The Benefits and Challenges of Farming in Mixed Crop-Livestock Production Systems in Ala-Buka, Kyrgyzstan

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Abstract

In Kyrgyzstan, the agrarian land reform has changed Soviet model of state-owned land with predominance of large-scale farm enterprises to a market-oriented model of privately owned land with predominance of small and medium-sized family farms. This study intends to analyze costs and benefits realized by farmers in producing major food crops, and to identify major challenges faced by these farmers in producing these crops. Field study was carried out in Baltagulov and 1-May Village Governments in Ala-Buka districts covering 240 households. Cost and benefits of cereals, vegetables and forage crops were analyzed separately crop-wise, and cropping pattern-wise. We found three types of cropping patterns adopted by farmers: single, double and transition. However, it was found that majority of HHs in the study area (81%) grow three crops: wheat, maize and sunflower as these crops are important for food for human, feed for livestock, and oil for human consumption, respectively. Among the crops, the highest Benefit-Cost Ratio (BCR) was obtained in maize (2.98) under mono cropping, and it was followed by tobacco and vegetables. Though wheat and sunflower have low BCR, farmers grow these crops as there is a low production risk while growing these crops, and they are important to make farmers' livelihoods. Cash crops (such as vegetable and potato) have benefit but there is high cost as well, and farmers bear more risks in their production. So, majority of households couldn't offer to grow these cash crops in larger land size. This study also triangulated major problems diagnosed from cost benefit analysis with those captured from farmers' perception, and found congruence between these two sources. Major constraints faced by farmers are machinery, irrigation, labor, seed, input and output price and unexpected weather as major challenges in crop production. However, there is specificity in constraints with respect to crops. For example, irrigation and unstable price of output are the major constraints in vegetables whereas lack of machinery is most important in wheat and forage crops.

1. Introduction

In Kyrgyzstan, the agrarian land reform prompted a move away from Soviet model of state-owned land with predominance

of large-scale farm enterprises to a market-oriented model of privately owned land with predominance of small and medium-sized family farms. The Land reform consisted of a two-pronged effort: change in legal ownership of land from state property to private property; and a shift in farming structure from corporate to household level farm management (Lerman et al., 2009). It is estimated that 75% (920,000ha) of the national arable land has been already distributed to households, and the remaining 25% (400,000ha) has been kept under Redistribution Fund Land (RFL) for future contingencies. By February 2009, the number of land owners reached 2.7 million household, and majority of them (80%) were from rural area (Lerman et al., 2009; Gosregistr, 2009). This land reform has changed specialized crop and livestock monoculture systems into mixed mountain crop-livestock production systems (MPS) (Schiere et al., 2006). The MPS is characterized by dominance of rain-fed arable and grazing land, poor market penetration and socio-cultural diversification. Some previous studies have been published about the land reform issues of Kyrgyzstan but they are focused on livestock-pasture issues (IFAD, 1999; World Bank, 2000; Ludi, 2003; World Bank, 2005; Farrington, 2005; Kerven et al., 2005; CACILM, 2005; Nogoev, 2008; FAO/WFP, 2010; USAID, 2010), and have identified shortage of water and poor land management as reasons for pasture degradation. There are very limited studies that incorporate both crop and livestock issues in the analysis though these components are the integral components of the farming system. A study by Steimann (2011) shows that crop production is less profitable than livestock production in MPS. He argues that crop management at household level is comparatively new to them and they still have not internalized crop production as their integral part of their livelihoods. Rather, easy access to pastures and geophysical terrain make livestock production more profitable in this area. Other studies have found shortage of inputs such as machinery, fertilizers, disel fuel and worsening irrigation-drainage systems (World Bank 2000, 2005; Fitzherbert, 2005; Akramov et al. 2009; USAID, 2010) as major constraints in crop production. These constraints were not based on empirical grounds but mainly based on observations and group discussions. This study analyzes costs and benefits of major food crops production and highlights the major production challenge.

2. Methodology

2.1 Study area

Ala-Buka district of Zhalal-Abad region was selected for the study, and it is located in the south-west of Kyrgyzstan. There is 21,134ha arable land with 79.1% land has irrigation facility. Larger size of irrigated land area in BVG is due to availability of ground water in three highly populated villages. People in the other villages depend on water from melting glaciers and precipitation. The land is managed by 73 agricultural cooperatives, 467 peasant farms, 4,731 individual farms (DADD, 2009). There are eight local administrations (Village Government, VG) in Ala-Buka. The research was conducted in two VGs: 1-May Village Government (MVG) and Torogeldi Baltagulov Village Government (BVG) (Figure 1).

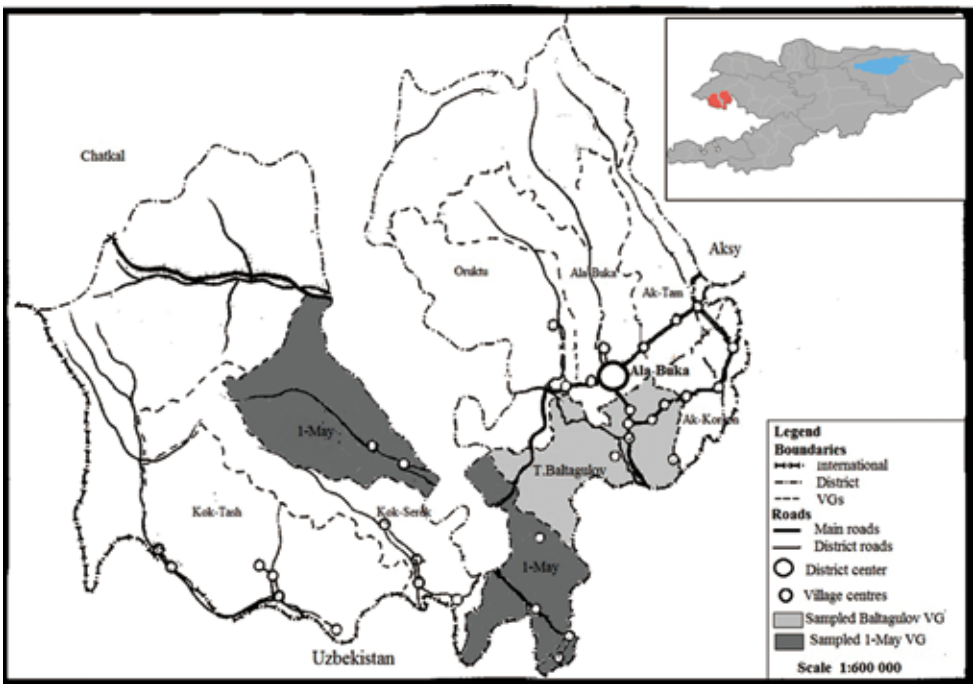

Figure1. The map of Ala-Buka district showing sampled VGs
Source: The geo-political map of Ala-Buka district (DA, 2009)

The total arable land area in MVG is 2,321ha, including 1,668ha irrigated and 653ha rain-fed land area. In BVG, the total arable land area is 2,512ha, including 2,155ha irrigated and 357ha dry land (DADD, 2009). Poverty is a challenging issue in these MVGs. A study shows that 39.9% and 37.3% HHs are under poverty in VGs and MVGs, respectively (DA, 2010).

According to cropping calendar, major cropping seasons in the study area are spring (April-October) and fall (October-July) (Appendix 1). Major spring crops are sunflower, maize, potato, pulses, gourds, tobacco, and vegetable species. Only wheat, which is important food and cash crop, is grown in fall season. Wheat has longer cropping period; it is sown in fall, whole winter new seedlings remain under snow cover, main vegetation period start in late spring and harvesting time is in summer. Due to climate condition, sowing and harvesting time can differ between villages in Ala-Buka.

2.2 Sampling and data collection

This study primarily usages household level data collected in 2010. A total of 120 households from each of the aforementioned VGs were randomly selected for the study. Special consideration was given to cover agro-ecological zones, socio-economic diversification, and so on. A semi-structured questionnaire was used in household data collection, covering the variables: cropping patterns, income sources, costs and benefits in crop production and problems associated with farming activities. To complement the information collected from household survey, group discussions were also carried out with government officials. Also, in 2012, the same households were revisited to collect additional information about production economics.

3. Results and discussion

3.1 Land size and ownership

Availability of per capita arable land in MVG is 0.18 ha, 66% of which has irrigation facility whereas it is 0.2ha in BVG but with higher proportion of irrigated land (85%) as compared to that of MVG. On the basis of the availability of arable land, households are classified into land less, small, medium and large (Table 1). Majority of the households fall under small and medium categories in the sample households; however, the proportion of households in each of these categories varies between these areas. In case of BVG, 65% of the households fall under medium land category whereas small land category households are in majority in MVG (50.7%). Some households are landless and their proportion is higher in MVG. This category of households makes their livelihoods mainly from off-farm activities[1]. The variation in land holding across the households might be due to the fact that in the course of the privatization process, every individual in a former *kolkhoz* and *sovkhoz* received an equal share of arable land, so that larger households were allotted more land than small ones.

Table 1. Number and percentage of households by owned land size

Land size	BVG		MVG		Overall	
	HHs	%	HHs	%	HHs	%
Land less	13	10.8	25	20.8	38	15.8
Small (<1ha)	35	29.2	61	50.7	96	40
Medium (1-2 ha)	65	54.2	31	25.8	96	40
Large (>2ha)	7	5.8	3	2.7	10	4.2
Total	120	100	120	100	240	100

Source: Field survey, 2010

Since land is the important input in crop and livestock production system, its size and quality affects the livelihoods of people who depend on it (Wright et al., 1995). In addition to growing crops in owned land, there is also system of land leasing. The proportion of household and land ownership in the study area is presented in Table 2. Household could get leased land from Land of Redistribution Fund (LRF) making formal agreement. However, they could also take land on lease from neighbors (34 % in BVG and 21 % in MVG), making formal (written document) or informal (verbal) agreements. Lessors are usually paid in cash according to the quality and location of the land.

Table 2. The percentage share of owned and leased land types to total operated land area (ha)

Land	BVG			MVG		
	Total land	**% to total land**	**HHs (*n*=107)**	**Total land**	**% to total land**	**Existed HHs (*n*=95)**
Total operated land	**165.73**	**100**	**107**	**105.36**	**100**	**95**
Owned land						
Irrigated	108.1	65.4	107	60.25	57.2	89
Rain-fed	22.76	13.7	48	21.24	20.2	45
Leased land						
Orchard	12.35	7.5	19	3.79	3.6	14
RFL land	32.78	19.8	16	15	14.2	7

Source: Field survey, 2010

In general, land size for both land ownership categories is larger in BVG; the average size of operated arable land per households in BVG is 1.56ha whereas it is 1.12ha in MVG. The average leased RFL size is almost similar in both VGs (2.04 in BVG and 2.01 in MVG). As in owned lands, RFL land is used for food production, and for orchard.

3.2 Major crops and cropping patterns

The major crops grown in study area are wheat, maize, sunflower, potato, perennial fodder crops, vegetable and tobacco (Table 3). Wheat is the major food crop which contributes 37.7% and 23.5% of the total cropped area in BVG and MVG, respectively in 2010. This proportion has been reduced by 31.3% and 20.7% of the total cropped area in BVG and MVG, respectively just after two year. The reduction in wheat area was due to substitution of its area with maize and forage crops. Maize and forage crops' share in 2010 was 20% and 11.1% of the total cropped area in BVG, and 31.7% and 24.9% of the cropped area in MVG. Sunflower is another important cash crop in the study area. In 2010, this crop's share was 20.5% in BVG and 12.3% in MVG but in 2012 it became 22.3% in BVG and 14.9% in MVG. Potato is another important cash crop and its share in the cropped area was 9% in BVG and 4.4% in MVG. But it has been decreased in 2012 (8.2%in BVG and 4.1% in MVG). The reason behind it is still poorly understood. The share of vegetable area increased in both VGs (2.1% in BVG and 3.7% in MVG in 2012, respectively). Tobacco is a minor crop which shares 0.23% in BVG and 0.9% in MVG, and its area has been further decreased in 2012 (0.19% in BVG and 0.6% in MVG). Other crops such as bean, cotton, and rice are also grown in the district, but with less quantity.

Table 3. Area under different crops in the study area (ha)

Crops	BVG				MVG			
	Total cropped land	**% to total operated land area**	**Ave land size per HH**	**Number of HHs (*n*=107)**	**Total cropped land**	**% to total operated land area**	**Ave land size per HH**	**Number of HHs (*n*=95)**
Wheat	62.75	37.7	0.89	71	24.78	23.5	0.52	47
Maize	33.19	20	0.46	76	33.41	31.7	0.36	66
Sunflower	34.03	20.5	0.54	64	12.97	12.3	0.36	37
Potato	14.93	9	0.24	47	4.62	4.4	0.14	34
Vegetable	2.5	1.5	0.08	31	2.38	2.3	0.10	23
Forage crops	18.33	11.1	0.52	37	26.26	24.9	0.47	34
Tobacco	0.38	0.23	0.12	3	.94	0.9	0.26	4

Source: Field survey, 2010

The choice of crops and cropping patterns adopted by households differ with economic class and geophysical settings. Poor category of households grows maize, wheat and sunflower as these three crops make their livelihood. For instance, maize is used as food, bio-fuel and surplus for sale; and sunflower is used as oil for household consumption as well as for cash. About 81% of the households in both VGs grow those three crops. Whereas, wealthier HHs, in addition to growing above-mentioned crops, grow other cash crops such as potato, vegetables and tobacco due to profit concerns. It is because wealthier households could bear higher risks and buy necessary inputs for the production of these high value commodities. It was found that major vegetables grown in the study area are carrot, onion, garlic, tomato, cabbage, cucumber and sweet pepper (Appendixes 2 and 3). During the Soviet time, tobacco was one of the main industrial crops in Kyrgyzstan. All activities related to tobacco cultivation were mechanized and labor was required only during drying and grading. But just after Soviet independence, tobacco production has been drastically reduced

because of low demand. Survey households believe that some of the reasons for low demand are lack of previous specialized machinery, labor inefficiency in its production and processing, and growing negative concern among consumers about the impacts of tobacco on human health.

Agro-ecological condition also shapes the cropping pattern. It was found that households adopt single, transitional and double cropping patterns. In higher altitudinal range, single crop/mono cropping is preferred. In this area, crops mature in 3-7 months and it might be possible to grow three crops in a year. Wheat is the most common crop grown under single cropping pattern which is sown in fall and harvested in the summer season. Households also argued that rain fed condition also motivates farmers for adopting mono cropping. Arable lands of majority of HHs (68% in BVG and 49% in MVG) are operated under single cropping zones (SCZ) (See Appendix 2). This cropping zone found at higher altitudes, in rain-fed land areas and irrigated crop lands with short growing season, situated closer to hilly and mountainous areas. Single cropping pattern also refers to 'spring growing season' with excluding winter wheat. The transitional cropping pattern refers to fall growing season. This pattern is adopted near village irrigated lands (18% in BVG and 27% in MVG), but not all irrigated land was found to be captured by second crop. Reasons for this include limited irrigation facility, and lack of seed and fertilizers and labor inputs. Maize is the most common crop grown as second crop in the transition cropping pattern but it is grown mainly as forage for livestock.

There are few households (14% in BVG and 24% in MVG) practicing double-cropping[2] (DCZ) with winter wheat[3] - maize (3% in BVG and 4% in MVG), wheat - bean (7% in BVG and 6 % in MVG), wheat - potato (2% in BVG and 5% in MVG), wheat - sunflower (2% in BVG and 9% in MVG). Existing double cropping practices are affected by changes in climate conditions because the planting of second crop is affected by precipitation patterns[4]. Also, sudden occurrence of snowfall or continuous rain and unexpected frost during pre-harvesting time in autumn can destroy the crop. Farmers believe that potato produced in wheat - potato cropping pattern has better seed quality and higher market price than potato in single cropping pattern. Associated reason for this might be due to the fact that cooler weather improves the durability and taste of potato than it is grown in hot and dry season. In single cropping pattern (spring season growing), hot weather condition does not favor for potato farming and also even the produced one is susceptible to diseases and fetch less price in the market.

3.3 Cost and benefit analysis of major crops

Table 4 presents the summary statistics of cost of benefit variables of different crops grown in the study area. Benefit cost ratio (BCR) of different crops has been calculated under different cropping patterns, and it is the ratio of benefit and total costs (Table 4) for one hectare land area for all crops. Appendixes 2 and 3 provide detailed breakdown on cost benefit analysis of different crops. Gross revenue was calculated by multiplying the yield with market price and benefit was calculated just subtracting total cost from gross revenue. The result shows that maize is the most profitable crop, which is followed by tobacco and vegetables. BCR of maize is 2.98 which means that one unit invest on maize farming leads to benefit to farmers by 2.98 units. The benefit from wheat is higher in double and transitional cropping patterns as compared to single cropping pattern.

BCR for potato production is low (0.36) mainly due to high seed cost, and it could be 4.0 while excluding seed cost from the analysis. The usual practice is that farmers buy potato seed from the market in the first year and it is recycled up to five year unless they realize significant reduction in its yield. To address this field reality, BCR of potato production was calculated for consecutive five years integrating seed cost only in the first year.

Table 4. Per hectare cost and benefit analysis and benefit cost ratio (BCR) of major crops

Cropping patterns	Gross revenue (som*.ha^{-1})	Total cost (som.ha^{-1})	Benefit (som.ha^{-1})	Benefit cost ratio (BCR)
Single cropping pattern				
Wheat	37,200	18,112	19,088	1.05
Maize	74,250	18,677	55,573	2.98
Sunflower	30,400	16,002	14,398	0.90
Potato	140,000	103,207 (28,000)	36,793 (112,000)	0.36 (4)
Vegetable	354,000	114,777	239,223	2.08
Fodder crops	97,500	51,965	45,535	0.88
Tobacco	132,000	36,577	95,423	2.61
Transitional cropping pattern				
wheat-green maize	64,700	36,789	27,911	0.76
Wheat (1st crop)	40,300	18,112	22,188	1.23
Green maize (2nd)	24,400	18,677	5,723	0.31
Double cropping pattern				
wheat-maize	111,450	36,789	74,661	2.03
Wheat (1st crop)	43,400	18,112	25,288	1.4
Maize (2nd crop)	68,050	18,677	49,373	2.64
wheat-potato	102,200	46,319	55,881	1.21
Wheat (1st crop)	44,950	18,112	26,838	1.48
Potato (2nd crop)	57,250	28,207	29,043	1.03
wheat-bean	82,200	36,114	46,086	1.28
Wheat (1st crop)	43,400	18,112	25,288	1.4
Bean (2nd crop)	38,800	18,002	20,798	1.16
wheat-sunflower	67,600	34,114	33,486	0.98
Wheat (1st crop)	39,850	18,112	23,738	1.31
Sunflower (2nd crop)	27,750	16,002	11,748	0.73

Source: Field survey, 2010, 2012

*- *som* is National currency of Kyrgyzstan, 1 USD is equal to 46.45 *som* (2010)

Note: Figures in the parenthesis for potato, indicate calculation without including seed cost (75,000 *som*)/ per ha

The result shows that farmers could realize the highest BCR in the second year (4.0), and it starts declining gradually in the subsequent years. In the fifth year, the BCR reached to 1.5. Farmers argued that this BCR is acceptable to farmers in the fifth year, and from sixth year they replace new seed. The decrease in BCR is due to declining tuber yield as this crop becomes susceptible to diseases while recycling same seed over the generations.

Table 5. The effect of seed quality on BCR of potato

Years of planting	1st year	2nd year	3rd year	4th year	5th year	Average *n*=5
Yield, ton/ha	10	10	7.9	5.6	4.8	7.66
Ave market price (som/kg)	14	14	14	14	14	14
Gross revenue (som)	140,000	140,000	110,600	78,400	67,200	107,240
Total Cost (som)	103,207	28,000	28,000	28,000	28,000	43,041.4
Benefit (som)	36,793	112,000	82,600	50,400	39,200	64,199
BCR	0.36	4	2.95	1.8	1.4	1.5

Source: Author's calculation from data of field survey, 2010, 2012

Note: The calculation may vary due to the changes in the average market price for crop and total cost within and between years

The perennial forage crops (0.88) and sunflower (0.90) based treatments appeared less efficient, even though net benefit of fodder crops is higher than other crops (45,535 som). It shows that the total cost of fodder crops (51,965 som,) is higher than net benefit, and it has the second highest total cost after the potato while considering the purchased seed. The high production cost in forage is due to large number of supplied labor, especially on mowing. During the soviet era, farmers used to mow forage crops using machinery but in recent days they mow the field manually around three times in a year. This has resulted into decreased efficiency in fodder production due to multiple harvesting manually. This finding is contradicting with previous studies (Wright et al., 1995; Farrington, 2005; Fitzherbert, 2005; Zhumanova et al., 2013) on profitability and necessity of fodder crops growing,

especially when farmers suffer from forage shortage and it's caused impact on declining livestock production.

While comparing gross revenue, it is the highest among the crops compared in the analysis. The benefit for vegetable is 239,223 som, which is larger than tobacco (95,423 som) and maize (55,573 som). But BCR of vegetable is lower than these crops due to higher total costs, especially labor costs as vegetables more labor intensive than other crops. Moreover, vegetable farming in this area also bears risks if farmers go for commercial production due to limited irrigation facility, lack of storage facility and appropriate management technologies against climatic extremes such as frost and chilling injury. Similarly, sunflower (14,398 som) and wheat (19,008 som) give less benefit to farmers but these crops serve as important for food security of farmers in the study area. Therefore, farmers keep on growing these crops instead of lower BCR as compared to other crops. Moreover, majority of HHs prefer to cultivate wheat and sunflower with maize because maize has highest BCR and can be produced using local resources, and it is the main crop for feeding livestock. It means farmers consider other social reason (food security) and connection of crop with other elements of farming system while deciding to grow for particular crop. It means decisions with respect to choice of crops and cropping pattern are influenced by several forces related to infrastructure facilities, socio-economic factors and technological developments (Das, 1999).

3.5 Farmers' perception on major constraints to cropping patterns

This section explains farmers' perception as major challenges in the production of crops discussed in the above section. The indicators for the challenges were identified based on how farmers could get from agriculture production, i.e., by maximizing production with minimum use of inputs, and by getting maximum value of their outputs. These indicators are low and unstable price, insufficient irrigation facility, shortage of machinery and labor, high cost of production inputs, bad weather, and lack of quality seed, technical skills and others. Farmers' perception in this regard has been analyzed according to crops in different patterns. The result shows that farmers face challenges in irrigation (20% in BVG and 21% in MVG), machinery (17% in BVG and 15% in MVG), labor (10% in BVG and 8% in MVG), other inputs such as fertilizer and diesel oil (14% in BVG and 10% in MVG), unexpected weather (15% in BVG and 17% in MVG) and quality seeds (8% in BVG and 5% in MVG). Also, it is clear from this analysis that the constraints realized by farmers are in line with what we analyzed in the cost benefit analysis. However, the intensity of particular challenge indicator varieties with crops and cropping patterns. For example, in case of wheat and forage crops, machinery is the first priority whereas in potato and vegetable unstable price is the major concern. Since the production of these crops subject to various kinds of risks, it is very difficult to realize stability in output price like in wheat.

Table 6. The percentage of households' perceptions of the main constrains to cropping patterns by cropping zones (multiple answers possible)

Cropping zone (CZ) and patterns	Low & unstable price	Inefficient irrigation	Machinery shortage	Labor shortage	High cost inputs	Bad weather	Quality seed	Technical skill	Others
Single cropping pattern									
Wheat	49	28	77	11	27	33	29	13	21
Maize	18	49	10	52	29	38	28	16	35
Sun flower	57	39	35	61	27	21	20	17	12
Potato	75	52	31	42	51	43	49	31	47
Vegetable	56	58	24	49	56	45	47	38	53
Forage crop	11	38	59	56	28	31	7	14	9
Tobacco	-	-	33	65	-	-	-	-	-
Transitional cropping pattern									
wheat- green maize	62	57	49	47	38	27	48	21	37
Double cropping pattern									
wheat-maize	86	38	61	48	28	25	59	26	54
wheat-potato	91	49	56	43	41	46	57	31	51
wheat-bean	78	32	13	39	11	24	14	19	35
wheat-sunflower	95	46	72	57	46	38	63	34	56

Source: Field survey, 2010, 2012

This study also shows that many farmers suffer from low/unstable price of their outputs. It can be explained by several reasons. Firstly, district location and distance from urban areas (350km to Zhalal-Abad and 650km to Bishkek) increase

transportation cost. Secondly, it will not be profitable for middle man to buy small quantity of crops from segregated fields as transport cost will be high. If they do so, they will buy with low price. Only few farmers, with large operated land, can offer to sell or to transport the produces to region center or to Bishkek. Thirdly, lack of winter storage buildings leads to sell all harvest with low bulky price. Fourthly, low price comes through inappropriate policy approach at regional level; most of the National Programs, resolutions and Acts provided financial and material supports only to backward farming operations, such as allocating goods-credits without interest rate (fertilizer, diesel oils and seeds), granting machineries and other equipment to majority farmers, for those farmers who are located close to urban areas.

If low and unstable price for crops continue to rise, all cropping patterns might converse or specialize on forage production. In future, this might create two big problems: the first, food security issues will be augmented due to food crop shortage. Households will depend on imported cereals, wheat flour and other food crops. The second, enhancing forage production will increase livestock number, at the same time; pressure on pastures also will be amplified. This finding is similar to that of Steimann (2011).

In study area, HHs experience substantial differences in precipitation both within the year and between years. So, low or high levels of precipitation pattern have led to a diverse range of coping strategies. Heavy rains at planting time resulted in higher soil moisture conditions and longer than normal snow cover in higher elevations which delayed farm operations by 2-3 weeks (FAO/ WFP, 2010). Severe frost and sometimes snow affected crops in single cropping pattern of the study area between April and May. This also leads crop losses with yield reduction (Zhumanova, 2011). Rapidly sharp increase in temperature in May and June, after heavy rain, hail and flood, caused unfavorable condition for seedlings; soil surface become hard and seedlings cannot grow up (Figure 2). Thereafter, farmers have to reseed crops.

Figure 2. View of the damaged maize crop land afterward heavy rain and mudflow in spring, BVG
Source: Field survey, 2012

4. Conclusion and recommendation

In this study, we analyzed the costs and benefits in producing major food crops in Kyrgyzstan using household level data, and identified major challenges associated with management of these crops. It was found that, maize is the most beneficial crop while it is grown in single cropping pattern as BCR of this crop is 2.98. It is followed by tobacco and vegetables. The lowest BCR belongs to sunflower (0.90), and wheat has also similar figure (1.05 in single cropping pattern). However, majority of the HHs (81%) grow these crops to address their food security. Maize is normally grown after wheat in double cropping pattern as the former one is considered as good fodder for livestock. This implies the farmers' behavior in considering the whole farming system to realize the benefits with low farming input costs. This study also analyzed farmers' perception on challenges they faced on the production of food crops. It was found that farmers' perception on crop production issue generally matches with what we identified from cost benefit analysis. Also, there is specificity in the constraint with respect to the crop. For example, low and unstable price is more serious in vegetable crops and potato where machinery issue is important in wheat and forage grass. These findings might have implications for designing appropriate policy for promoting appropriate research and development activities that address these problems.

Endnotes

[1] This variation of land size depends on former *kolkhoz's* (1-May *kolkhoz*-MVG) and *sovkhoz's* (Birlik *sovkhoz*-BVG) arable land area and its population in 1995. During Soviet times, *kolkhozy* were cooperatives comprising a number of families which pooled land and equipment together and whose members were paid according to the work undertaken. Members did not receive an annual salary, but a division of the collective income after costs. This variable monthly portion was often in kind. In *sovkhozy* (state farms), planned and budgeted by the Ministry of Agriculture, every *sovkhoznik* (worker) received a wage, the same amount with a bonus at the end of the year if the income of the operation was sufficient. *Sovkhozy,* according to Humphrey (1983) in the case of Soviet Buryatiya, having been considered a 'higher' social economic form than the collective farm (*kolkhoz*), received large subsidies and other advantages over collective farms.

[2] According to agriculture glossary, usually in double-cropping pattern, two arable crops per year are grown. Unlike that definition, in study area double cropping refers to 'double harvest', which the first crop was sown in a previous year, after that harvest it can be possible to sow and harvest the second crop. As a result, the scenario will be as follow: For a previous year - two crops sowing and one crop harvest; for current year - two crop harvests and one crop sowing.

[3] Usually farmers grow winter wheat in study area. Winter wheat (*ozimaya pshenitsa*) is used as a specific terminology in Kyrgyzstan. It is so called, because sowing time is in fall, seedlings remain under snow cover whole winter and main vegetation starts in spring. Recent years, it was started to grow spring wheat in Ala-Buka. However, it was insufficient there, due to hot weather in spring and summer. Spring wheat growing exists in mountainous regions of Kyrgyzstan with a short growing season.

[4] Majority HHs in both VGs responded that cash crops fare reasonably well because higher temperatures and longer growing season than 12-18 years before become more favorable for double cropping. Previously they grow mainly under single cropping and rare transitional (who has well-access to irrigation) cropping due to cooler weather condition and changes in precipitation pattern (personnel communication, 2010).

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Appendix2. An economic CBA for major crops cultivation (1 hectare) SCZ in study area (price for items is given for 2010)

No	Activities and cost	Amount and cost	Major crops						
			Winter wheat	**Maize**	**Potato**	**Vegetable**	**Sunflower**	**Tobacco**	**Lucerne**
1	Ploughing	Labor payment, som/ha	550	550	550	550	550	550	550
		Diesel fuel, 35 l/ha	1225	1225	1225	1225	1225	1225	1225
2	Levelling (Harrowing)	Labor payment, som/ha	250	250	250	250	250	250	250
		Diesel fuel, 10 l/ha	350	350	350	350	350	350	350
3	Sowing	Labor payment, som/ha	300	300	300	300	300	300	300
		Diesel fuel, 7 l/ha	245	245	245	245	245	245	245
4	Row bedding	Labor payment, som/ha	200	200	200	200	200	200	200
		Diesel fuel, 7 l/ha	245	245	245	245	245	245	245
Sub-total cost for land preparation (1+4)		Labor payment, som/ha	1300	1300	1300	1300	1300	1300	1300
		Diesel fuel, 59 l/ha	2065	2065	2065	2065	2065	2065	2065
		Sub-total cost	**3365**	**3365**	**3365**	**3365**	**3365**	**3365**	**3365**
5	Intercultural operations 1*	Labor payment, som/ha		150	150	150	150	150	
		Diesel fuel, 10 l/ha		350	350	350	350	350	
6	Intercultural operations2	Labor payment, som/ha		150	150	150	150	150	
		Diesel fuel, 10 l/ha		350	350	350	350	350	
7	Intercultural operations3	Labor payment, som/ha			150	150		150	
		Diesel fuel, 10 l/ha			350	350		350	
8	Intercultural operations4	Labor payment, som/ha			350	350		350	
		Diesel fuel, 10 l/ha			150	150		150	
Sub-total cost for cultivation (5+8)				**1000**	**2000**	**4000**	**1000**	**2000**	
9	Seed	Sown kg/ha	300	20	3000	5	15	0.1	20
		Price per kg, som	15	20	25	600	45	9000	150
		Total price, som	**4500**	**400**	**75000**	**3000**	**675**	**900**	**3000**
10	Fertilizer	Required kg/ha	300	300	400	500	250	400	300
		Price per kg, som	15	15	15	15	15	15	15
		Total price, som	4500	4500	6000	7500	3750	6000	4500
		Application payment	200	200	200	200	200	200	200

Appendix 2 continues…….

No	Activities and cost	Amount and cost	Major crops						
		Total cost, som	**4700**	**4700**	**6200**	**7700**	**3950**	**6200**	**4700**
11	Pesticide, Herbicide	Total price per ha/som	600	600	1000	1000	400	600	
		Spreading payment	200	200	200	200	200	200	
		Total cost, som	**800**	**800**	**1200**	**1200**	**600**	**800**	
12	Irrigation payment	Per payment, som	45	100	100	100	100	100	100
		Total payment	**135**	**300**	**400**	**400**	**300**	**700**	**400**
13	Harvesting	Total cost	3000	5000	10000	10000	3000	9000	15000
14	Transporting to house	Total cost	700	1000	3000	3000	1000	3000	8000
15	Cleaning	Total cost	300	500	500	500	500		
16	Land tax		306	306	306	306	306	306	306
17	Payment to Social Fund		306	306	306	306	306	306	306
18	Other expenses			1000	1000	80000	1000	10000	16888
	Grand total cost, som (1+18)		**18112**	**18677**	**103207**	**114777**	**16002**	**36577**	**51965**
19	Crop yield ton/ha		2.4	5.5	10	17	1.9	2.4	13
20	Cost, som per kg/ yield	100%	**7.56**	**3.39**	**10.32**	**20.08**	**8.42**	**15.24**	**39.97**
21	Market price of crops, som/kg	Min	6	5	8	7	12	45	
		Max	25	22	20	35	20	65	
		Average	**15.5**	**13.5**	**14**	**21**	**16**	**55**	**7.5**
22	Gross Benefit	Min price	14400	27500	80000	116000	22800	108000	
	Net Benefit	Min price	-3712	8823	-23207	76223	6798	71423	
23	Gross Benefit	Max price	60000	121000	200000	595000	38000	156000	
	Net Benefit	Max price	41888	102323	96793	552223	21998	119423	
24	**Gross Benefit**	Ave price	**37200**	**74250**	**140000**	**354000**	**30400**	**132000**	**97500**
	Net Benefit	Ave price	**19088**	**55573**	**36793**	**239223**	**14398**	**95423**	**45535**

*- this activity includes hoeing, weeding and threshing

Appendix 3. An economic CBA for major crops cultivation (1 hectare) in TCZ and DCZ (price for items is given for 2010)

No	Activities and cost	Amount and cost	Major crops				
			TCZ	DCZ			
			Wheat-green maize	Wheat-maize	Wheat-potato	Wheat-been	Wheat-sunflower
The 1st crop - wheat							
A	**Total cost (som)**		**18112**	**18112**	**18112**	**18112**	**18112**
B	Crop yield (ton/ha)		2.6	2.8	2.9	2.8	2.57
C	Average price (som/kg)		15.5	15.5	15.5	15.5	15.5
D	Average cost per kg yield (som)		6.97	6.47	6.24	6.47	6.71
E	**Gross Benefit**		**40300**	**43400**	**44950**	**43400**	**39850**
F	**Net Benefit**		**22188**	**25288**	**26838**	**25288**	**23738**
The 2nd crop							
1.	Ploughing	Labor payment (som/ha)	550	550	550	550	550
		Diesel fuel (35 l/ha)	1225	1225	1225	1225	1225
2.	Levelling (Harrowing)	Labor payment (som/ha)	250	250	250	250	250
		Diesel fuel (soml/ha)	350	350	350	350	350
3.	Sowing	Labor payment (som/ha)	300	300	300	300	300
		Diesel fuel (som/ha)	245	245	245	245	245
4.	Row bedding	Labor payment (som/ha)	200	200	200	200	200
		Diesel fuel (soml/ha)	245	245	245	245	245
5.	**Sub-total cost for land preparation (1+4)**	Labor payment (som/ha)	1300	1300	1300	1300	1300
		Diesel fuel (soml/ha)	2065	2065	2065	2065	2065
		Sub-total cost	**3365**	**3365**	**3365**	**3365**	**3365**
6.	Intercultural operations	Labor payment (som/ha)	1050	1050	1050	1200	150
		Diesel fuel (som/ha)	350	350	350	-	350

Appendix 3 continues……

No	Activities and cost	Amount and cost	Major crops				
7.		**Sub-total cost**	**1400**	**1400**	**1400**	**1200**	**500**
8.	Seed	Sown (kg/ha)	20	20	1000	40	15
		Price per kg (som)	20	20	5	15	24
		Total price (som)	**400**	**400**	**5000**	**600**	**360**
9.	Fertilizer	Required (kg/ha)	150	150	200	100	100
		Price per kg (som)	15	15	15	15	15
		Total price (som)	2250	2250	3000	1500	1500
		Application payment	200	200	200	200	200
		Total cost (som)	**2450**	**2450**	**3200**	**1700**	**1700**
10.	Pesticide Herbicide	Total price per ha (som)	400	400	400	-	-
		Spreading payment	200	200	200	-	-
		Total cost (som0	**600**	**600**	**600**	**-**	**-**
11.	Irrigation payment	Per payment (som)	100	100	100	100	100
		Total payment	**200**	**200**	**300**	**300**	**200**
12.	Harvesting		6000	5500	7000	8000	5000
13.	Transporting to house		1000	1000	3000	800	1000
14.	Cleaning		1000	1500	500	500	2500
15.	Other expenses		1962	1862	1742	537	1377
16.	**Grand Total Cost, som (1+13)**		**18677**	**18677**	**28207**	**18002**	**16002**
17.	Crop yield ton/ha		2.4	5	2.3	1.8	1.7
18.	Average cost per kg yield/ som	100%	7.8	3.7	12.2	10	9.4
19.	Market price of crops,	som/per kg	10	13.5	25	22	16
20.	**Gross Benefit, (15*17)**		**24400**	**68050**	**57250**	**38800**	**27750**
21.	**Net Benefit (19-15)**		**5723**	**49373**	**29043**	**20798**	**11748**
21	**Total Cost (A+15)**		**36789**	**36789**	**46319**	**36114**	**34114**
22	**Total Gross Benefits (E+19)**		**64700**	**111450**	**102200**	**82200**	**67600**
23	**Total Net Benefits (F+20)**		**27911**	**74661**	**55881**	**46086**	**33486**