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Abstract

A regional shift in haricot bean production occurred in Talas Oblast in Kyrgyzstan during the last decade. Almost half of the agricultural land in the region is now dedicated to bean cultivation, primarily for export outside the Central Asian region. This paper includes an overview of the region, agricultural production and trade statistics, and an empirical analysis of rural household production, with a focus on the land productivity of bean farmers and other micro scale producers. The analysis is based on the cross-section survey of 297 rural households and analyze agricultural production in Talas Oblast during the 2010-2011 season. A positive correlation exists between the choice to produce beans and higher agricultural output among the sampled households. The location of the land and the altitude zone are important conditions for land productivity and bean productivity in Talas.

Keywords

Rural Export, Land Productivity, Kyrgyzstan, Talas Oblast, TSLS

JEL Codes: D24, Q12, R14, R15

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Acronyms

GDP	Gross Domestic Product
Ha	Hectares
HHs	Households
NSC	National Statistical Committee of the Kyrgyz Republic
OLS	Ordinary Least Squares
TSLS	Two Stage Least Squares
UN	United Nations
WB	World Bank

1. Introduction

One of the biggest problems in the rural sector of Kyrgyzstan is the low export potential of agricultural products. A limited number of agricultural products are exported, and those that are go primarily to neighbouring countries. However, during the last decade new rural export potential has emerged in the Talas Oblast, oriented mainly to new markets outside Central Asian and traditional Post-Soviet markets. Due to the efforts of regional businesses, local authorities and Turkish food exporters, a new crop was introduced among farmers in Talas Oblast - haricot beans (kidney beans). This foodstuff is relatively new in the country and basically dedicated for export. Initially the volume of bean production was low but it has increased significantly in recent years.

Talas Oblast is geographically isolated from the main markets of the country (Figure 1). During the Soviet period, the regional economic capacity in the agricultural sector was based on the common Central Asian planning system, with open access to Kazakh and East Russian (Siberian) markets. Since independence in 1991, trade barriers between the Central Asian post-Soviet republics emerged due to the general disintegration trend in the region. These barriers gradually decreased the export potential of agriculture in the region. Talas Oblast stagnated due to the low local market potential and complicated access to other parts of the country. Formerly, transport flows between the Oblast and the rest of the country passed through Kazakh territory, and Talas Oblast was integrated within the Kazakh transport network. Currently, with new national borders, the main transport flows lie through high mountain passes. Despite low population density and comparatively higher access to land resources, agriculture in the region significantly declined during the post-communist transformation period. High poverty and low local productive capacity characterised the economy of the region. Since the end of the 1990s, bean production in the region started to increase rapidly, and now the production of beans is an important source of support for the local economy.

Figure 1. Talas Oblast on the Kyrgyz Republic Map

Source: University of Central Asia

The case of Talas is interesting because of a significant change in the rural sector. Farmers there shifted production to a totally new crop within a relatively short period of time. This shift brought new opportunities to the rural population in Talas, but also created a number of potential threats and risks typical of a monoculture, including a dependance on external market volatility, the absence of a domestic market, land degradation due to the absence of soil compensation techniques, and increased risk of diseases and pest invasions.

This paper describes and analyses the growth in Talas in haricot bean production and trade. The analysis is based primarily on official statistics. A separate evaluation incorporates household level analysis of the impact of this new production crop on rural microeconomic behavior. Conclusions summarise the main findings of the study and offer policy recommendations.

2. Talas Oblast Overview, Bean Production and Export Dynamics

Talas Oblast is one of the most remote areas of Kyrgyzstan. The region is located in the Talas Valley of northern Kyrgyzstan area. It borders Kazakhstan to the north and Uzbekistan to the south-west. The oblast has easy geographical access to Kazakh territory, but its access to Uzbekistan is impossible due to mountainous terrain. Access to other parts of Kyrgyzstan is possible, but only through high mountain passes. Talas consists of four administrative Rayons (districts) - Talas, Bakai-Ata, Kara-Buura and Manas.[1] In the region are one town, one urban type village and 90 villages located in the 36 aiyl okmotu (sub-Rayon division). The territory comprises 13.5 thousand square kilometres. The altitude of the valley ranges dramatically from 650 to 4500 meters above sea level. The population of the area is 219.6 thousands inhabitants, living predominantly in rural areas (84.7 %). The region is almost fully populated by those of Kyrgyz ethnicity (91.8 %), with small proportions of Russians, Kurds and Kazakhs in the population. The share of the men in the rural population is insignificantly different than the share of woman - 50.4 % men and 49.6 % women. The biggest disparity is the women's share in the working age group. The average age of women is higher than the average age of men - 27.2 years for women and 25.8 for men. This disparity is because of the large share of elderly women in the population with smaller shares in the younger and working age groups. This trend is common for all parts of the region.[2]

Talas Oblast depends on rural production activity and 54.7 % of regional Gross Domestic Product (GDP) is produced by the agricultural sector. Other important sectors are construction and retail trade and services.[3] The construction sector grew out of local mining projects that were recently initiated but not yet launched. Agriculture is basically oriented towards crop production because of better access to productive land and the remoteness of pastures for most of the rural population in the region.

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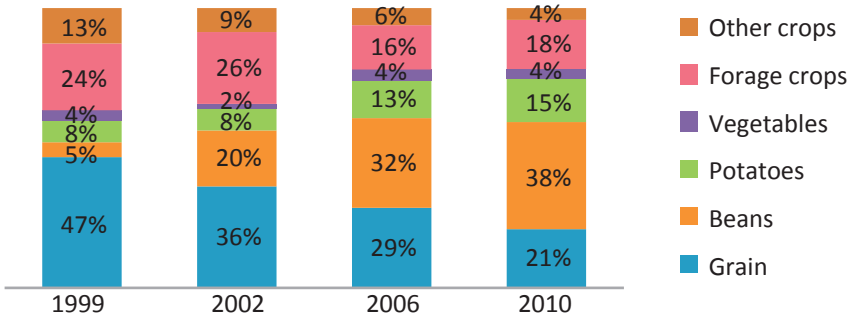
1 Rafis Abazov, *The Palgrave Concise Historical Atlas of Central Asia* (New York: Palgrave Macmillan, 2008).

2 National Statistical Committee (NSC), "National Census of the Kyrgyz Republic 2009. Volume 3. Talas Oblast" *Technical Report* (Bishkek: NSC, 2010).

3 NSC "National Accounts of the Kyrgyz Republic 2006-2010," *Technical Report* (Bishkek: NSC, 2011b). *In Russian.* http://www.stat.kg, Bishkek, Kyrgyz Republic (date accessed: Nov.2012).

According to official statistics, the share of crop production in total agricultural output increased from 60 % in 1999 to 71 % on average over the 2006-2010 period.[4] The main crops in the region are grains (mainly wheat and maize), haricot beans (or kidney beans), potatoes, vegetables and forage crops (perennial grasses such as sainfoin and alfalfa). Figure 2 shows how the structure of crop production changed in the region during the last decade. Approximately 100 thousand hectares (Ha) of irrigated land was used for agricultural purposes, primarily for growing grain and forage crops. Land reform in the late 1990s changed the structure of micro-scale farming towards the production of more eligible crops. The share of potatoes doubled to 15 % of total crop production on irrigated land from 1999-2010, and the share of haricot beans increased from 5 to 38 % of production on all agricultural land. Beans and potatoes replaced grain (mostly wheat) and forage grasses.

Figure 2. Land Use Dynamics by Crop in Talas Oblast, 1999-2010, %



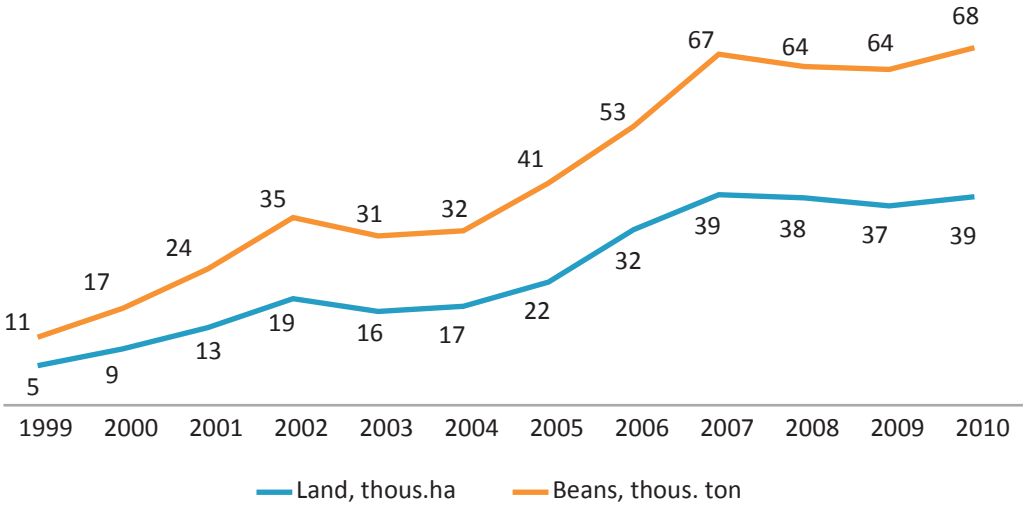
Source: NSC 2004, NSC 2009, NSC 2011

Talas rayon is the most mountainous areas of the region. It has the highest share of livestock production due to easy access to mountain pastures and a higher concentration of potato production. The Bakai-Ata and Kara-Buura rayons located in the center of Talas Valley are the main locations of haricot bean production. Manas rayon is the least mountainous area in the oblast and the most densely populated (see Figure 7). Bean production is not widespread there; typical crops are vegetables and grains. The most common livestock in the Oblast are cattle, sheep and horses.

The shift towards the production of potatoes occurred in other parts of Kyrgyzstan, but production growth of haricot beans is localised in Talas Oblast. Bean production began its expansion in Talas in 1999-2002. Production stagnated from 2003-2004 and then increased in 2005-2007 (Figure 3). The different waves of bean production from 2002 to 2007 were due to fluctuations in the purchase price of beans.

[4] NSC, "Agriculture of the Kyrgyz Republic 1999-2003." *Technical Report.* Bishkek: NSC, 2004. *In Russian*, and NSC, "Agriculture of the Kyrgyz Republic 2006-2010," *Technical Report.* Bishkek: NSC, 2011a. *In Russian*.

Figure 3. Haricot Bean Land and Production Dynamics in Talas Oblast, 1999- 2010



Source: NSC 2004, NSC 2009, NSC 2011

The land dedicated to the cultivation of beans in the Oblast increased from 42.7 to 45.4 thousand Ha from 2011-2012.[5] The share of the agricultural land used for bean production reached 45 % in the Talas region and 4 % in the country. Eighty percent of all bean production in the country in 1999 was concentrated in Talas Oblast. This trend strengthened over time, and by 2010, 92 % of the all beans were produced in Talas. Other areas of the country produce beans, but are usually oriented towards demand in the local market and the cultivation of other types of beans, including peas and soya beans. Cultivation of these other types of beans comprises approximately 4 thousand Ha, and the total annual production volume varies between 6 and 7 thousand tons.[6]

Bean productivity per unit of land is quite low, and is similar for all types of beans. In 1999, it was 2.1 tons per Ha, but this decreased to 1.7 tons per Ha since 2007.[7]

According to the the Ministry of Agriculture, the main problems in the bean sector are weak seed supply, the absence of plant protection systems developed specifically for haricot beans, a weak production base, and the absence of efficient purchasing schemes.[8]

The introduction of the bean seeds from Turkey occurred in 2003. It was not a varieties, but a varietal types of haricot beans, without stable genotypic qualities that provide high yields. Among five French hybrids, two were adopted locally in 2011 and recommended for intro-

5 NSC, "Crop Production Land Distribution in 2012," *Technical Report* (Bishkek: NSC, 2012). *In Russian*

6 NSC, (2004), and NSC, "Agriculture of the Kyrgyz Republic 2006-2010," *Technical Report* (Bishkek: NSC, 2011a.) *In Russian*.

7 NSC (2004), NSC (2011a) and NSC, "Agriculture of the Kyrgyz Republic 2004-2008," *Technical Report*, Bishkek: NSC, 2009). *In Russian.*

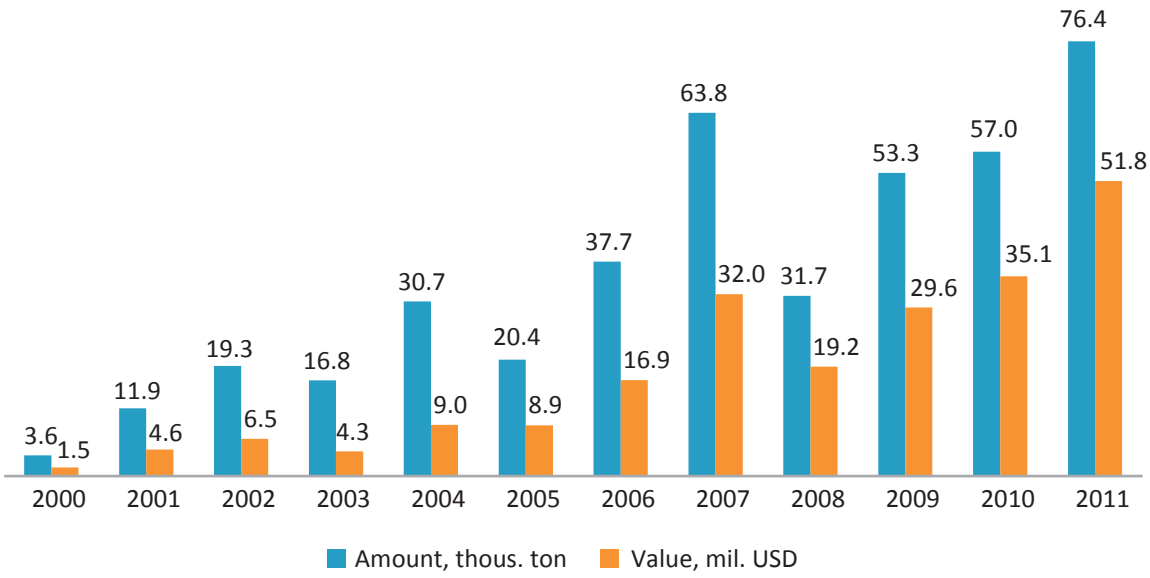
8 G. Joldosheva, "Information on the Production and Export of the Haricot Bean in the Republic," *Technical report*, Ministry of Agriculture of the Kyrgyz Republic (Bishkek: Ministry of Agriculture, 2010). *In Russian.*

duction in 2012.[9] However, there is no available information from the Ministry of Agriculture about the promotion of these new types of seeds among Talas farmers.

Exports of beans do not coincide perfectly with the amount of beans produced. The difference is due to four conditions: a) the time lag between harvesting and consolidation of the stock of beans to be traded; b) complicated logistics due to both exports directly from Talas (half of the volume), and also from reconsolidation centers in Chui oblast and Bishkek; c) the loss of harvested beans during the cleaning, sorting and drying process; and d) different statistical sources for production and external trade. The data on production are collected by the National Statistical Committee (NSC), while the data on trade are collected by the customs authority. These two organisations use different methods to collect their data, and part of the difference in trade and production reporting is explained by these statistical anomalies.

The total bean export volume followed a positive and growing trend similar to the trend in production volume (Figure 4). Within the last four years, bean exports increased dramatically after a large decline in 2008. The export price showed positive growth since 2005.

Figure 4. Haricot Beans Export Dynamics in Kyrgyzstan, 2000-2011



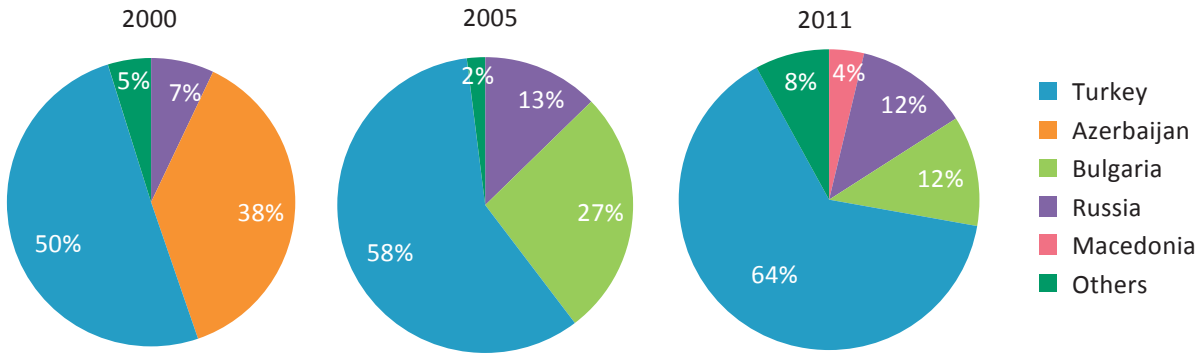
Source: UN 2012

The largest export market is Turkey (Figure 5). Despite a large variation in the volume of exported beans over the last decade, Turkey continued to absorb most of the beans exported. Russia and Bulgaria were also important bean consumers in the last five years. Exports to other countries are minor.[10]

[9] Ministry of Agriculture of the Kyrgyz Republic, "State Register of the Crops Varieties and Hybrids Approved for Cultivating on the Territory of the Kyrgyz Republic," *Technical Report,* State Commission for Agricultural Crop Varieties Testing (Bishkek: Ministry of Agriculture of the Kyrgyz Republic, 2012). *In Russian.*

[10] United Nations. *United Nations Commodity Trade and Statistics Database* (United Nations, 2012). http://comtrade.un.org/db. (date accessed: Nov. 2012)

Figure 5. Haricot Beans Export Dynamics in Kyrgyzstan, 2000-2011, by Trading Country Share, USD



Source: UN 2012

Talas Oblast is a good example of the rural shift toward a new export oriented monocrop: in this case, haricot beans. Available data demonstrate the growing importance of the crop for rural population in Talas and the export potential of rural products. At the same time, a deeper analysis is needed of the impact of haricot bean production on the well-being of the rural population. Section 3. examines household data from Talas region and explains the important correlations between bean production and rural production capacity at the household level.

3. Empirical Analysis of Haricot Bean Influence on Agricultural Output at the Household Level in Talas Oblast

The shift of rural farmers in Talas Oblast toward haricot bean production signals economic rationality in supply deisions. Macroeconomic descriptive analysis is not sufficient to demonstrate a link between the choice of haricot beans as the main crop in the region and higher income of bean producers. To estimate this possible correlation, microeconomic data at the rural producer level is necessary.

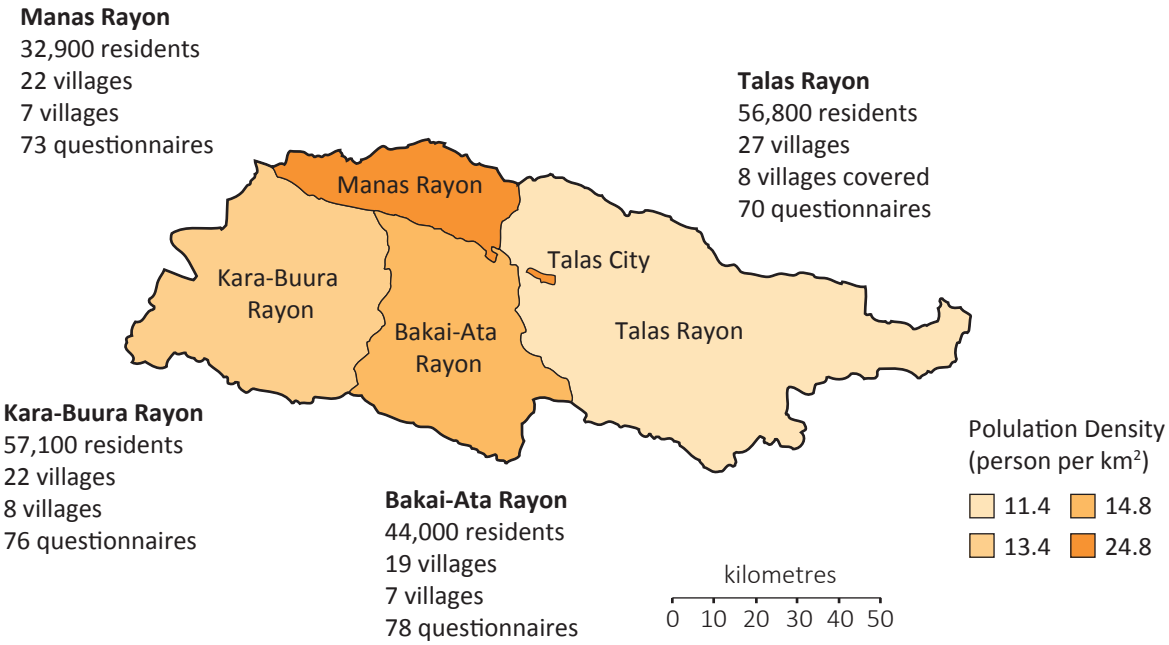
Figure 6. Talas Haricot Beans

Source: Author's photo from field survey.

A random sample of household level cross-section data for the entire Talas Oblast was collected in 2011.[11]The survey was conducted in two stages. A pilot survey was implemented in October - November 2010, and the main field survey was implemented in May - June 2011. This data set provides detailed information on household income, transfers and expenses, agricultural and non- agricultural activities, and demographic characteristics of household members. The detail on income and agricultural production make this an ideal data set for the study of agricultural production and assessment of the impact of haricot bean production at the household level.

3.1. Sample Design, Data Description and Sample Statistics

Figure 7. Map of Talas Oblast with the Sample Description



Source: Author's representation of the map in NSC 2010

The survey data are representative at the regional and sub-regional levels and cover only the rural part of the population. The database includes 297 rural households in 30 villages in Talas Oblast. Every third village was included in the survey. Villages were randomly distributed geographically across the region. Eight villages in both Talas and Kara-Buura rayons and seven villages in both Bakai-Ata and Manas rayons were selected for the sample. Villages were ranked and selected in each rayon following to their size:

- < 5000 inhabitants - 4 villages (one village in each rayon),
- 3001 - 5000 inhabitants - 4 villages (one village in each rayon),
- 2001 - 3000 inhabitants - 4 villages (one village in each rayon),

[11] The data collection is described in detail in Kanat Tilekeyev,"Rural Poverty Determinants in the Remote Rural Areas of Kyrgyzstan: A Production Efficiency Impact on the Poverty Level of a Rural Household." *PhD Thesis (unpublished).* (Giessen: Justus Liebig University of Giessen, 2012).

- 1001 - 2000 inhabitants - 10 villages (two or three villages in each rayon),
- > 1000 inhabitants - 8 villages (two villages in each rayon).

Stratification by village size was needed to adequately represent the rural population living in small and medium size villages. Villages were also selected to ensure geographical representation. The biggest villages in each rayon, if it was possible, were excluded to avoid the dominance of big villages in the sample. Villages covered in the pilot stage were excluded from the main survey.

Within the selected villages, a target number of households were selected based on geographical randomization. Houses (dwellings) were randomly selected across the territory of the village. Maps of the villages were obtained from the regional branches of the State Registration Service. To use the village maps, the privacy of the interviewed households had to be assured. In the larger villages, approximately every fortieth house was covered; in the small villages every twenty-fifth house was selected. The smallest number of households covered in one village was three, and the largest was 30.

The questionnaire contained sections on household structure, education, migration, housing and property data, agricultural activity, food and non-food expenditures, additional food consumption, loans and savings data and non- agricultural activity and remittances. The questionnaire was based on the Living Standards Measurement Survey design, introduced by the World Bank, modified by the NSC. It was also modified additionally for the specific research purposes of this author.

The sample consisted of 1616 individuals listed as the members of 297 interviewed households. The share of women in the sample was even more unequal than in the official statistics; 51.8 % of the household members were men and 48.2 % were women. Similar to the NSC data, the average age of women was higher than the average age of men in the sample. The ethnicity structure of the sample was similar to the Census data.

Household heads were primarily male (86 %), and female family heads were mostly widows (75 % of 14 % of families with female heads). The average age of female household heads (56.7 years) was much higher than the average age of male household heads (49 years). Men were significantly more likely to identify themselves as 'Farmers' (92.8 % of men in this status group) and 'Self- Employed' (67 % of men), while women are more likely to report 'No status' (93.9 % of women in this group) or Pensioners (70.2 % of women).[12]

3.2. Agricultural Production Statistics of the Sample

Land resources play a basic role in agricultural production and subsistence activity of the rural population. Three categories of land are: irrigated land (88.7 % of all land resources belonging to the sampled households), non- irrigated land (2 %) and kitchen gardens (8.9 %). Gardens and hayfields were reported by only five households, making up only 0.4 % of all land.

[12] Tilekeyev (2012).

Figure 8. Kitchen Garden in Talas Oblast

Source: Author's photo from field survey

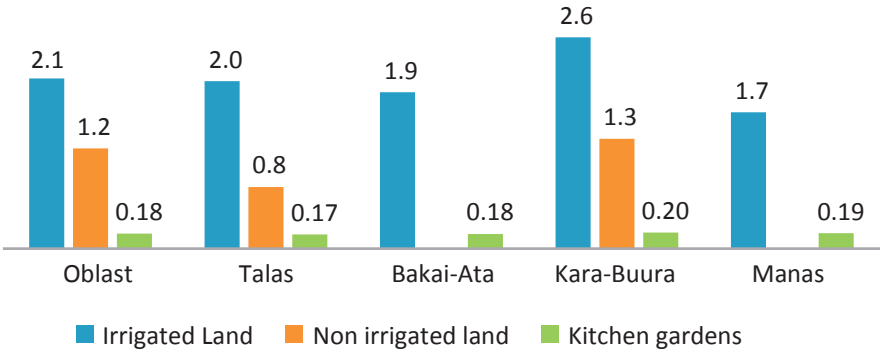
Among the sampled households, 88% own irrigated agricultural land. The kitchen garden is an extremely important for subsistence of food production and is located near the house (Figure 8); only four households (or 1.3 %) did not have a kitchen garden. Ten households owned non-irrigated land; two households were in Talas rayon, and eight were in Kara-Buura rayon.

The biggest share of land resources is irrigated land. The average size of land plots is to 2.1 Ha, but differences in plot size exist across regions (Figure 9). The largest irrigated land plots are in Kara-Buura rayon, while the smallest are in Manas rayon. Talas and Bakai-Ata rayon land plots are similar in size. Non-irrigated land plots are bigger in Kara-Buura rayon than they are in Talas rayon. However, the average kitchen garden size is about the same (.17-.2 Ha) across the region.

Households differ in their use of land. Some farmers (12 %) rent additional plots, while some households (8 %) rent out their land due to their inability (or unwillingness) to work on it. Among 36 households without their own land plots, only six households rent land plots, while the majority choose subsistence farming in their kitchen gardens, alternative non-agricultural types of activities or gains from social and private transfers.

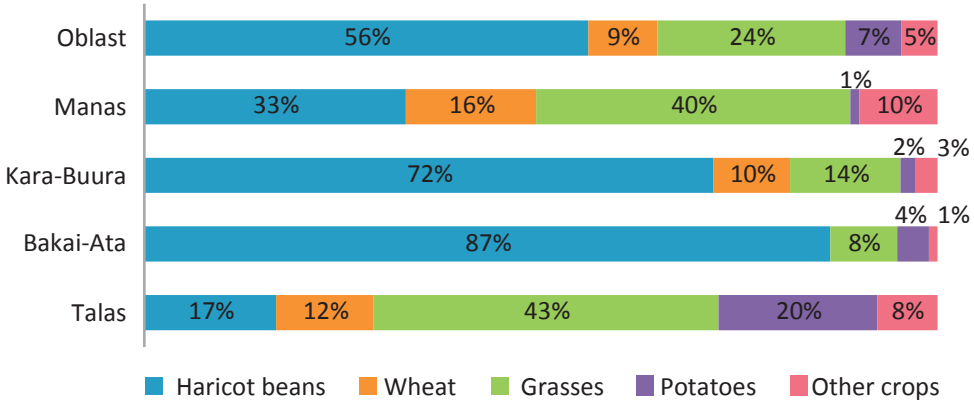
Crop production on household land can be classified into two groups. First, production occurs on the main land plot (including irrigated, non-irrigated lands, hayfields, gardens) and kitchen gardens. Most cultivation on the main land plots is for commercial production, while the kitchen garden is dedicated primarily to household consumption. Only four crops (haricot beans, wheat, perennial grasses and potatoes) cover 95% of the main land plots and 87% of all land used for crop production (Figure 10). Households grow almost 30 different types of plants for food subsistence and some tradable quantities in their kitchen gardens.

Figure 9. Average Size of the Land Resources, Ha per Household



Source: Survey data

Figure 10. Main Land Plot Use by Crops, Rayons and Oblast, %



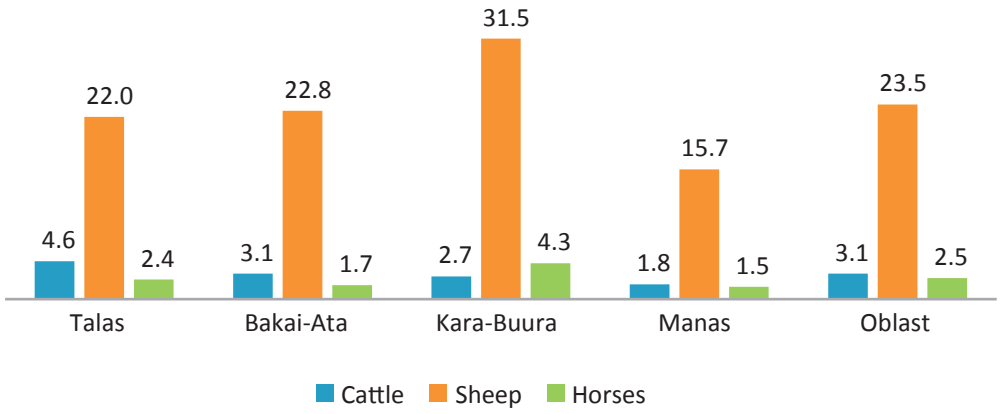
Source: Survey data

Haricot beans hold a central place in the crop structure. The strong dominance of haricot beans is seen in Kara-Buura and Bakai-Ata rayons (Figure 10). Perennial grasses are in second place and dominate in Talas and Manas rayons. Wheat is absent in Bakai-Ata rayon and varies from 10 to 16 % of total production in other rayons. Potatoes are important in Talas rayon, occupying 20 % of the land; in the whole sample, the share of potatoes was only 7 %. Other crops cultivated on the main land plots include barley, apples, sunflowers, onion, sugar beets, corn and sweet peppers.

The second type of production on the land is livestock. Three main types of animals are important for the rural population in the oblast - cattle, sheep and horses. The distribution of livestock is not as widespread as production on agricultural land. Up to 71 % of households report some type of livestock production, including cattle, sheep, horses, poultry, goats, donkeys and rabbits; the last four in small amounts. The highest level of livestock breeding is in Talas rayon (79 % of households) while Manas rayon reports livestock breeding in only 60 % of households. Cattle is the most popular livestock in the region; 59 % of households keep cattle, basically for the milk. Only 48 % of households deal with sheep breeding, and only 14 % of households raise horses.

Figure 11 shows the regional distribution of livestock per household. Talas rayon shows the highest level of cattle breeding, while Kara-Buura leads in sheep and horses. Manas rayon has the lowest level of livestock production in all categories.

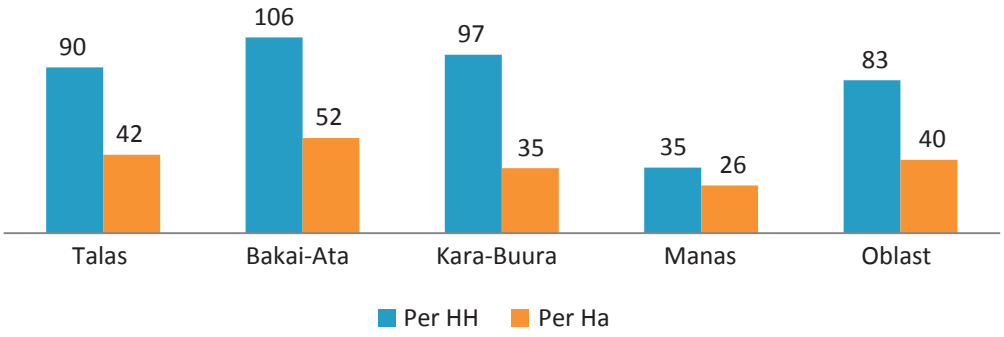
Figure 11. Average Heads of Livestock per Household



Source: Survey data

In the sample, 97.6 % of households were crop producers. Crop production of the households consists of products grown on the main land plot and the kitchen garden, including sold products, stock, barter operations and home consumption. In the sample, 74% of crop production came from traded harvest of crops grown on the main land plot; the stock of crops is 6 % of total production, and home production from the kitchen garden is 19 %. Barter operations are rarely observed (only 0.2%). The low level of stock is explained by the timing of the survey: most of the harvest was already sold when the data were collected.

Figure 12. Average Crop Production per Household and per Ha, Thousand of Soms



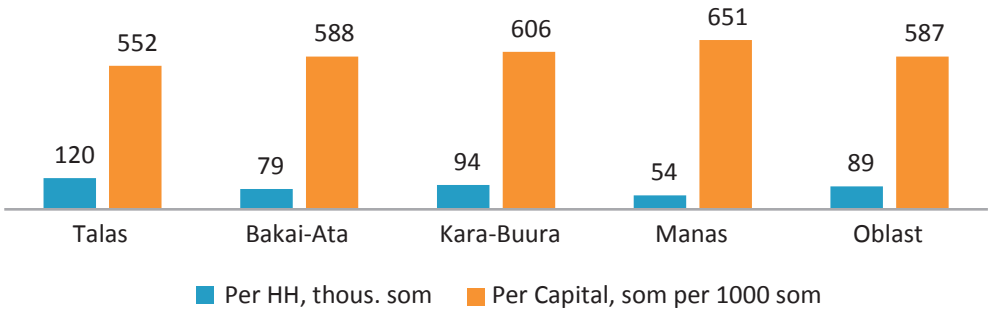
Source: Survey data

Crop productivity differed by unit of comparison (Figure 12). The highest productivity, average crop production per household or per Ha, is in Bakai-Ata rayon. Kara-Buura rayon is in second place when productivity is measured relative to the household, but this rayon drops to third place when productivity is measured per Ha. The lowest level of crop production with either measure is in Manas rayon, but the difference between production per unit of land and per household in this rayon is not large because of low availability of land in this part of the oblast.

Livestock production includes the production of livestock and livestock products for sale, livestock products for consumption, and the capital value of livestock increase over the last 12 months. Livestock production occurred in 211 or 71 % of the 297 households. Livestock typically is sold alive (39 % of all livestock production). A significant amount of livestock production (24 %) is consumed by the household. The biggest share of home consumption is in Manas rayon (33 %), and the lowest is in Talas rayon (14 %). The third use of livestock is sales of livestock products; 23 % of households with livestock report this activity. The main livestock product for sale is milk (94 % from this category). The last category of livestock production (14 % of livestock output) is the increase in the capital value of livestock, which usually means the production of offspring and increased value of animals due to maturation.

Figure 13 shows the distribution of livestock production per household or capital value (livestock value at market prices) by rayon. The average livestock productivity per farmer is highest in Talas rayon, and Kara-Buura rayon is in second place. Bakai-Ata and Manas rayons occupy third and fourth places in livestock production. The regional differences are much smaller when productivity per capital unit (total value of the livestock production per total value of the animals in market price in thousand soms) is measured. Households in Manas rayon produce more products per unit of livestock than in Talas rayon. However the difference in the intensity of animal production is not significant.

Figure 13. Average Livestock Production per Household and per Capital, Thousands of Soms



Source: Survey data

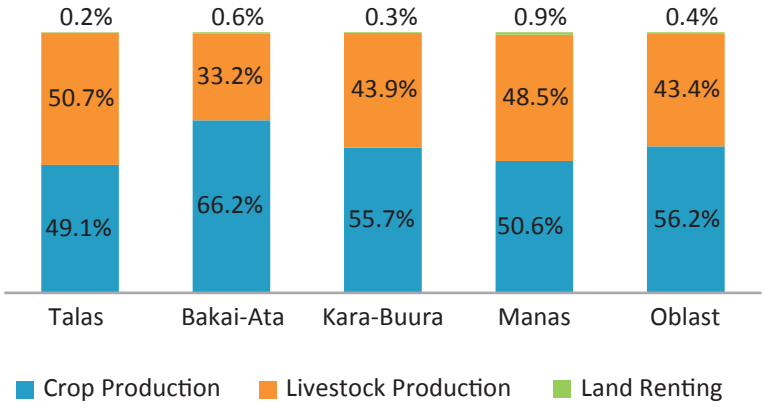
Overall, agricultural production demonstrates the prevalence of crop production against livestock production, particularly in Bakai-Ata and Kara-Buura rayons (Figure 14). In Manas and Talas rayons, the crop and livestock subsectors are almost equal in their shares in total production volumes. Household income also includes revenue from renting out land plots. This type of income is minor and varies from 0.2 to 0.9% of total output in Talas and Manas rayons respectively, and the average share across all households in the sample is equal to 0.4%.

3.3. The Research Model and Results

Agricultural production in Talas Oblast is characterised by the combination of fixed and variable inputs. Fixed inputs are land and household labour. Variable inputs are livestock and other purchased or own produced inputs (seeds, transport, water, fertilisers). The combination of the available fixed and potential (or changeable) variable inputs by a farmer defines a final structure of mixed agricultural output, as presented in the previous section.

To explain the link between a haricot bean production choice and a consequent higher output level compared to other crops, data on the 297 households in rural Talas was analysed to estimate agricultural production. To emphasise bean cultivation, the model was limited to crop production only.

Figure 14. Agricultural Production Structure per Rayon, %



Source: Survey data

The value of crop production output includes the value of household products (sold, consumed and stored). An explanation of output aggregation is necessary. The original data set was designed to measure poverty and therefore includes very detailed price information for all produced tradeable goods. The quantity of all crop product goods was multiplied by an average price per unit of product (kilogram) calculated for the total sample. Prices were unavailable in the database for three products produced in minor quantities in kitchen gardens for household consumption, and their average price was obtained from the NSC for the second half of 2010 and used as the household's implicit product prices.

Households which did not produce crop products and did not use agricultural land for production purposes were excluded from the sample, leaving a working sample of 290 households or 97% of the original sample. Our dependent variable is the crop production output, and land is the main explanatory variable. Land includes the area of the main land plot (own and rented), hayfields, gardens and a kitchen garden. Only land that was actually used was counted in the explanatory variable; the value of any land that is rented or given for free (for relatives) by a household was excluded.

Among the 290 households in the working sample, 157 households produced haricot beans. On average, haricot bean producers have more land than other producers, and their average crop output per household is larger than the average output of the selected sample (Table 1).

To estimate if bean production increases the overall agricultural income of the household, a modified linear land productivity model with some changes was used. The output vector is crop production output in monetary terms, while the input vector in the model is the land variable described above. In addition, we inclide another explanatory variable (a dummy variable indicating whether the household is a bean producer) to test whether haricot bean production increases the value of crop output. Bean production was expected to have a positive influence on the overall production capacity of the household.

Table 1. Descriptive Statistics of Land Used and Crop Output Variables for the Working Sample and Bean Producing Households

	Crop Output, thousand Soms		Land Used, Ha	
	Working Sample	Bean HH's	Working Sample	Bean HH's
Mean	83.3	111.7	2.1	2.7
Median	59.7	91.3	2.0	2.3
Maximum	582.4	582.4	12.1	11.9
Minimum	1.0	16.5	0.05	0.5
St. Dev.	83.3	79.7	1.77	1.65

Our final crop production model is given in equation 1 below. We estimate this model with linear regression:

$$\ln Y_i = \beta_0 + \beta_1 \ln \text{Land Used}_i + \beta_2 \text{Beans}_i + \varepsilon_i , \qquad (1)$$

The regression results are given in the Table 2.

There are several implications of the regression results. The coefficient on the bean variable is positive and supports the hypothesis that haricot bean production increases the value of agricultural output of the household. Households that produce only non-bean crops in the region are at a disadvantage, and their household income from agriculture, on average, is lower. The results also show the importance of the land factor for agricultural production.
A physical constraint exists for land in Kyrgyzstan. In the 1990s, land reform redistributed the majority of agricultural land among rural households. However, there is still no absolutely free land market in Kyrgyzstan.[13] A number of restrictions on land sales make land redistribution a very complicated process. The land rent market helps solve the problem of optimal land use but only partially.

Table 2. Regression Estimation of the Impact of Haricot Bean Production on the Value of Crop Output per Household

Dep. Var. No. obs.	Coef.	Aggregate Crop Production 290
Const.	β_0	3.25*** (0.07)
Land Used	β_1	0.60*** (0.05)
Beans	β_2	0.74*** (0.11)
R^2		0.54
F-Statistic		172.03***

*Notes: Each cell contains the regression coefficient with the standard error in parentheses. ***=significant at the 1 % level.*

[13] Zvi Lehrman and David Sedik, "Agrarian Reform in Kyrgyzstan: Achievements and the Unfinished Agenda," *Technical Report 2009-1* (Budapest: Food and Agriculture Organization, Regional Office for Europe and Central Asia, 2009).

The regression results suggest that bean production is important to overall agricultural production in Talas. However, there may be an endogeneity problem in the empirical model if the choice to produce beans or the amount of land used in production is correlated with unobservable characteristics of farmers that affect the value of their total production. For example, if better managers (an unobservable determinant of production) choose to produce beans or purchase (rent) more land, then the regression estimate of the effect of bean production on output may be due to managerial skill and not the choice of crop. To isolate the effect of bean production on the value of total output, we reestimate the regression using two-stage least squares (TSLS). The key difficulty is finding appropriate instrumental variables to identify the model.

The database provided a choice of instruments. The variables had to be uncorrelated with the residuals in the regression but strongly correlated with the suspect explanatory variables. The instrument for the land capital variable was an assessment of the distance from the dwelling to the main land plot as reported by the farmer. The assessment scale ranged from 1 to 4, reflecting the distance needed to pass to the main land plot (1: less than 1 kilometre, 2: from 1 to 5 kilometres, 3: from 5 to 10 kilometres and 4: over 10 kilometres). If the respondents do not know the distance or had no land, the score was 0. We transformed this scale for our purposes and created a dummy variable equal to 1 if land was located in the zone of 5 kilometres from the dwelling and 0 if distance to the land exceeded 5 kilometres.

We used land altitude to instrument for bean production. We knew the location of the household by rayon, as well as the altitudes of the different rayons. The highest altitude is in Talas rayon; between 1200 and 2500 metres above sea level. Bakai-Ata and Kara-Buura rayons are located in the medium zone; between 1000 and 1400 metres above sea level. The lowest altitudes are in Manas rayon; from 650 to 1200 metres. Three rayon zones in the oblast were thus defined: mountain (Talas rayon), medium (Bakai-Ata and Kara-Buura rayons) and low (Manas rayon). A dummy variable was created for each zone; 1 if the household lived within the zone and 0 if not. In the final specification, only the medium zone variable was used as our instrument.

Table 3. Two-Stage Least Squares Regression Estimation of the Impact of Haricot Bean Production on the Value of Crop Output per Household

Dep. Var. No. obs.	Coef.	Aggregate Crop Production 290
Const.	β_0	3.18** (0.10)
Land Used	β_1	0.76** (0.15)
Beans	β_2	0.77*** (0.21)
R^2		0.52
F-Statistic		64.4***
Instrument list:		LAND DISTANCE MEDIUM ZONE

*Notes: Each cell contains the regression coefficient with the standard error in parentheses. **=significant at the 1 % level, ***=significant at the 5 % level.*

The TSLS regression results are in Table 3 and support our preliminary conclusions. Land is a significant input, and is positively related to crop output as expected. Bean production also shows a significant impact on the value of crop output. The instruments shows the importance of land location as a productivity factor. Confidence intervals are more weak then in the Ordinary Least Squares (OLS) estimation results, but the model maintains its statistical significance. Our future research will examine the validity of the instruments and analyse the specific conditionality of crop productivity.

4. Conclusions

Rural farmers are able to shift from traditional crops to a new types of production when markets are open and stable. The increase in haricot bean production generates a higher and stable income because the export market for beans has been strong and stable for a numbers of years. Households that increased their crop area for beans experienced, on average, an increase in the value of agricultural production, and this supported an improvement in the wealth of rural residents in Talas Oblast. Export earnings support the balance of payments for Kyrgyzstan. The growing Turkish demand for beans from Kyrgyzstan provides an excellent opportunity to expand this specific regional experience to other parts of Kyrgyzstan with a similar production and demographic situation.

Households in this poor rural population rationally adjusted their production decisions in response to market signals. Expansion of haricot bean production also increased the potential of Kyrgyz traders to export their products. Such experience is critically needed for the promotion of other potentially profitable crops in other parts of the country.

Analysis of the bean - land productivity correlation shows that the study of bean profitability is important and needs more research attention. Our OLS and TSLS regressions supports our conclusion about the positive impact of the bean production. However deeper study needed to understand the influence and correlation of the other important variables - labour force, seeds and fertilisers.

A specialised public policy programme could be relevant regarding the promotion of haricot beans cultivation in Talas and other regions of the country. There are many directions for future research to inform public agencies responsible for a sectoral and regional development. Market barriers should be alleviated to produce more efficient markets for Kyrgyzstan goods. Some important policy interventions and research questions include the following:

- Reduce constraints on farm production by increasing and promoting the varieties of seeds to farmers, adopted to Kyrgyz climatic conditions;
- Initiate research to improve plant protection technologies and farmers'
- knowledge of agricultural methods, to increase land productivity;
- Continue research in the Talas region at the household level to assess the impact of public policy interventions on household welfare and to predict future risks and threats of climate change, pests invasions, and land degradation;

- Create and support more agricultural cooperatives and provide easier access to machinery leasing, credit and technical services;
- Engage in deeper study of haricot bean export stakeholders to understand the market mechanisms which lead to regional changes in farming; and
- Support the promotion of beans from Kyrgyzstan in potential export markets in other countries.

All of these initiatives would make the agricultural market in Talas and other regions of Kyrgyzstan more efficient, adaptable, and open to change. This strategy would improve the performance of the agricultural sector in the long run and increase the welfare of Kyrgyzstan's rural inhabitants.

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