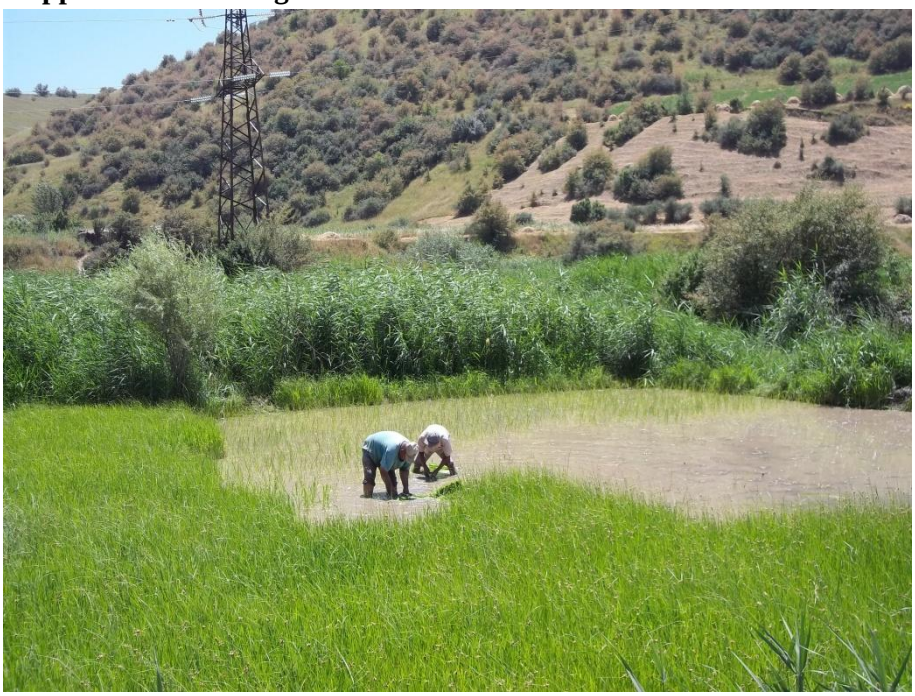
**Appendix 2: The research team**

**Appendix 3: Survey implementation**

**Appendix 4: Rice growing household**

**Appendix 5: Paloo dish**

**Appendix 6: Planting rice**



**Appendix 7: Rice fields**