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Policy Options for Economic Growth of Remote Village in Kyrgyzstan: an Analysis with Village CGE Model

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ABSTRACT

Since gaining independence Kyrgyzstan has implemented drastic macro reforms to restructure its economy from the centrally planned type to the one oriented to market relations. Agricultural sector was always important for Kyrgyzstan's economy and in transition agricultural reforms took the form of complete liberalization of the sector and privatization of the collective farms.

New class of private farmers emerged but is faced with numerous constraints and problems to ensure stable agricultural food production and maintenance of the livelihood strategies in rural areas. The hope that as a result of the reforms the efficient markets would emerge did not materialize. Complete state withdrawal led to underinvestment in rural infrastructure and failing input and output markets. There is great risk that without public policies the rural economy of Kyrgyzstan would fall into a situation of persistent under development and poverty trap.

One of many reasons for the absence of efforts to deal with problems of farmers in the post reform era has to do with lack of appropriate information on the effect of the reforms on the rural sector; lack of the knowledge on policy options and policy impacts on private farmers. This study attempts to fill this gap and contribute to formulating and optimizing the viable options of rural development strategies.

It is argued that rethinking the role of the state in the post reform period is necessary for reorienting the public policies away from minimalist toward more activist approach, as the former is not deemed appropriate under the conditions of the transition economy.

In this study, the village level approach is taken to study the behavior of the rural farm households in Kyrgyzstan. It is motivated by the distinctive features of the rural sector in Kyrgyzstan, namely: remoteness; the importance of the village/local economy and heterogeneity of rural households; the existence of the local linkages between village households.

The study was based on unique survey data of rural farm households which was collected by author in a remote village on the South of Kyrgyzstan. The study found that village households take decision in non separable way, which in turn confirms the fact that in post reform period farmers are faced with imperfect markets. This highlights the importance of household non tradables in making production and consumption decisions of rural households.

This study developed the village social accounting matrix which in quantitative way demonstrated the heterogeneity of rural households and numerous inter household linkages that exist in local economy. The distinctive feature of the village SAM used in this study is in incorporation of the local markets and accounting for non separability of rural households.

The underdevelopment of the rural sector in Kyrgyzstan is argued to be very much related to the spatial dimension of the rural areas i.e. lack of access: to markets; technology; external inputs; capital and limited labor opportunities. Based on this, it is argued that appropriate rural strategies should involve as central element the easing geographical and access constraints.

The study employed the village computable general equilibrium (CGE) model to study the potential effects of the rural policies. It is argued that in the presence of the local interactions between different farm households, the village CGE modeling approach yields consistent picture of the production and consumption behavior.

The policy simulation runs showed the impact of policy measures on the levels of production, income, marketed sale and home consumption. The results seem to provide support to the policies that aim at improving access to credit, making financial resources available for increase of household capital stock and at improving access to better technologies, thus increasing the agricultural productivity of the households. These policies produced better outcome in terms of production and income growth, while equally benefiting all household groups. In large extent the findings highlight those factors that are more constraining and critical to village development (e.g. credit, capital and new technologies). At the same time, other studied policy instruments like reduction of transaction costs, external input price subsidies and expansion of labor opportunities are also highly relevant for the village development, but involve large trade offs in terms of marketed production and differential income gains for different household groups.

It is believed that these findings would contribute to the efforts of identifying the key development pathways and sectoral investment priorities that help to launch the village economy and rural sector of Kyrgyzstan in the direction of sustainable development.

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1 Introduction: Agricultural reforms and problems in Kyrgyzstan; Motivation of the study

This is an introductory and overview chapter. The starting point is the overview of the agricultural reform process in Kyrgyzstan. One of the main results of the reforms is emergence of the new type of farming system based on independent private farmers as main agricultural production unit. The conclusion derived from observing the farmers in the post reform era is that they face a great deal of constraints, entailing poverty and underdevelopment in rural areas. The elimination of the state regulated agricultural system was not followed by market formation to replace the old system. Market and coordination failures are distinct phenomena that characterize the post reform rural areas in transition. In this chapter we overview on theoretical level the issues related to market failures. This has dual purpose. First to understand the problems that prevent rural development in Kyrgyzstan and second to motivate policy interventions and analytical policy study. Finally, we explicitly state research objectives and research framework of this study.

1.1 Agricultural reforms in Kyrgyzstan

About 7 % of approximately 198 500 sq. km. of land area in Kyrgyzstan is arable and 80% of the arable land is irrigated. Kyrgyzstan is predominantly mountainous country, crop production is mainly located in limited number of valleys, and most of the land below 1500 meters above the sea level is cultivated (McKinney, 2006). In terms of agro-ecological zones, there are two distinct regions: North with continental climate where mostly grain is grown on a large scale and South with milder climate where crops like tobacco and cotton are cultivated on industrial scale.

Historically, the Kyrgyz people led a nomadic life and only under the Soviet regime the republic started to develop modern agriculture, this coupled with its climatic conditions and mountainous level of elevation demonstrated the republic's advantage in livestock rather than in plant production (*Kyrgyz Republic: Livestock Sector Review*, 2005).

Despite heavy reliance on industrialization in the Soviet development policies, compared to other republics of the Soviet Union, the Kyrgyz Republic was less industrialized, less developed with higher level of poverty in pre independence years (reaching 27% of population measured by wage poverty (Babu, 2006)).

In pre-independent Kyrgyzstan 62 % of the population resided in rural areas and 35 % of the labor force was employed in agricultural sector. Thus, the agricultural sector was always a sector of high importance. Before 1991, a third of country's GDP originated from agriculture, half of the republic's export was agricultural (mainly wool, meat, cotton and silk, fruits and veggies). The Republic was specializing in livestock, which accounted for 65% of all agricultural output. Livestock numbers included 10 million sheep and goats, 1.2 million cattle, and 0.3 million horses (*Kyrgyz Republic Agricultural Policy Update, Sustaining Pro-poor Rural Growth: Emerging Challenges for Government and Donors*, 2004).

Major organizational units in rural sector were collective and state farms established in the 1930-40s, they incorporated the function of agricultural producers (with state ownership of land and all productive assets) as well as social and administrative functions in the rural areas. Just before independence, there were 265 state farms with average land holding of 30 thousand ha and 179 collective farms with average land holding of 40 thousand ha in Kyrgyzstan (generally, there were no major differences between the two). Typical state farms included two or three villages, but not all residents worked in collective farms, about half of the population was employed off farm, and 20 % of on farm employment was administrative.

In soviet times the agriculture sector was heavily subsidized and mechanized. Like in other sectors of soviet economy, the production activity in agriculture was centrally planned and plans were strictly enforced. Rigid vertical integration of agro-food system in production and sale of output meant reliance on the whole chain of marketing and central supply of inputs for agricultural production. In terms of trade, 90% of markets for Kyrgyz output were in other former Soviet Union (FSU) countries, indicating the importance of republic's specialization and central coordination of production and trade.

Even long before independence and the start of the wide spectrum reforms in the Republic, it was evident that agricultural sector was not very efficient and was not achieving its targets on demand for agricultural products. The soviet statistics of those years were pointing to the high cost of agricultural production in Kyrgyzstan compared to other republics of FSU. Collective farms were inefficient because of agency and free rider problems - the types of externalities when supervision is inherently weak (unenforceable) and there were incentives for workers to shirk.
Food shortages were common, productivity levels were low compared to other countries, despite high level of mechanization and fertilization, and losses in output at all stages of production and realization were systematic and high. The alleged advantages of economies of scale of large state farms were outweighed by absence of motivation and interest on part of the members of the state farms, absence of independence in decision making, absence of entrepreneurship of large farms and their management.
As a result the reforms in the sector were needed long before 1990s and especially so in terms of incentives structure.

Kyrgyzstan's specialization in livestock: sheep and wool was heavily supported by out of republic supply of fodder and grain. Generally, every republic had its role in soviet inter republican labor division system, reflecting comparative advantages of every republic and resulting in limited number of crops grown. Consumption needs were met by inter republican trade. For the Kyrgyz Republic this also implied severe dependence on import of foodstuff and consumer goods from other republics and countries.

The political freedom for Kyrgyzstan, in the form of collapse of USSR, came unexpectedly; it was not fought for nor demanded and even less prepared for. Political break up led to de facto independence, including economic one which meant for underdeveloped republic like Kyrgyzstan the cease of investment and development assistance inflows for which the republic was greatly reliant (up to 20% of GDP was in form of development assistance from Moscow). Dismantling the political system meant

rooting out everything that was associated with communist party rule: the planned economy and collective farms.
The worsening of the economic situation in agricultural sector led to whole array of problems starting with rural-urban migration and food insecurity of the country. As the Republic lacked resources to provide for basic needs relying on discredited old planned-normative system, it was compelled to end the state monopoly and stimulate private sector development i.e. introduce the whole new system, by destructing the old one. To the extent that natural resources determine the political economy of reform, Kyrgyzstan as a resource poor country with no exportable cash crops or mineral resources was not motivated to hold on to the old political and planned economic system.

It is important to describe the complexity of the background of that time against which the reforms were unfolding and were shaped by. New economic strategy of central soviet government included as its central element the price liberalization, which brought about the hyperinflation in the whole ruble zone (which included all former USSR republics). As economic crises erupted, the payment mechanism between republics broke down, the Kyrgyz Republic was losing its traditional export markets, and transfers from Moscow dwindled down. Terms of trade for the Republic quickly worsened, as prices for oil, gas and coal increased while republic was heavily energy import dependent. These manifold shocks naturally led to deep and unprecedented economic crisis, which reduced the power and capacity of the republic's government to stick with central control in regulating the republic's economy. Agricultural sector was directly affected by volatile macro conditions so that agricultural output and rural incomes collapsed by 30 % of pre independence level in the first years of reforms.

Those conditions laid the basis for motivating the agricultural reforms in Kyrgyzstan.
While there was consensus that reforms were needed, it was hotly debated on how to go ahead with agricultural reforms. On the one hand, the then existing management of collective farms argued for preserving the old regulatory structure but correcting some inefficiencies of large state farms, by introducing more competition. On the other hand, based on observations from western countries and support of international donors the government felt for need of more efficiency based on totally new liberalized system. Market economy became an overriding objective, market economy which is based on private ownership and which ensures the most efficient use of assets and allocation of goods, at least theoretically. Efficiency was a driving factor of reform rationale - reforms were preoccupied with a theory that farmerization and private ownership would lead to more efficiency as the independent farmers shrug off the inefficiencies of collective farms.

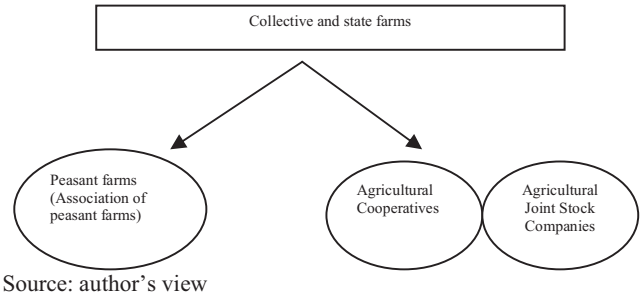
The directors of the collective farms kept arguing for maintaining the state ownership and re-orientation of large collective farms towards new needs and demands of the changing political and economic reality. They argued for economy of scale and the need for less destruction of then existed system. Opposing camp, among them was then Minister of Agriculture, proposed the radical strategy of full farmerization, as the most efficient system, citing the example of Norway with 80 thousand farmers who provided food security for the whole country. The so called "shock therapy" was favored, with full fledged privatization and liberalization of economic relations, including complete elimination of the state agricultural support system together with state regulation (state

involvement). They argued that with no sufficient local supply/input base in Kyrgyzstan (fertilizers, fuel, and mechanization) as well as with reliance on government's subsidies the large farms were not viable in the new reality of the fast changing economy. Whereas, private independent farmers would be much more flexible and efficient in agricultural production, with more private investment, better crop mix and responsiveness to market signals, i.e. prices, as was perceived from experience of western countries.
According to government publications of those years, agricultural reforms had to be implemented gradually. Without destruction of profitable large collective farms, the remaining inefficient farms had to be dissolved and their land was to be distributed on competitive basis to new farms and cooperatives, which should prove and demonstrate their capabilities as professional farmers to the local authorities.

Unlike in other agricultural reforming countries (e.g. China), the agricultural reforms in Kyrgyzstan were launched not with land reform, but with the efforts to restructure the inefficient large collective farms. This restructuring was done on paper, as a result, in the first years of reforms, the farm structure changed a little and management retained its positions- farms continued to produce in the way the collective farms used to do it for decades. At that stage, reforms were largely superficial reflecting the resistance of large farm directors and uncertainties of macro-economic turmoil. Reform policies were difficult to implement due to lack of experience and weak enforceability and as system still favored the big farms (in terms of provision credit, input etc.) thus discouraging the independent private farmers.

Persistently state collective farms coexisted with few emerging independent farmers who got the land on a long term lease. Independent farmers were disadvantaged, as they got land of worse quality, and it required to go through endless bureaucratic procedures to establish an independent business, where officials decided on how much land to allocate. This of course was detriment to success of independent farming. Superficial reforms, which allowed for independent farming but not for private ownership of land, could not change the situations and state farms still dominated the agricultural sector in 1991-1993.
As Kyrgyzstan introduced its own currency in 1993, it was free and able to carry out its own independent economic policies. The agrarian reforms received new impetus in the form of introduction of land reforms - new legislation was advanced allowing for 49 years lease (later to 99 year lease) of land and freedom to become a farmer to any national of the Kyrgyz Republic. Collective farms at that time had to be mandatorily restructured, via division into peasant farms and association of peasant farms or reorganizing into agricultural joint stock companies and cooperatives, as shown in Figure 1 below.

Figure 1: Scheme of collective farm restructuring process



Source: author's view

With galloping mass privatization in other countries of the former Soviet Union, privatization also became an overriding objective of the Kyrgyz government. The privatization accelerated in agricultural sector as well, where the policies were understood to mean the elimination of the state farms and fragmenting the large farms into the numerous independent farmers. The smaller farming units were created by distributing shares of the land and of non land assets to all rural residents and the collective farm workers with fragmented land holding of the collective farms' land.
According to legislation of those years, the rural shareholders were to choose either to leave their shares in large reorganized (into Joint Stock Company or cooperatives) farms or withdraw their shares to become independent farmers. In reality, large reorganized farms were no different than collective farms with the same mode of operation and no change in incentive structure. By the end of 1994 the number of peasant farmers reached the level of 20 thousand farms, controlling only 8% of the arable land, who in the absence of affordable inputs for large sale agricultural production were quickly falling into subsistence production (Bloch, 1996).

The critics of reforms at that time indicated that reforms were producing only the quantity of farms but not the quality of farmers/production and thus the state should revise its strategy or impose the strict examination of the new farmers in order to filter out the most viable and professional entrepreneurs. The pro reformers reacted against the revisionism and subjective approach of examination and argued that the reforms should proceed in a way to allow for the private ownership of land and giving the way to free trade, which will bring about the market institutions and naturally filter out the professional farmers.

Most of large state farms were highly indebted and as government promised to write off the debt for fast reorganization, the restructuring was gaining momentum. The opposite was true for reforms in land ownership. As international experience show, land reform is a prerequisite for deep agrarian reforms. Plain restructuring and privatization of state assets as was done in the industrial sector of the Republic's economy and service sector would not be enough to change the system in agriculture. In agriculture the main asset is land and without private ownership of land it is difficult to expect the emergence of efficient independent farmers. The road to private ownership in Kyrgyzstan started with introduction of land user right ownership, with possibility to inherit, sell, etc the land. However, the institutional basis for land transactions were absent and thus de facto land was still not an asset worth investing in.

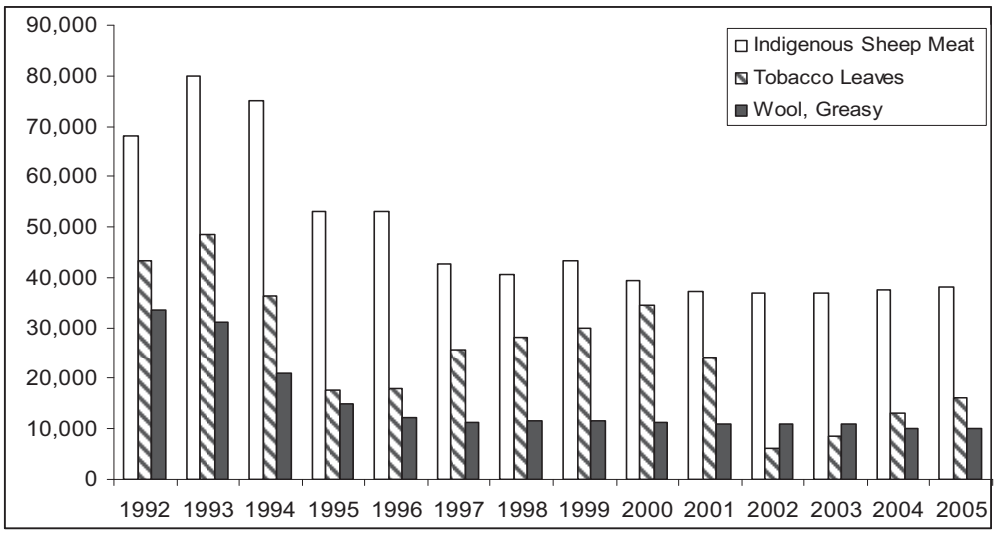
Nevertheless, one of the biggest, but veiled predicaments in initially institutionalizing the private ownership of land was the issue of nationality/ ethnicity in the use of land. Historically, ethnically Kyrgyz people were nomadic and preferred nomadic life, as they were not settling down for a long time the best and fertile land on south and north was used and cultivated by other nationalities/ ethnicities (Russians, Uzbek and some Muslim Chinese). Thus, if the land was quickly to be distributed to those who lived and used the land, then land would have gone to non Kyrgyz population. Reflection of those fears was creation of the Fund for National Entrepreneurship and Land with a purpose of ensuring that Kyrgyz populace and farmers receive the state protection.

It could be argued that only after the large scale out-migration of non Kyrgyz during the 1993-2000, the reservations that land might end up in hands of non Kyrgyz receded and it

became possible to introduce the private ownership of land in year 2000 with introduction and adoption of new Land Code.

Thus the agrarian reforms proceeded in several distinct stages. Initially, with radical political changes in the USSR, with disintegration of backward and forward linkages of the Soviet economy, with problem of conceptualizing the reforms and deciding on land ownership the reforms saw a slow start. Agricultural output and livestock numbers declined and productivity levels were falling. The Republic turned to produce food crops such as wheat, potatoes for internal use in pursuance of food self sufficiency strategy. The second stage coincided with macro stability, after 1995, the reform efforts took off. By the end of 1996, there were more than 23 thousand independent peasant farmers with average landholding of 6-10 Ha occupying more than half of all arable land in republic. Since then agricultural output, as well as productivity levels started the slow recovery. Finally, the third stage of reforms emerged with introduction of the private ownership of agricultural land and conclusion of restructuring of old farms and distributing all arable land in 2002 (except for 25% of Land Fund and pastures, which continue to remain in state property) (Childress, 2000). However, agricultural production was not stable showing great variability and vulnerability to all sorts of shocks.

Figure 2: Dynamics of the agricultural production in Kyrgyzstan (meat, tobacco, wool)

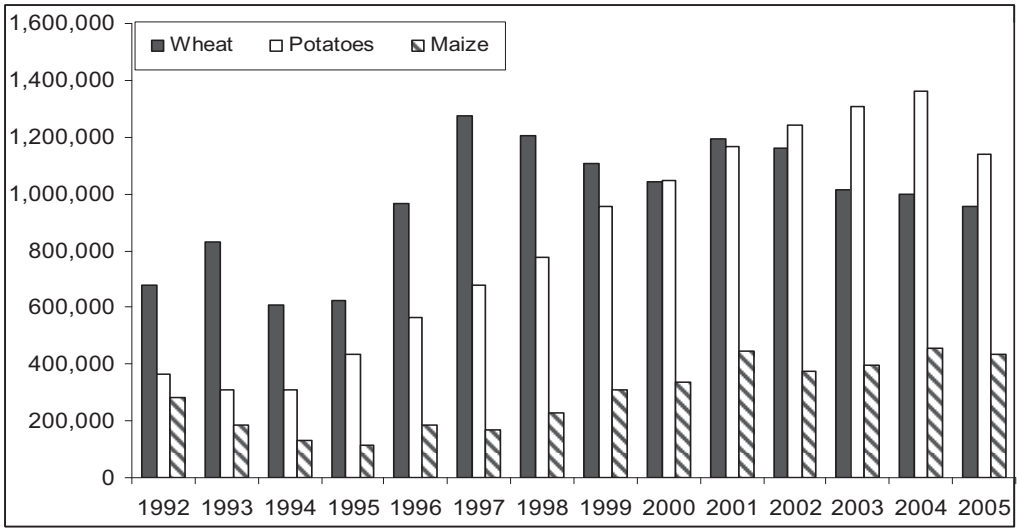


Source: FAO country statistics

Overall, the essence of reforms in agriculture boiled down to collective farm restructuring and large scale privatization of their assets including land. As a result, the new agricultural structure were created mainly consisting of the independent peasant farmers (250 thousand fragmented private farms, who hold 75 % of arable land (World Bank, 2004) with average land holdings of 10 Ha and with heterogeneous levels of asset holdings (land, livestock, machinery, management). Some statistical observations (Childress, 2003) show that there are wide variations in terms of farm characteristics. For example, new farms range from very small 2-4 Ha land and 4-6 member farms to very large farms with landholding of 1000-2000 Ha and membership of several hundreds.

During transition, the crop production shifted from fodder towards staple food, reflecting the shift to the strategy of food self sufficiency, in response to collapse of trade, e.g. wheat production increased by 170 % of pre independence period. Whereas, the subsidies reduction and fodder unavailability required the adjustment of livestock from 10.5 million heads of sheep in 1990, to about 4 million heads in 1998 (Mudahar, 1998).

Figure 3: Dynamics of the agricultural production in Kyrgyzstan (wheat, potato, maize)

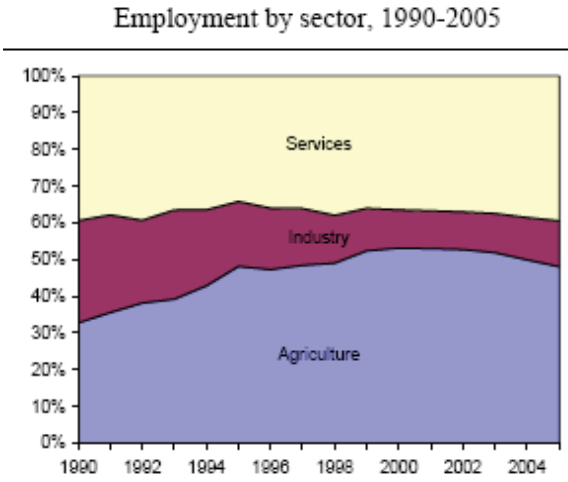


Source: FAO country statistics

Land distribution, based on family size and number of working years in state farm, was not without problems but to a large extent was fair and egalitarian. It is difficult to say the same for the distribution of non divisible assets such as equipment, machinery, buildings etc. These either were left in large agricultural farms or went to former state farm elite: management and well connected workers. So many new smaller farmers left with no sufficient machinery, even fewer possessed the necessary human and social capital: entrepreneurial and technical skills, network of connections. The lack of knowledge of agronomy of agricultural production is very important problem as former truck drivers and accountants of state farms became the private land owners and cultivators with limited specific agricultural knowledge.

As a result of the reforms, the use of labor in agricultural sector of Kyrgyzstan had increased: in pre reform period, agriculture employed the third of workforce, whereas by 2005 it accounted for half of working population, see figure 4. Although, the reforms were accompanied by reduction in output, the growth in agricultural labor force could be explained by two effects: first input substitution effect- as labor was released from large farms and wages were low, the prices for capital inputs soared high, causing increase in labor demand. Second, in the context shrinking industry sector the agriculture provided the alternative livelihood strategies and some urban population may have had opted for land farming. In 2002, land per worker was 1.16 Ha, 25% below 1995 levels and 53% below 1990 levels (Mudahar, 1998).

Figure 4: Rise in agricultural employment level during transition in Kyrgyzstan



Source: adapted from World Bank Report, 2005

At the same time, many young people migrated out from agriculture in search for better opportunities, especially in foreign countries such as Russia and Kazakhstan with their booming economies and construction sector. This trend changed the structure of rural population and contributed to the outflow of skilled labor.
Labor intensiveness of agriculture in Kyrgyzstan has two main implications: first, it reduced the labor productivity during the reform period and also it points to some advantages of small scale farming, which is inherently labor intensive.

Within the short time span of just 6-8 years (1995-2002), the large collective farms were replaced by smallholdings. Over time some farmers had increased their holdings, while others leased their land and gone to work in limited non farm sector. In some rare cases, farmers with adjoining land holdings begun to organize themselves into agricultural cooperatives.

1.1.1 Problems of the independent farmers in post reform era

Rate of growth in agricultural output was negative in the first stages of reform, 1990-1996 with average decrease in rate of 5% annually, while the second stage of reform, 1996-2000, was marked by average annual growth in output of 6% (*Kyrgyz Republic Agricultural Policy Update, Sustaining Pro-poor Rural Growth: Emerging Challenges for Government and Donors*, 2004). At the same time, the agricultural sector after reforms shows the low levels of productivity, profitability and tendency to retreat to subsistence farming. Despite drastic liberalization policies and deep reforms, the growth rates in agricultural sector in Kyrgyzstan are low and unstable.
Looking at the current conditions in which new class of independent farmers work reveals numerous constraints and problems, impairing their ability for commercial production and thus for ensuring food security for the whole country.

Generally speaking, the reforms were destructive, failing to foresee the evident outcomes and lacking consistency. Nothing was introduced in exchange/substitution for complete withdrawal of the state support and elimination of the main institutions in the rural areas,

as well as elsewhere in the economy. The untested beliefs (fed by massive technical assistance from foreign donors, like IMF, World Bank etc) that abolishment of the state controls will give way to the emergence of the markets and private system capable of stimulating more efficient production simply did not materialize. At best, the new agricultural market-oriented systems of allocation and exchange are developing very slowly and there is no assurance of their effectiveness. Change in policy ideology aiming at the liberalization and reduction in state intervention led to economy wide institutional weakness. As the state was in crises itself it failed to lead the creation of new institutions, thus multiplying the risks and uncertainties of a transition. The state's fiscal budget was in deficit and authorities considerably reduced the important public investments in public goods in the sector. The absence of institutions, markets in the context of absence of investment lead to high transaction costs and market failures, thus depressing the agricultural activities and rural economies (Dorward et al., 2004).

Observations show that assets received by new farmers are wearing out and in many cases require substantial repairs or replacement. Funds to repair and replace equipment, buildings and livestock are extremely costly to acquire through the financial sector. Credits are expensive with interest rate reaching 26% p.a. and capital markets are not geared for small farmers. The commercial banks are unwilling, based on high risks and low return of agricultural sector, to provide loans to private farmers, thus preventing them to break (seasonal) cash constraints and invest in more capital intensive technologies. In turn, the farmers are getting caught in risk and low asset traps, as farmers are unwilling to accept the high risks and low returns which prevent them from generating/ finding the investments. Thus while initially the shocks of transition adversely impacted the agricultural sector, later those died out and the low investment and dismal state of rural infrastructure played the main roles in the problems of the sector. With no capital investments it is difficult to achieve the much needed growth in the sector.

It is not disputable whether it was needed and/or possible to sustain the old system of agricultural organization and production, but it is debatable whether the current situation is socially optimal and contributes to the poverty reduction and food security objectives. Theoretically, the privatization itself creates the environment for efficiency, but this is only necessary not a sufficient condition. Improvement in agricultural productivity and incomes critically related to the existence of input and output markets, public investment in public infrastructure, private-public cooperation in infrastructural projects, creation of financial and insurance mechanisms for small farmers.

In words of Spoor (2004) what happened in Kyrgyzstan was: *"…the elimination of the old Soviet system of social organization created a vacuum, which has still not been filled in many places. Transport infrastructure collapsed, property rights were not clearly defined, market outlets became uncertain, credit was unavailable, and new market institutions, such as standardization, contract legislation and enforcement, and insurance had not yet developed. Local and regional administrations had little capacity to stimulate change, while central governments were more focused on the macroeconomy, on specific sectors such as oil and gas and the improvement of urban infrastructure."*

The agro-processing business remains very weak and inadequate. Hostile business environment with high taxes, lack of investment and management capacities, low returns

and demands limit the emergence of processing enterprises, which in turn reduces demand for agricultural sector and impairs the export potential of agricultural commodities.

The key issue for post reform farmers is inability to make productive use of their land and other resources. The current main challenge is to survive and maintain the production under the adverse economic conditions of transition. And limitations to profitable farm operation are numerous. Agricultural machinery, working capital and access to markets are limited. The fertilizers, pesticides and veterinary services are no longer affordable and accessible. Since beginning of reform, the application of fertilizers and organic manure has drastically declined, with fertilizer use plunging from 490 thousand tons in 1990 to 16 thousand tons in 1996 i.e. 100% reduction and it is not recovering. After reforms, the agricultural production became more risky activity than before, not only is it susceptible to whether conditions, but dismal state of infrastructure and collapse of centrally planned activities like provision of quality seeds, timely vaccination, maintenance of drainage and irrigation infrastructure resulted in more frequent occurrences of animal disease outbreaks and crop failures. This is coupled with the lack of means to insure the agricultural risks. Inefficient land management due to lack of farming knowledge and crumbling rural infrastructure led to deteriorating land quality/problems (water lagging, erosion etc) and soil nutrient depletion (McKinney, 2006).

Overall, this has resulted in a decline in soil fertility and yields, characterized by *"downward spiral of declining output, worsening productivity, retreat in self-sufficiency and falling earnings"* (World Bank, 2004). Thus agricultural growth will be impossible to achieve without institutional development of rural service sectors, markets and increase in public and private investments, which presumes the more active role for the state.

One can conclude that, in large, agricultural reforms took place in the context of the broader macroeconomic and macro political reforms, with implications that agricultural policies has been primarily dictated by macro policies, thus little explicit concerns were directed to agriculture, rural development and poverty. The dominant paradigm of development was orthodoxy of “Washington Consensus”, the neoliberal view centered around free markets. The structural adjustment loans from IMF , WB and others were strictly conditioned to radical economic reforms that included as its core economic (and sometimes political) liberalization and retrenchment of state from economic affairs. As a result the public measures in agricultural sector have been downsized to level below minimum during the transition period.

1.1.2 Rural poverty and households

As a result of economic contraction and severe crisis, naturally the poverty levels in the first decade of transition increased dramatically, from about 29% before 1990 to the level of 55% in 1999 (*Kyrgyz Republic Poverty Update*, 2005). However, as the economy stabilized and showed signs of recovery the poverty levels had been brought down, between 1998 and 2003 from 60% to 47% in rural areas. As World Bank Report (2004) puts it : *“Agricultural growth and the land reform program was pro-poor since the gains in land holdings, agricultural sales and food consumption were substantially higher for poorer households, helping many of them to “graduate” to higher income quintiles by*

2002". Between 2003 and 2005 the rural poverty levels continued to decline albeit at slower rate, from 57% to 51%. In addition to redistribution of agricultural assets in favor of the poor, increased out migration and thus increased remittances played the considerable role in reducing the poverty levels in rural areas (it is estimated that there are 300 to 500 thousands of Kyrgyz migrants in Russia, Kazakhstan, sending back between the estimated 500 and 800 million of USD annually).

Despite the past reduction in poverty, rural poverty is very high, 51% versus 30% in urban areas, with 14% of rural households in category of severely poor who could not meet their basic needs. Three out of four poorest reside in rural area, thus poverty remains the phenomenon disproportionally affecting the rural Kyrgyzstan. Rural poor have lower access to water supply, to living amenities (gas, telephone, etc) and have less durables in possession.

Profiling the rural poor shows that majority (60 %) of poor work in agriculture whereas only 40 % of those who are employed in non farm sector are poor. In non farm rural sector: commercial services and public services, work only 30% of rural population. Given that agricultural sector is very labor intensive, it also experiences underemployment- huge slack of labor, especially seasonal. This is indicative of limited opportunities in off farm sector in rural areas as well as in urban areas. Not surprisingly, the poor rural households are the ones with larger number of members and lower educational attainment.

The same report revealed that in terms of rural income the most important source is wage earnings, whereas more than half of households also engaged in agricultural sales (crop and livestock), and both rich and poor households supplement income by various transfers. Thus rural households in Kyrgyzstan pursue mixed strategies diversifying the income sources.

More than 90% of rural households have access to land, though the land holdings likely to be small, less than 2 Ha, especially in South. The poor rural households tend to have smaller land holding averaging 1.8 Ha than non poor rural counterparts, who on average own 2.8 Ha of land plot.

Table 1: Distribution of land holding in the Kyrgyz Republic (%, 2005)

Region	Land Area				
	0 Ha	>0, <2 Ha	>2, <5 Ha	>5, <12 Ha	<12 Ha
Country	4	81	12	2	0.5
North	6	73	18	3	0.6
South	3	87	8	1	0.5

Source: adapted from World Bank Poverty Report, 2005

The small land holdings are characteristic of livestock holding. More than half of rural households have on average 2.7 cattle and 12 ruminant heads. In view of the fact that livestock has low profit margin, that activity is mostly for cash and risk management purposes.

Table 2: Distribution of cattle and small ruminants in the Kyrgyz Republic, by regions (%, 2003)

Region	Cattle				
	0 head	1 Head	2-6 Heads	7-11 Heads	> 11 Heads
Country	51	15	33	0.8	0.6
North	56	17	24	1	1
South	46	13	40	0.6	0.4

Region	Small ruminants				
	0 head	1-9 Heads	10-24 Heads	25-59 Heads	> 59 Heads
Country	67	17	12	3.2	0.5
North	72	14	11	2.3	0.5
South	64	20	12	3.8	0.6

Source: adapted from World Bank Poverty Report, 2005

Another feature of the rural household which emerged from the surveys is low access to capital. Farm machinery, such as tractors and mechanization tools is scares; only 3% of rural households report such assets. As less than 25% of rural households accessed the credit, the funds were predominantly used for consumption, not for capital investment.

Growing number of rural population report out migration as a resort from falling into poverty. Third of rural households has members migrated to neighboring richer countries, mostly to Russia and Kazakhstan, thus implying greater reliance on remittances in their livelihoods.

1.2 Market and coordination failures, poverty traps and state intervention

The review of the rural sector in post reform period reveals several important characteristics of the rural economy that influence the theoretical and empirical analysis of agricultural sector in Kyrgyzstan.

First and foremost the farmers do not face well functioning markets. The issue of market failures needs to be taken into account for our analysis. The economic reality in post reform Kyrgyzstan is that incomplete, imperfect, thin markets are more norm than exception. The erroneous conclusions might be drawn if one applies the neoclassical approach with perfect markets assumption for policy analysis of imperfect markets.

In Kyrgyzstan with the state abandoning the sector, failing infrastructure and geographical isolation of the rural sector, the transaction costs increased considerably. Along with information asymmetry and poor contract enforcement, these departures from neoclassical assumptions lead to market failures - absence or weakness of institutions that supposed to coordinate marketing and exchange functions and link the producers and markets, resulting in limited, at best localized, markets with little market transactions. In such environment rural households tend to be subsistence oriented and shy away from markets ensuring only own food security. Embedded in market failures are risk aversion and lack of investment which eventually lead to low returns and low levels of productive assets.

The setting in the rural sector of post reform era in Kyrgyzstan is exactly such that there are conditions for rural households to fall into persistent poverty trap. In other words, the answers to the question: "who in Kyrgyzstan is structurally prone to experience persistent poverty?" point directly to the rural households. In this regard, we provide a brief discussion of how the low asset endowments of the Kyrgyz farmers coupled with market imperfections associated with transition period, predispose the rural households to fall into the chronic poverty.

The economics of poverty traps assumes multiple equilibriums in the context of missing (financial) markets and fixed cost of productive investments. In essence, this is a model of capital asset accumulation, with different production technologies and the credit constraints. The fundamental idea of trap is that poverty perpetuates itself preventing the household from accumulating investment for growth, which in turn is a result of local multiple equilibriums and threshold levels of capital in the dynamic setting (Barrett, 2005).

The poverty trap works itself through different forms of rural household endowments, e.g. nutrition, health, education, social network, access to infrastructure, geography, physical capital. Increasing return to capital implies that there is a positive relation between level of assets and returns to assets. So there might exist two technologies of production: with low returns and with higher returns, but requiring the minimum level of investment. Both production technologies are concave (exhibiting diminishing returns), but the rural households with capital of less than minimum would choose the low return technology and thus gravitate to low level of equilibrium, whereas those rural households with capital above minimum would end up at higher level equilibrium-higher income level. The low level equilibrium would be optimal for household with low return technology, because there is increasing returns in the vicinity of minimum level of required investment, thus driving the household to low equilibrium.

With credit market failure, the poor household would never be able to borrow and jump to the high production technology. As a result the asset-poor households will be trapped with the low return technology at or around the lower steady state. Autarkic saving strategy may not be feasible for poor households as that would require the diminished consumption which by virtue of being poor and not allowing the minimum consumption is not viable.

The presence of market failures in post reform rural system of Kyrgyzstan and its consequence of the poverty trap have two important implications. First, there are coordination failures that prevent the market formation and second, there is need for state interventions to correct for market failures. But first we need to look into why markets fail and how the coordination problems persist.

Idealized neoclassical picture of complete set of competitive markets gives idealized outcome in terms of efficient allocation by means of prices. In this view, "traditional" market failures are due to increasing returns to scale and possibility of monopolies; existence of public and common goods which are non excludable; and finally existence of externalities. Externalities are effects which influence the utility of other agents by action of some agents; pollution is a classical example of externality. One could think of

implications of market failures in terms of divergence of private rate of returns from those of social. The mainstream neoclassical economics assumes that markets are constantly efficient except for three special cases mentioned above.

However the recent advances in theory of markets with asymmetric information proved that externalities are pervasive, whenever there is imperfect information or imperfect risk markets. Information economics established that assumption of perfect information needed to establish efficiency of market is exceptional rather than common, thus rendering that it is the perfect market which is unique construct whereas the transaction costs and informational asymmetry, which are important at any market and all the time, lead to inefficiencies and market failures. In words of Greenwald and Stiglitz (1986) *"whenever markets are incomplete and /or information is imperfect, even competitive market allocation is not constrained Pareto efficient"*, implying that there is a scope for intervention to improve on situation.

The problems of market formation seriously hamper the development of rural sector in Kyrgyzstan. Social as well as productive infrastructure: roads, communication, irrigation, storage facilities which was transferred from state farms to local authorities due to lack of funds is in collapse. Rural business environment is very unfavorable: high risks and enforcement problems, with no agricultural and financial services and high taxes. There are virtually no input markets and output marketing system suffers from high costs in agricultural sector of Kyrgyzstan. Those problems of farmers are coupled with lack of private investments in rural sector, which further sustain the problems. The theoretical models of underdevelopment point that these problems are rooted in coordination problems, which can be viewed as another factor of market failure.

To introduce the idea of coordination failure, one starts with positing that farms productivity and profitability depend on the one hand on its own endowments, abilities, efforts, macro conditions, and on the other hand on provision of public goods, regulation, infrastructure, and action of other farms and private agents in the economy. Further, if one establishes that there are economies of scale in the markets and spillover effects one can derive the multiplicity of equilibriums. As early as in 1943, Rosenstein-Rodan hypothesized that investment of one agent in the economy might induce the investment from other agents in economy and positively affect the profitability of all agents, under aggregate demand spillovers and economies of scale (Hoff, 2000). So, two equilibriums might be observed under those conditions: 1) low investment and 2) high investment equilibriums. Pareto efficient outcome could be reached at high equilibrium but there is no assurance that market will ensure this. Market outcome would not be efficient one as established under the presence of externality- aggregate demand spillover effect in this example. So concerted efforts i.e. coordination is required to achieve the superior equilibrium if economy is stuck in inferior equilibrium.

It is useful to present slightly modified model of Hoff and Stiglitz (2001), in more formal terms and directly relating to rural sector with characteristic relevant to contemporary Kyrgyz farming system, which illustrates the possibility of multiple equilibriums.

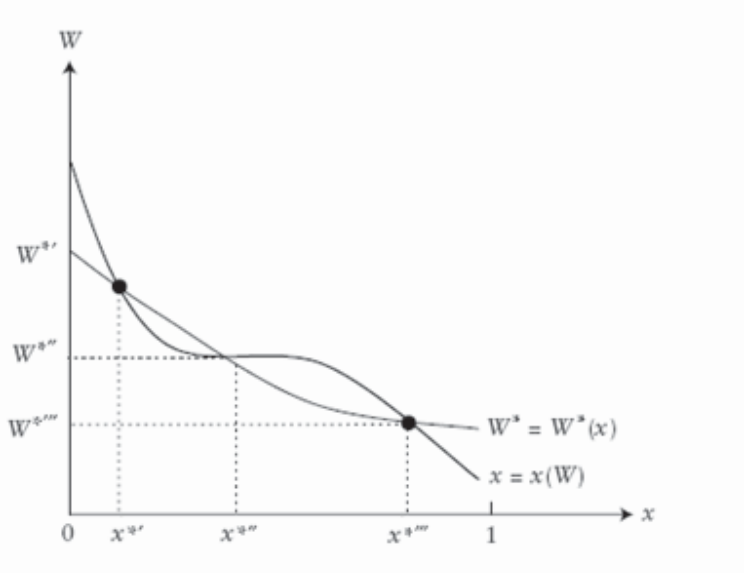
Take rural sector, where there are two ways of livelihood: entrepreneurship (commercial farming) and subsistence farming. As in the case of Kyrgyzstan rural credit is limited and

interest rate is very high reflecting the problems of moral hazards and adverse selection. Thus, the poor farmer will choose to become an entrepreneur only if expected return to more effort of being entrepreneur is high enough to cover the costs of borrowing.
Naturally, a farmer opts for that livelihood strategy which yields him the greater utility in the context of given number *x* of commercial farmers in the rural economy.
We denote the utility of commercial farming as *V*(*e, x, W*) and *V*(*n, x, W*) as utility of subsistence farming, where the *W* is a initial endowment of wealth.
There should be the critical level of wealth *W** such that *V*[*e ,x, W**] = *V*[*n, x, W**], i.e. farmer is indifferent between two strategies at this *W** wealth endowment.

Let us change the *x*- the number of commercial farmer: ↑ *x* then *V*[*e ,x, W**] > *V*[*n ,x, W**], as the larger the number of commercial farmers the higher return to commercial farming (positive complementarities);
Now, change *W* the wealth of farmer: ↓ W then *V*[*e ,x, W**] < *V*[*n ,x, W**], as entrepreneur has to repay the borrowings.
As there are complementarities among commercial farmers, the dynamics entail negative association between *x* and *W*,* there should be some point *W* = W*(x)* with subsistence farming lying below *W** and commercial farming above *W**.

For a given distribution of wealth, there is proportion of *x** whose income exceed *W*:
x = 1-F(W) = x(W)
The simultaneous solution to *W* = W*(x)* and x = *1-F(W) = x(W)* then describes the equilibrium number of commercial farmers, and the associated threshold wealth level, *W**.
Two schedules are downward sloping and intersect at more than one point.

Figure 5: Dual stable equilibria in a model with heterogeneous actors



Source: adapted from Hoff and Stiglitz 2001

Only farmers with wealth in excess of the critical level *W*'* become commercial. If there is small number of commercial farmers *x*'* then positive externalities push the system to the low level and there is incentive for majority to stay there with subsistence farming

and producing low output (with low efforts). The opposite is also true, with more farmers, availing themselves more wealth and moving to commercial farming $x^{*'''}$ the positive spillovers kick in which makes the critical wealth level to fall to $W^{*'''}$ and attainment of high and better point of equilibrium possible, with high efforts and production.

So the model shows how low level of initial wealth endowment can lead to coordination failures in the rural sector.

There is another simple, highly stylized model, which is very pertinent to rural sector of Kyrgyzstan that looks at how the coordination failure might persist along the whole chain from production to marketing and processing of agricultural products.

We take the rural economy, where the profits of farmer, input supplier/trader, processor, and marketing trader depend on respective prices -p, his action to run the business -a_i and action of others- a (along the chain) to run their respective businesses, i.e. $U_i[p(a), a_i, a]$. For given actions of others, say farmer or processor would maximize the profit such that: $u_i^1[p(a), a_i, a] = 0$ with respect to his own actions to run business. This also implies that given others action the farmer or processor cannot obtain a higher pay off by a marginal change in his action to run his business. Whereas the higher level of action by all businesses would translate into higher payoffs for every business, as businesses in rural sector are complements. Intuitively it is clear, that farming is not profitable unless there are traders and marketing system and vice versa, processor would not be interested in investing in equipment/machinery unless there is stable supply from farming etc.
The stable situation is possible with two equilibriums of a^* when nobody takes the decision to run rural business and when all decide to run the business thus benefiting all and each economic actor.

Then if businesses are forward looking, they should, because of higher benefits, follow the rational strategy allowing the move from low to high level equilibrium. However, Hoff and Stiglitz (2001) cite the results of similar theoretical work by Adsera and Ray (1998) with conclusion that: *"If the positive externalities from moving to the more favorable set of activities appear with a time lag (that can be made arbitrarily short), then the final outcome depends entirely on initial conditions unless there is some gain to being the first to switch. To put it another way, without some gain to being among the first to switch, each individual will rationally wait for others to switch first, and so no one will switch at all! Initial conditions will thus determine the entire equilibrium outcome".*

Thus, there is convincing implication and strong case could be built for the state intervention to correct market and coordination failures in order to break unfavorable path development, as failures tend to perpetuate the low level equilibrium, trapping the rural households in the chronic poverty, as our observation of the post reform rural sector confirms.

We discuss the state intervention later in separate section as we make the case for agricultural sector and policies since this deserves the detailed attention. However, next

we focus on the effect transaction costs can have on rural markets and rural household behavior. Apart from being pervasive, the transaction costs are another important reason and instrumental in explaining why markets fail to emerge and at the same time why it is rational for rural households to remain self sufficient (autarkic).

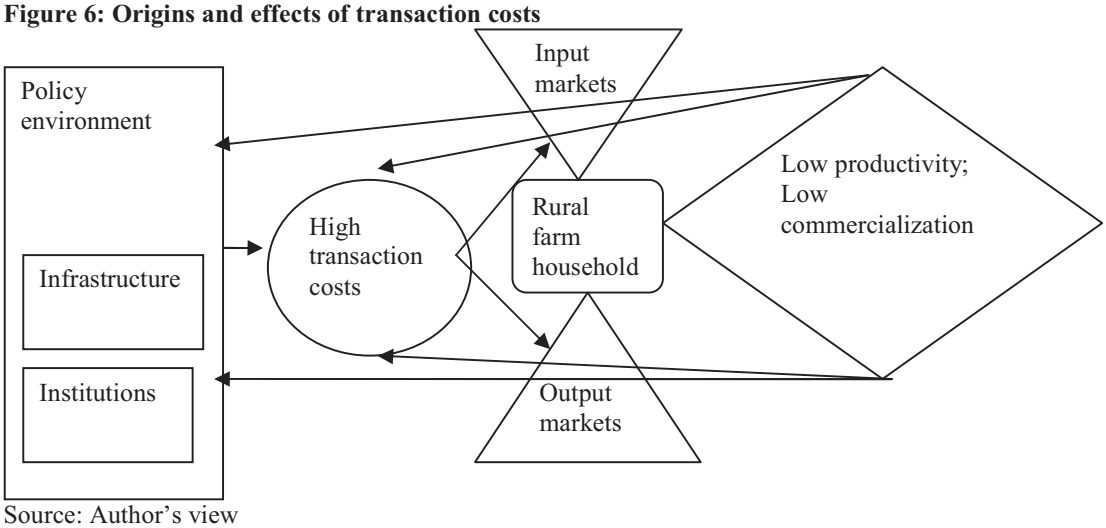
It is easy to draw the relevancy of transaction costs to the case of rural sector in Kyrgyzstan. Largely, destructive reforms left the rural sector of Kyrgyzstan in "institutional vacuum", with crumbled infrastructure and policy neglect; this led to more "isolation" of the rural sector beyond physical remoteness, which is itself the problem for mountainous country like Kyrgyzstan. In that situation the transaction costs are likely to increase and matter significantly.

The transaction costs are generally defined as costs of participation in the market and these costs could be internal to household characteristics such as access to assets as well as same for all households in a given location or sector, such as distance to markets and local infrastructure. Transaction costs are: tangible and intangible, fixed and variable, direct as well as opportunity costs associated with (Eggertson, 1990): the search for information about potential contracting parties and the price and quality of products and resources; the bargaining and negotiation; the contracting i.e. defining the obligations of the contracting parties; the monitoring of contractual partners, co-ordination, and enforcement of contracts. In general, everything, which farmer incurs in terms of information and facilitating the transaction are the transaction costs, meaning that they might be observable (e.g. transportation) as well as not observable (e.g. risks perception, uncertainties and obtaining information).

As the concept of transaction costs makes it clear the origins of these costs are in information inefficiencies and institutional problems. The latter encompasses the poor provision of public goods, poor infrastructure, and weak contract enforcement and coordination problems. As reflected in low market participation of Kyrgyz farmers, with trade to production ratio of only 30 %, the compelling case of high transaction costs could be applied to rural sector in Kyrgyzstan, where the costs stem from sheer distance to the input and output markets, coupled with the collapsed infrastructure, poor access to assets and information.
The manifestation of transaction costs is in difference or gap, between perceived buying and selling prices of agricultural product or factor. With transaction costs potential farmers-sellers might observe the low selling price and thus sale would not occur, whereas potential buyers get exposed to the high buying price and become discouraged to buy. The result is that market fails when the cost of a transaction through market exchange creates a disutility greater than the utility gain that it produces (de Janvry et al, 1991). Simply put, farmers will not use the market and will not enter market transaction (exchange will not take place) when the value of participating is outweighed by the costs of undertaking the transaction (Sadoulet and de Janvry 1995).

High transaction costs elucidated the possibility of market failure in a number of studies and markets: in credit markets, in labor markets, in land markets and in output markets.

Figure 6: Origins and effects of transaction costs



Source: Author's view

We cite Omamo (1998) to describe the effects of transaction costs: *"The higher are unit transaction costs in markets, the more costly are strategies to specialize in production with a view to trading for items in the consumption bundle, and thus the greater is the pressure toward domestic production of some of these items".* The rational response of rural farm household is then to reject the commercialization as a viable strategy in presence of transaction costs large enough to override the benefits of market participation. The notion of transaction costs is broad enough to encompass the uncertainties and risks of agricultural markets. With missing insurance market, high risks and lack of information the rural risk adverse farmers rationally chose to self insure, thus risk factor constitutes the special case of market failure due to high transaction costs when benefits of staying subsistent - self provision of agricultural products offset the potential gains of market participation.

1.2.1 Institutions and underdevelopment

We looked at the mechanics of market failures pertinent to the agricultural sector of Kyrgyzstan on a general theoretical level. The deductive implication of above discussion of market failures is that fundamental reason for underdevelopment, especially in rural areas, is weaknesses or outright absence of market supporting institutions. Transition period, macro and agricultural liberalization reforms completely diminished the role of the government. Resulting institutional gap is largely attributable to the state withdrawal from sector as government agencies were formerly providing the institutional support to rural sector. Contextually, during the reform period in Kyrgyzstan, the agricultural policies seemed to be a passive appendage to more proactive noninterventionist macro policies. Invariably, nowadays as government in many cases even failing to provide public goods and as private and non market institutions are slow or unwilling to emerge, the rural sector of Kyrgyzstan is increasingly exposed to market failures.

Thus it is critical to understand the nature and forces that influence the emergence and evolution of markets, market supporting and non market institutions. This will give us further insights of resolving important market failures that constraint the independent

farmers and more importantly redefining the role of government in agricultural development.

The importance of institutions for economic development received wide recognition relatively recently. Although the role which institutions might play in the economy had been acknowledged as early as in writings of Adam Smith, nevertheless, the only institutions in the neoclassical sense are perfect and complete sets of markets contingent throughout time, space and state of nature. As it is explicitly recognized that most markets are plagued by information and uncertainty problems, there never exist perfect markets in goods, risks and futures, on which the neoclassical economics is based on. In the neoclassical framework there is no place for other institutions, no explanation of evolution of institutions, this contradicted the reality in which the developing countries, like Kyrgyzstan, operate.
The task of endogenizing the institutions within the paradigm of neoclassical economics has been taken up by the "New Institutional Economics", the school of thought that put institutions as an additional constraint for the optimizing economic agent (North, 2005). But what are the institutions, what function do they carry out, how do they change.

Logic of institutions is quite simple: if one starts with autarkic economy where consumption and production is indivisible and then opens up for trade then economy would need the market which also brings improvements in efficiency and productivity. One can view the market itself as an institution which governs the coordination and exchange of the property rights. And if market is imperfect then non market institutions might emerge, in other words the limitation of markets give rise to non market institutions. On the similar note, the emergence of the market is not automatic and there are obstacles and conditions to be fulfilled in order for markets to become operational. Requirements for efficient markets, such as efficient property right enforcement, efficient information flows, developed institutional environment allowing for low risks and low transaction costs, are quite restrictive for transition country like Kyrgyzstan. Implication is that there are might be complementarities between institutions in the process of development, and markets as main institution might need to evolve as element of complex system of other institutions.

Generally, institutions are the formal and informal rules that govern and structure people's interaction and behavior (Williamson, 2000). Institution, as the rule, constrains the behavior of economic agents over certain domain and causes the behavior regularities. On more particular note, it is useful to make a distinction between institutional arrangements, structure and environment. Arrangements are specific rules and contracts, the entirety of arrangements constitute the structure (organizations, laws, customs and ideology) and the context of arrangements form environment (property rights, enforcement mechanisms, power relations, communication infrastructure and informational flows). These three levels of institutions constantly interact and largely produce the institutional change consequently impacting the economic performance.

The institutions at different levels are interdependent meaning that how well one institutional arrangement works, depends critically on emergence and degree of development of other auxiliary institutions, for example institutions preventing or reducing the opportunism. At the same time, it is difficult to make an unambiguous

distinction between institutional arrangements and economic environment as it is possible for one institution to be nested within another thus blurring the criterion. Interactions among institutions might take the form of competition between different arrangements and thus conceivably ensure the survival of most efficient ones. But for this is to occur the evolution has to be frequent and more importantly costless (including in political economy terms). Otherwise there is possibility for institutional rigidity and inertia. To the extent that performance of institution changes radically with subtle changes in surrounding institutions as well as in presence of inertia, the institutional changes might not automatically be beneficial- there is spectrum of possibilities ranging from anti development to pro development paths. And in the end, by influencing transaction costs and co-ordination possibilities, institutions can have the effect of either facilitating or retarding economic growth

On the other hand, economic growth often results in change in institution thus establishing mutual way of influence between development and institutions. In early stages of development, when production is dominated by risks and subsistence factors, the institutions like kinship, communities, tribes might be optimal to ensure low cost of opportunism. Whereas, with more economic development and need for more distant, impersonal trade, exchange and production become more complex thus requiring more complex institutions. Nevertheless, the beneficial institutional changes might be held back by distributional reasons, with an implication that inefficient institutions might persist in the presence of few disadvantaged by changes players.
Institutions may also change because of exogenous factors, for example, international trade and globalization prompt the need for official and internationally recognized grades and standards as a form of new institutions.

The disposition of institutions is in the functions they carry out. Institutions reduce uncertainties and transaction cost in interaction of economic agents. As rules which structure relations, they allow agents to improve their welfare without necessarily making others worse off, by constraining alternative opportunistic actions, by improving information flows, by coordinating transaction i.e. by establishing the rule of action. Like in village economy, with small, closed peasant community the transaction costs are low, whereas due to limited market and possibilities of labor division and specialization the production costs are high allowing only personal- face to face exchange process. In more complex and bigger economy, the network of interactions considerably increase and with it the extent of all sorts of transactions, including the ones that entail larger costs and opportunistic possibilities. As a result, there arises the demand for institutions such as laws, property rights, courts, guarantees, contracts or less conventional arrangements like networks, communities, bonds, social norms which might coexist and influence the efficiency of formal institutions. Some literature points that western industrial countries evolved that way. Technological changes, changes in relative prices and expansion of trade called for more complex institutions which are capable to reduce uncertainties of interactions and preventing transaction costs to be prohibitively high. This in turn led to productivity, efficiency improvements, realization of the gains of the new technology, by facilitating transactions beyond face to face trade, by providing framework of enforceable commitments and coordination. Some of these or all of these institutional structures are absent (failing to emerge) or too weak in transition counties like Kyrgyzstan. Soviet market mechanisms have been quickly disbanded, but new institutions are not able to

emerge on their own, as it happened during the development process of Europe. However, still a lot remains to be researched to find out how and what factor influence the emergence/evolution of efficient institutions, but it is believed that political system, social and cultural factors can play a big role in shaping institutional framework. Many developing countries strive to built or replicate the formal institutions of western countries but the experience of South –East-Asia tells us that decentralized institutional framework of industrial countries may not be the only way. The success of Asian countries may lie in the role of the state that took the responsibility of market creation in more centralized manner. Therefore the discussion of the state and state intervention for development and ensuring conducive institutional framework is in order.

1.2.2 State and interventions

The view of the state's role in economic development has been contrasting over the time. Early interventionists' approaches replaced the minimalist views, which also became a subject to serious criticism. Now one can say that there is general agreement that state needs to provide for macroeconomic stability, fiscal soundness and enforceable legal framework with secure property rights. Beyond this minimum, state policies play important role in provision of public goods and in the cases of the markets with externalities. The main practical dilemma for the state is to find the border line between ensuring the stability and equal economic growth on the one hand and committing itself not to crowd out the private sector and market led growth, on the other hand. Views range from strong but limited states capable of ensuring growth to the states which pursue only special group's interests, and serve as device for bureaucrats and politicians with limited motivation and capacity to spur economic development.

Important characteristic is that state has advantage of imposing the coercive powers and thus state is naturally designed for enforcement functions. At the same time, the problem of imperfect information, which renders that even market equilibrium is not Pareto efficient, also plaques the view of state role in development. There is no *a priory* assumption that state has better information or better equipped than private sector and markets. And even in provision of public goods state lacks the incentives for more quality and less costly provision. As Coase (1960) pointed even in case of externalities with well defined property rights and low cost of negotiations, private bargaining and voluntary negotiations are superior to government interventions.

However, in early stages of development when the markets are incomplete and information imperfections are acute, the complexity of problem is compounded by coordination failure, as we discussed earlier. We identified above how private agents may choose the inward –inferior strategy although there exist outward-superior strategy but which also involves the need for cooperation. Massive investment and breaking the rural constraints are needed for rural development in Kyrgyzstan to take off. Infrastructural investment and investment in emergence of the whole marketing chain, from farm production to output processing and sale are all interdependent i.e. strategically complementary, but very difficult to coordinate. As literature on East Asian experience indicates the state played one of the major role in coordinating the investment and emergence of institutions. State, there, intervened actively in establishing public development banks, allocating regulated credits, provision of guarantees, pooling risks,

stimulating firms and new technology, encouraging investments and production. State facilitated the cooperation and institution by creating the incentives and opportunities for rent (Dorward, et al., 2005).

Let us formally look at the model of rational state which concerned with economic growth and ultimately interested in avoiding the excessive intervention in economy's productive capacity (Woo-Cumings, 1999).
State provide for public goods –infrastructure (G). Private sector provides labor (L), which in combination with G result in national output via standard production function F. As an optimizer, state maximizes net revenue, given by $[\tau F(G,L)-G]$, where τ is tax rate. The private sector decides on amount of L, by maximizing $[(1-\tau)F(G,L)+W(1-L)]$ given τ and G, where W is wage rate in non official economy. So the FOC of the private sector is $(1-\tau)F_2(G,L)-W=0$, with $L^*(\tau,G)$.
The state's objective then is to max $[\tau F(G,L)-G]$ with respect to τ and G, subject to $L=L^\bullet(\tau,G)$. The FOC with respect to τ is $F_2\left(-\frac{\partial L^\bullet}{\partial \tau}\right)\Big/F = 1/\tau$.
With diminishing marginal productivity the expression $\partial L^\bullet/\partial \tau$ is negative and if marginal product of labor increases in G then $\partial L^\bullet/\partial G$ is positive. This means that the state is interested in tax rate less than maximum possible rate and in more infrastructural public goods. Model assumes that state internalizes costs of its action and maximizes its objective given the reaction function of private sector. Thus, the rational and strong state (Stackelberg leader) would intervene in the right amount and in a right way, beyond what minimalist would argue for, encompassing the cases of market and coordination failures in early stages of development. The illustration of rational state that commits to supporting the market and withdraws when market develops is the experience of East Asian countries. Of course it is a big question what makes the state rational and how it evolves to become rational. Again the issues of multiple equilibriums and path dependency are highly pertinent here, as well as political and socio-cultural factors which influence and predispose the state to become an institution that internalizes the cost of its policies and effectively engage in development of private sector such that to maximize the economic growth and private tax base.

Our focus here, however, is to draw the rationale for more active state intervention. The case of Kyrgyzstan is very compelling in this regard. On the one hand, the collapse of the Soviet economic system called for radical changes in the role of state in the economy. The reforms and swift liberalization policies resulted in current dominant paradigm of "laissez faire". This liberalization paradigm limits the scope for state to actively engage in leading the private sector and markets. On the other hand the private sector is too weak, facing imperfect markets and unable to emerge on its own and invest in development of the markets since the latter are too risky and too thin. Together, these trends might eventually lead to stagnation and low level equilibrium with economy stuck in trap, unless the state takes more proactive role and commits to infrastructural investment and supporting rural financial markets, input /output markets, farmers' production, research and extension. State's role then expands from merely minimalist

paradigm to the interventionist function with objective of coordinating and supporting the rural market development, in terms of infrastructure, finance, direct input/output support, reduction of risks etc. The economic development of rural areas from subsistence inward village agriculture to become modern outward oriented sector would inevitably entail the expansion of linkages beyond village to allow access to inputs and market the outputs. The institutional solution to support these linkages needs to come from the state.

The institutional reliance only on competitive markets in early stages of development may seem to be very narrow policy view. When the institutional environment is too weak there may be other non market, non competitive institutional arrangements, with state involvement that are more effective and efficient in promoting rural development. When efficient market mechanisms are difficult to emerge then the state externally might impact the agricultural transformation to a better outcome. Dorward et al. (2004) reviewed the experience with agricultural economic development in recent history and came out with conclusion that conditions for successful rural development such as stable markets and environments for reasonable returns from agriculture, good technologies, financial markets and infrastructure all had to do with a big role for government to play.

In terms of public policy, this view is presented as follows. At initial stages, the interventions are needed to set up infrastructure and basic institutional/legal reforms. As these are in place, the farmers still would not be able to access the input and output markets as well as be influenced by high risks and transaction costs. To kick start the market emergence and growth then, the subsidies and direct state support is needed to alleviate the prohibitive transaction costs. With growth and gaining the critical mass of input demand, output supply, rural credit transactions, non farming activity the markets and other exchange enabling institutions will be able to emerge, sustain and further develop, facilitated by reduction in transaction costs, uncertainties, risks and stabilities in prices and input supply. It is believed that ultimately the growth and local coordination will cumulate to the threshold level from which the private investment along the rural marketing chain kicks in, i.e. it becomes self sustainable. The last and arguably the most important stage is when the government needs to gradually remove itself from supporting the sector, when markets thicken, in direct way and allow the private sector to take over the rural economy. Here, the control and accounting for interrelationship between institutions and agricultural sector illuminate the nature of rural development and provides the framework for the analysis of policy interventions. The theoretical proposition is in terms of the agricultural sector as a part of the economic system with embedded institutions which are still in embryonic and inadequate stage of development thereby leading the system to stagnate. State intervenes are to provide the way for more effective way for mutual growth in institutions and in the rural sector.

This view is highly controversial as reflected in the literature on state interventions. At least two problems may exist with state interventions. First is deadweight cost of these interventions or the government failures and second is an administrative difficulty in managing these interventions.

So in implementing active state policies it is critical to account for these costs and more importantly to adhere to well defined time periods or benchmarks when government needs to withdraw and shift its policies more on environment and promoting conducive

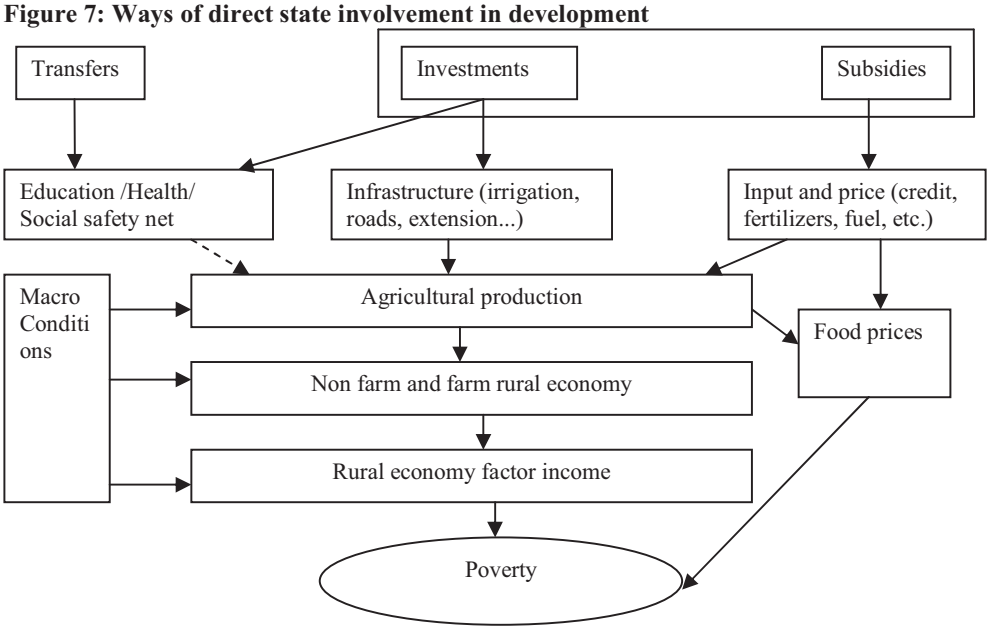
conditions for rural development. Indeed, costs are inevitable, interventions are in many cases are very costly, but the role of the government is in providing the otherwise non existent coordination mechanism for making the sector viable, ensuring higher returns by buffering the risks and providing stability. In this view the role of the government and other non market institutions should not be measured against costs and efficiency. In this, the role of the government is vital and indispensible, more so in early stages when institutions are underdeveloped. So the main problem is then to overcome the inherent state failures of rent seeking, lack of incentives and lack of capacity. In other words, development requires not just any state but the developmentalist state which can be characterized as having competent and insulated economic apparatus, relative autonomy, effective management of non-state economic interests, and repressions, committed and determined development elite (groups) (Leftwich, 1993). Another important factor for materializing the developmentalist state is to adopt the proper development paradigm specific to country, its conditions and history.

At present, Kyrgyzstan is at the crossroads in its development process where it has already implemented the comprehensive programs of economic stabilization and structural adjustments, and is far on the way to making the transition from central planning to market based system of economy. Government has put forward an economic strategy to continue the process of structural changes which is hoped to broaden the base for economic growth.

Although government in its strategy documents formally puts agriculture as a priority sector, in reality the government favors hydro power and gold mining sectors given their export and foreign exchange earning potential, tax collection capacity, reliance on foreign investment and large impact on rates of GDP growth (i.e. implementation of one project in gold mining industry can double the rate of GDP growth). So, development and problems of the Kyrgyz agricultural sector and rural economy in large have been neglected and negatively biased by government development policies.

What makes the Kyrgyz post reform experience interesting is that it points to the necessity of defining the new role of the state. Kyrgyzstan went through fast and drastic changes in the agricultural system. It seems that without a certain involvement and investment from the state the rural livelihoods will not be ensured as the undeveloped market itself will not address the constraints of agricultural development and the development process in the wider sense.

Figure 7: Ways of direct state involvement in development



1.3 Motivation and the objectives of the study

In the 20th century agricultural growth was key to reducing poverty and stimulating economic growth in East and South Asia. Agricultural growth is directly linked and to the large extent drives the growth in the non farm rural economy (Dorward et al., 2004).

The agricultural sector of Kyrgyzstan is the backbone of the economy, in terms of employment, value added and as a source of livelihood strategy in rural areas. Rural population is heavily dependent on agriculture and poverty is pronounced in rural areas.

It is believed that development of the agricultural sector serves as a basis for agricultural led industrialization, the strategy that has the most poverty reducing potential (El-Said et al., 2001; Tarp and Tarp, 2004). Moreover, agricultural sector has unrealized capacity for providing employment, stimulating off farm sector, improving the food security and producing goods for export.

At the same time the agricultural sector shows low productivity, profitability and tendency to retreat to subsistence farming. Despite drastic liberalization policies and deep reforms, growth in agricultural sector in Kyrgyzstan is low and unstable. In turn this hampers food security, growth in rural on-farm and off-farm employment contributing to rise in rural / urban unemployment, international and internal migration and to the rural poverty persistence.

Stable agricultural growth and modern agricultural sector should provide the fundament for the emergence of competitive agro processing industries, leading to agricultural led industrialization (Davis et al., 2002). The effective performance of rural off-farm sector highly depends on the performance of agricultural production.

Therefore, it is imperative to implement policies that stimulate agricultural production, impacting agricultural productivity, increasing commercialization and preserving land sustainability.

The issue is not whether or not the state should be involved in supporting the agricultural sector. It follows from our discussions that under conditions of underdeveloped markets and coordination failures public investments and direct state support are legitimate, but as markets evolve state intervention should become more flexible.

The government should stimulate agricultural production by providing (seasonal and long term) finance, access to input and output markets and stabilizing prices and risks. With build up of critical mass, as agriculture and related industries become profitable and growing interest from the private sector to take over some of the service provision (in credit, input, and output fields) the gradual phasing out of large scale of government involvement should be introduced.

The dependence of rural economy on agricultural production and dominance of private farmers in the agricultural sector imply that, in the short to medium term, the performance in the national and rural economy depends on the performance of the rural farm households.

Thus the objectives of achieving the increased level of rural employment, food security, and poverty reduction should encompass policies that address the constraints of agricultural smallholders, paying attention to direct input price and credit support, adoption of agricultural technologies and sustainable use of land resources. Raising agricultural productivity is seen as the first step in economic transformation out of agriculture towards rural industrialization (Dorward et al., 2004).

In order to investigate the potential and impact of agricultural policies supporting the smallholders and private farms to increase their marketed/commercial production of cash and food crops, in term of rural poverty and welfare, it is proposed to build an empirical model of rural economy. But any such attempt is bound to be locally specific. Moreover, the rural sector in any developing country (often also in developed countries) is necessarily remote, marginalized and disadvantaged. Thus the study by focusing on rural economy also embrace the investigation of household behavior of remote, less favored areas, i.e. specific village that located far away from trade centers.

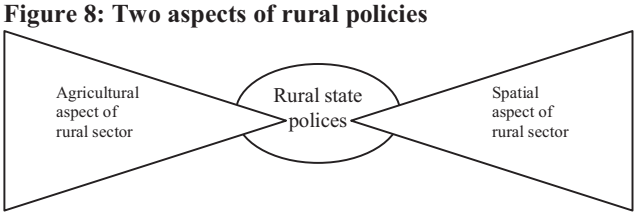
To realize the potential of the private farmers, the constraints on agricultural production and commercialization should be addressed. As the new structure of agriculture has evolved the question is whether the agricultural smallholders – private agricultural farms can escape the trap of imperfect markets. What are the potential, scope and opportunities of smallholding agriculture, in terms of rural welfare and rural farm- non farm linkages?

It is believed that policy shocks are needed to push the farmers (and rural households) out of low equilibrium and launch them on the track of more efficient agricultural production, more market oriented production, with increased level of productivity while maintaining land sustainability. This should contribute to rural poverty reduction.

In the context of rural policies there is additional aspect that is related to the prominent characteristic of the rural sector. Country economy is viewed as bundles of more or less integrated local economies. Thus in addition to sectoral focus the state policies have to be regionally specific, especially for areas that located in the periphery. In other words, government regional policies should be defined as those policies that have formal geographic focus. The objectives of the regional policies are the same as for the country policies (reducing unemployment, increasing incomes, promoting structural adjustments etc), but usually they put more weight on equity considerations and realizing development potentials of the disadvantaged areas.

Rural policy should reflect the endemic features of the rural economies and be considered in a more spatial development context. Government is used to looking at competitiveness and development issues in sectoral terms; however it is becoming clear that the conditions that underlie the development in the wider sense are often localized. If one needs to understand and explain the national development process one should start by looking at aspects of regional development. Regional policies for less-developed regions are of several types: infrastructure investments, grants, loans and other facilities to support and encourage private local activities, which are mainly agricultural based. Thus rural policies are necessarily the regional policies, targeting simultaneously the agricultural sector and regions which are lagging in terms of unemployment rates and per capita income. Then the present research maintains that state policy should focus on integrating and stimulating the local economies more successfully into the national economy and in facilitating national economy growth from within, from local base. This approach is consistent with views of rural sector as isolated and small farm based systems, who persistently loose in economic terms and become caught in a poverty/disadvantage trap.

Figure 8: Two aspects of rural policies



Source: Author's view

The main contribution of the study is in modeling the rural economy. It is hoped that study sheds light on working of rural economy, its linkages and agricultural production and thus delineate factors of food security, farm and off farm employment, issues of rural urban migration, farming methods etc. This knowledge is indispensable for proper policy making aiming at stimulating rural development and agricultural growth.

Accordingly the main research questions of this study are:

- Under what environment the new class of farmers operate after the agricultural reforms?
- What are the main interactions that exist in local markets between village households?

- How can one study and structure the local economy, taking an example of the village economy?
- What are the development options and impacts of agricultural policies that address the constraints of private farmers on rural household's welfare?

  Potential policy scenarios/measures include:

  -Input subsidies (for external inputs fertilizers, seeds, etc);
  -Dramatic improvement in local infrastructure and research:
  -Credit/Investment support;
  -Reduction in transaction and marketing cost;
  -Expansion of internal and external labor market opportunities

Main objectives of the research are:

1. To obtain an in-depth understanding of the functioning of rural economy in Kyrgyzstan, paying attention to institutional characteristics and rural farm/non-farm linkages.

2. To apply a village CGE model for analyzing the economic growth options and policy implications of rural support policies.

3. To evaluate impact of different rural development polices on rural welfare in the context of remote village.

4. To derive policy options for sustainable agricultural-based pro poor rural development. To provide the policy makers with the solid applied tool for policy analysis in agricultural sector.

5. To revisit the role of a state in transition countries in light of need for institutional development.

The problems of private farms in Kyrgyzstan are not unique, however, the impact of policies that address their problems are highly country specific (Taylor and Adelman, 1996). Moreover, the impacts are not only country specific, but locally specific. There are few studies that employ the rural village economy approach to the analysis of impact of direct policy measures and there are virtually no studies of this problem spotlighting Kyrgyzstan. This research intends to fill this gap by developing a rural economy / village model for Kyrgyzstan to analyze the debated policy measures, their likely impacts in rural sector and rural linkages.
The sound theoretical model based on empirical data would contribute to both: literature on workings of rural economy and applied policy making, based on the case of transition country like Kyrgyzstan.

Understanding the working of the rural economy, its constraints and its internal and external / farm and non farm linkages should provide the policy makers with the tool to shape policy interventions.

For policy making, it is important to understand the functioning of the rural economy taking into account the rural interactions (specifically farm/non farm) in the environment

of imperfect markets. The latter justify the supportive policy interventions and policy makers need the tools to analyze the impact of policy measures on rural welfare, within the context of local economy.

So far the village level analysis has not been applied to Kyrgyzstan or other transition country of former USSR. Our problem statement indicated that rural sector in Kyrgyzstan is only slowly developing and various market imperfections could be observed. These market imperfections and failures result in low level of market integration. High transaction cost prevents rural households to market its output to markets (internal or external). Input markets are also not fully integrated. Labor and land markets are thin and observed only at village/local levels.

Local level markets bring about local level households interactions and thus call for village level modeling approach as opposed to pure farm household modeling approach for analysis of rural households' behavior to exogenous changes and rural farm/ non farm linkages.

Village economy comprise of distinct sectors with their idiosyncrasies and large degree of heterogeneity between households which result in not uniform response to policy shocks. The advocated policy interventions should take into account these features of rural economies. The authorities in Kyrgyzstan acknowledge the importance of non-farm income and need for rural based industrialization, and at the same time call for measures to increase agricultural incomes in order to stimulate rural economy. The village economy level analysis should be capable to provide the policy makers with a tool to account for heterogeneous households' response to policy measures, to identify the most constraining factors facing rural households and to highlight the farm/non farm linkages (Davis et al., 2002).

In summary, rural economy wide modeling approach (i.e. village CGE) is used to investigate the major linkages within rural village in Kyrgyzstan and assess how agricultural supporting polices that intended to address the production and marketing constraints of newly emerged private farms impact on welfare of rural households in a transition country such as Kyrgyzstan.

2 Theoretical aspects of the village wide and agricultural household models; Non separability of households, as related to the village CGE model

In the previous, introductory chapter we argued that since rural households are central elements of the local economic system, village level modeling as representing the local economy would be the appropriate approach for policy analysis. In this chapter we outline the theoretical aspects of the village model and justify the choice of the modeling framework, which later will be used for policy simulations. In studies related to the rural household behavior in developing countries with market imperfections different models are used ranging from micro agricultural household models (AHM) to large macro computable general equilibrium (CGE) models. Both have advantages and disadvantages. The main disadvantages of the big CGE models are their aggregate character, data requirements and lack of heterogeneity in capturing the household response. On the other hand, the limitation of AHM is ignorance of local interactions and local general equilibrium effects. As a result, we are compelled to use the village model, which combines the advantages of the AHM and CGE models. So given the importance of the AHM for the village models the concept of AHM and non separability is presented for analytical purposes.

2.1 Village level analysis as appropriate framework

AHM is a very powerful and versatile tool in empirical analysis of rural household behavior, but has also some limitations. In practice AHM is implemented in two general ways: in reduced form, estimated econometrically and as optimization problem solved in mathematical programming way (Kuiper, 2005).

From the general household model (of the type similar to the one we will present later in this chapter), the equations are derived from the first order conditions (FOCs) of the household utility maximization problem. Then these reduced form equations are estimated, which relate endogenous variables of interest to some exogenous variables, without necessarily specifying the underlying production and utility function. Kuiper (2005) underlines that reduced form models generally hide the internal adjustment process of household behavior. Analysis with this type of models may show that non separable household is unresponsive to some changes, while internal shadow prices undergo large changes. This is the case with autarkic households who do not participate in the market and thus by definition unresponsive to market price changes.
Additional problem with econometric estimation is that the household production and consumption structures are very complex and thus may be too complex to be able to analytically derive a set of equations relating endogenous and exogenous variables. For example, autarkic household may not participate in the labor market and thus the wage rate for them is unobservable and endogenous, which is not normally accounted in econometric models.

The optimization approach to household modeling is more straightforward in application. Without deriving FOCs, the objective functions as well as constraints are specified. The utility function has to be explicitly specified, but at the same time the utility is unobservable. The downside of the optimization household model is their limits on heterogeneity in rural households. By construction, in the optimization models one needs to aggregate households into the groups of representative households. But the aggregate behavior might not be equal to the sum of the individual (group) behavior, as there are also inter group interactions. Thus the household based optimization models necessarily loose diversity in modeling the response behavior.

On a general note, both types of the modeling approach to rural household have advantages and limitations. However, the main reason that would drive our choice of the modeling is related to fundamental limitations of household models. By definition household models alone are not capable of dealing with possibility and impact of interactions among rural households.

Rural households are elements of a rural economy. Taylor and Adelman (1996) provide simple illustration of local interactions that is akin to inter sectoral interaction in a country economy. Consider an exogenous price increase for food commodities, which under classical assumption would bring about increase in the food supply (food production). Higher profit from higher production feeds into the rise in income and demand (including for food) from rural households and also increase in marketed surplus. However, apart from profit effect influencing the marketed surplus, there are income linkages and local general equilibrium effects operating inside local village economy. As a rule, food producers (rural households) purchase local inputs and factors from other households in the village (including labor). In addition, food producing households with higher income also increase their demand for local non tradable goods. The result of this might be the rise in the prices of local goods and factors that are also inputs in the production of food commodities, thus diminishing and even cancelling the effect of initial price increase on marketed supply. These income and general equilibrium effects necessitate that in studying the rural household behavior we have to take into account conditions, institutions and links of local rural economy. Because potentially direct effects of policies or shocks might be smaller or reversed by indirect effects which stem from village wide household and market interactions.

Spatially, the rural economy is defined, as a rule, by bounds of a village. Village in that sense represent the local environment and economy in which the rural households operate. Despite the complexity of village in terms of say, social organization, politics and cultural traditions, the economy of village is amenable to economic analysis in a straightforward way.

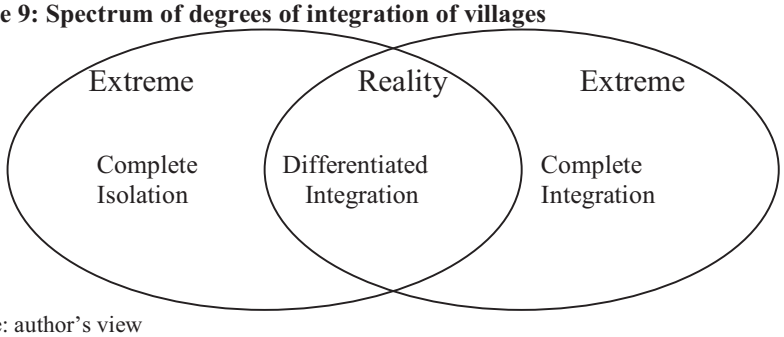
In majority of cases, the fundament of the village economy is agricultural on-farm activities of households. These activities are carried out by employing inputs and factors, which might be imported and produced locally. On the other end, the outputs are produced both for village export and for domestic household consumption. The extent to which village interaction with rest of the world and within village occurs provides an important basis for village typology and village models.

Market imperfections cause the non separability of household decision making and lead to household specific shadow prices for factors and commodities (more on this later in this chapter). In a similar way, market imperfection, transaction costs associated with trade and village isolation from outer markets create the non separability of the decision making on the village level (Holden, 1999). Remoteness of the villages and different factor endowments, as well as household specializations in the village markets all creates local village markets, with local village specific prices. So, in addition to household specific/shadow prices, in the village models the village specific prices are important, which derived from household interactions, factor trade, expenditure links.

The role of the additional nest, to the household model, represented by nest of village market is dependent on condition of the markets and village conditions for the households. Let us look at the case when rural households are self sufficient in its production and consumption. In other words, we are assuming the case of all missing markets. The other side of this is the case of perfect markets of the neoclassical economics type. In both cases, the local village economy is nonexistent because it is not needed. In the first case, the households suffice and supply themselves with all its non tradables, in the second case all goods and factors are tradables for a household and come from external markets. Thus the households interact with outside world only and do not depend on local markets (local interactions). Accordingly, if one needs to model the household behavior, one would just need the model of autarkic (non separable) household, for the first case and separable household for the second case.

However, the reality is not reflected in both of the above cases. The assumptions of complete absence of markets and equally the assumption of full perfect working of each and every market are both too strong. In practice markets exist and operate to a different extent of integration, and due to high transaction costs, isolated village markets emerge. There is another plausible reason that can also contribute to the existence of the strictly local markets. And this is local assets differentiation, local heterogeneity of households might be responsible for local specialization of households, i.e. households with more of commercial output and others being providers of labor and other factors to the commercial households.

Figure 9: Spectrum of degrees of integration of villages



Source: author's view

So, casual observation of the rural sector would convince that majority of the rural economies/villages in developing countries are middle case of two extremes (extreme isolation and complete integration). Rural households produce for village markets as well as for outside village. Households carry out not just agricultural and on farm activities,

but also engaged in off farm work, migration and trade. Factors and inputs are both imported and locally bought. Land and other fixed inputs are unevenly distributed among households. Commercially oriented larger households coexist with smaller (and often poorer) households. Holden et al., (1998) provided a useful typology of the village economies using two criteria: level of transaction cost and extent of differentiation between households in a village. Thus, taking into account the transaction costs and integration with rest of the world, the households in the village, demand and produce goods that are household tradables and non tradables, village tradables and non tradables. In parallel to the agricultural household models, the extent of the market imperfection will determine whether the village is separable or non separable and thus if the village is net exporter or importer, or altogether self sufficient for some of the goods or factors.

So the village framework helps us to understand that households might interact in the local markets and through this not all households are isolated from all markets. To see this we present the simple household model by Dyer et al, (2006) that highlights inter household interactions occurring within bounds of local economy.

The local village economy consists of N subsistence households and at least one commercial household/farmer. For simplicity we assume that commercial farmer produces food crop with simple Cobb Douglas production technology:

$$Q_c = A\overline{T}_c^{1-\gamma} L^{\gamma} = \lambda_c L^{\gamma} \qquad (2.1)$$

Where subscript c denotes commercial, L is variable input-labor and T is fixed input-land. To reflect our village economy we impose that all labor is supplied by local subsistence households. For given wage, w and output price, p, the profit maximization of commercial farmer yields the labor demand:

$$L_c^D(w) = \left[\frac{p\gamma\lambda_c}{w}\right]^{\frac{1}{1-\gamma}} \qquad (2.2)$$

At the same time, subsistence households have a linear utility function defined over home produced food Q and market bought good M:

$U(Q,M) = \alpha Q + \beta M$, maximizing utility subject to (2.3)

production function: $Q_s = A\overline{T}_s^{1-\gamma} L^{\gamma} = \lambda_s L^{\gamma}$ (2.4)

cash-income constraint: $M = wL^s$ (2.5)

and time constraint: $L + L^S = 1$ (2.6)

where $\overline{T}_s < \overline{T}_c$, and L^S is a labor supplied by households to commercial farmer.

Solving utility maximization problem for subsistence households would produce:

Labor supply equation: $L^S(w) = 1 - \left[\frac{\alpha w}{\beta\gamma\lambda_s}\right]^{\frac{1}{\gamma-1}}$ (2.7)

and for N households: $NL^S(w)$.

By equating labor demand from commercial farmer to the labor supply by subsistence households would produce equilibrium wage:

$$w^*(p,\underline{Z}) = \left(\frac{\phi(p,\underline{Z})}{n}\right)^{1-\gamma}, \tag{2.8}$$

where

$\underline{Z} = [\gamma, \lambda_c, \lambda_s, \alpha, \beta, n]$ is a vector of parameters of system of equations and

$$\phi(p,\underline{Z}) = (p\gamma\lambda_c)^{\frac{1}{1-\gamma}} + n\left(\frac{\beta\gamma\lambda_s}{\alpha}\right)^{\frac{1}{1-\gamma}} \tag{2.9}$$

It can be seen that increase in price of food will result in increase in village wage $\left(\partial\phi/\partial p > 0\right)$.

If one substitutes an equilibrium wage equation, $w^*(p,\underline{Z})$ into labor supply equation $L^S(w)$, one gets a reduced form of labor supply:

$$L^S(p,\underline{Z}) = 1 - \alpha\left(\frac{n}{\phi(p,\underline{Z})}\right)(\beta\gamma\lambda)^{\frac{1}{1-\gamma}} \tag{2.10}$$

which is also an increasing function of market food prices.

Now, by making a substitution of reduced form labor supply $L^S(p,\underline{Z})$ into production function of subsistence households Q_s:

$$Q_s(p,\underline{Z}) = \lambda_s\left[\left(\frac{n}{\phi(p,\underline{Z})}\right)\left(\frac{\beta\gamma\lambda_s}{\alpha}\right)^{\frac{1}{1-\gamma}}\right]^{\gamma} \tag{2.11}$$

We derive that $\frac{dQ_s(p,\underline{Z})}{dp} < 0$, i.e. the subsistence production of food is a decreasing function of its price.

The key conclusion of the model is that even subsistence households which do not participate themselves in the commercial food production are nevertheless influenced by market prices via factor market for labor used in commercial farming. By having a tradable good or factor and local markets, shocks in one market will eventually translate to the other markets and overall outcome is determined by household's integrations to the local markets. In other words, local markets and interactions highly matter in shaping the result of exogenous changes on behavior of not one but all group of village households.

Household model alone only captures the direct effect of exogenous changes on particular households. Village models by integrating the local markets for factor and commodities take into account the indirect effect, which work through the local markets. Changes in local labor wages or land rents transfer the effect of changes to laborer or landholder local households. Further changes in income and demand linkages (general-equilibrium effects) affect the producers of the demanded goods both locally or from the rest of the village.

The bottom line of the discussion is that micro household models do not take into account the interaction between households; on the other hand the macro CGE models although are designed as general equilibrium models they also miss the heterogeneity of micro household behavior. However, there is a middle ground that merges micro household and macro country models, which is village model, with important feature of allowing for interaction between different types of households in local markets. Village model is not partial, but general capable of covering all sectors in the village economy and all households, including their interactions. Interaction and local markets are crucial characteristic of the village models that are missing in single household and country models and which might dramatically alter the results derived from other models alone.

2.2 Theoretical structure of the village model

Before we present the more specific empirical description of our village model, it is beneficial to outline a general model structure that will help us to understand the working of the village model without focusing on specific details (Taylor and Adelman, 1996).

At the heart of any village model is the behavior of different groups of village households, as such village model encompasses household model like larger Russian "*Matryoshka*" doll encapsulates the smaller one. When household's income changes it affects the demand and expenditure in the local and non local markets and thus village model should account for general equilibrium effects. Similar to AHM, households in village model maximize their utility derived from leisure and income that earned by employing households' factors in on and off farm activities both within the local economy and outside.

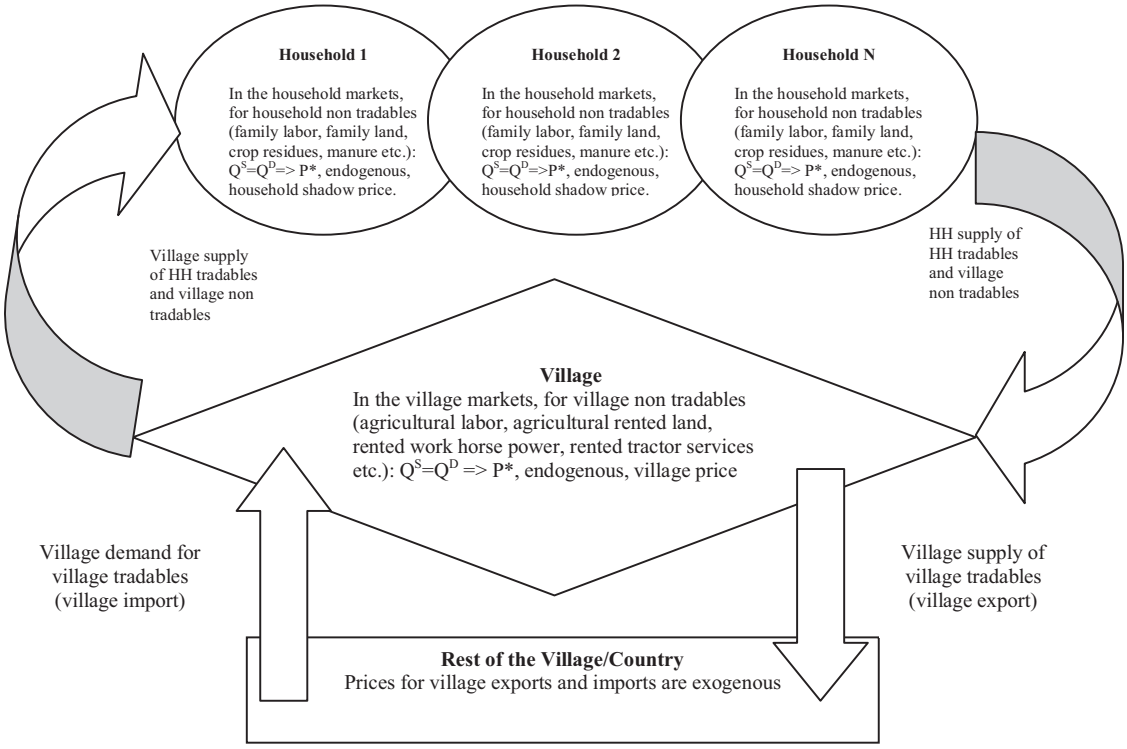
With high degree of plausibility, we assume that village household is unlikely to be completely self sufficient, so within and between households there exist markets for households' tradables and households' non tradables.

Household tradables are the goods for which prices are given exogenously (be it from rest of the world or from within the village). As our households are not of "*Robinson Crusoe*" type, they import and export a lot of commodities from the rest of the world. Thus, with a similar logic of household non tradables, those goods which prices are given from the rest of the world are village tradables.

On the other hand, we also assume that households do not face perfect markets for all goods and factors. The prominent example of the factor for which the market is missing is a family time/labor. Market supply of this factor is virtually absent and there is no perfect substitute for this factor. Hired labor in that sense is imperfect substitute and regarded as separate factor/commodity. Thus households need to balance and face trade off between fixed supply and demand of family time in terms of leisure and work. Instead of non existent market price the households value the time in terms of shadow or household specific price. In this aspect the households in village model are nonseparable. So the goods or factors for which household face shadow prices are treated as household non tradables. To some degree the household non tradables can be viewed as goods for which household face too high transaction costs and thus they are better off remaining self sufficient. If the cost associated with supervision, information provision and

transaction of hired labor was zero then hired labor would be perfectly substitutable for family labor, and households would be separable.
Further, in interacting with the rest of the world, the villages also face transaction costs. Too high cost might force the village to avoid trade with outside world but make possible to trade within the village, thus creating village markets. In the presence of local markets, the demand and supply is balanced locally thus sustaining the local market with local endogenous price. It is those changes in the village prices that affect all village households and motivate the use of village models. Thus we can define that goods and factors which are household tradables and are not traded with the rest of the world, but traded only within the village are village non tradables. Although not universally true, the hired agricultural labor and hired animal draft power could be the examples of village non tradables. Having supply and demand of agricultural labor within the village, the village might face high transaction cost in importing/exporting the labor, due to remoteness or other reasons. As such the local market exists with clearing endogenous price for village and exogenous price for household. Graphical representation of village model which embeds the households is shown in Figure 10.

Figure 10: Representation of the village model



Source: Author's view

Thus the core element of the village model is a household, namely its behavior. Village households are viewed as utility maximizers.

$$Max \quad U(X_i), \qquad (2.12)$$

where X_i is household demand for tradables and non tradables including consumption of labor as a leisure and other factors. This optimization problem is subject to the following constraints.

First is technology constraint in the form of production function.

$$Q = Q(X_i), \tag{2.13}$$

where X_i are both variable and fixed factor/inputs which also might be tradables and non tradables. Another feature of production inputs is that they also might be outputs i.e. outputs of some activities serve as the input to another activities as intermediate goods.
Next is cash-income constraint.

$$\sum_{i=1} P_i X_i = \overline{Y} + \sum_{i=1} Y_f \ , \tag{2.14}$$

where $\overline{Y}$ is exogenous income (remittances, from government, transfers), Y_f is household income from supplying its factors to different activities, including household, village and for rest of the world.

The last is a set of constraints related to the goods and factors balances.
Total family time endowments should be equal to the family time use:

$$X_l + \sum_{i=1} FL_i \le \overline{T} \ , \tag{2.15}$$

where $\overline{T}$ is household's time endowments, X_l is household leisure demand, FL_i use of family labor for household activities, for off-own farm /village labor supply, for outside village labor supply (temporal migration). Thus we assumed here that family labor is household non tradable and hired labor is imperfect substitute for family labor i.e. a separate commodity.

In a similar way, we define the related constraint which is commodity balance.

$$X_i^C + X_i^I + X_i^S \le X_i^O + X_i^E + X_i^B \tag{2.16}$$

where:
X_i^C - use of factor/goods use for consumption, X_i^I - use of factor/goods as inputs, X_i^S - selling factor/goods, X_i^O -output of factor or goods, X_i^E -endowment of factor or goods, X_i^B - bought factor or goods.
Essentially this constraint defines that demand for a commodity should be matched by supply or endowment for this commodity. For example for household non tradable, like family time above, the demand for leisure and for activities should be equal to the household family labor endowments. For village non tradables, say village agricultural labor, demand for village labor as an input should be equal to supply of labor as an output (production) of agricultural labor by household. For tradables, like fertilizers, the uses as an input should be matched by import/buying. Similarly, the export/sale of village and household tradables is matched by production of export goods.

This utility optimization problem describes a household behavior, such as family labor is utilized to a point where marginal effect of household income is equated with opportunity cost of family time (shadow wage) and that each commodity is demanded to the point

where marginal utility of consumption equal to opportunity cost. Thus, constrained optimization also yields supply function: $Q_i^* = Q_i^*(P)$ (2.17)

and demand function: $X_i^* = X_i^*(P, Y)$. (2.18)

The decision price that household face is of three types: first is household related shadow endogenous price, second is household exogenous but village related endogenous price, and third are completely exogenous prices.

The exogenous prices determine the net village marketed surplus: $MS_i = Q_i - X_i$. For the village non tradables the village equilibrium prices is determined by the condition that marketed surplus is zero $MS_i = 0$ and village prices clear village surplus and demand: $VMS_i = VS_i - VD_i$, when $VMS_i = 0$, the village prices are defined. For goods and factors for which household is autarkic i.e. no trade occurs, prices are endogenous to household, shadow prices at which the condition : $HMS_i = HS_i - HD_i$, when $HMS_i = 0$ i.e. household demand for household non tradables is equal to households supply (endowments) holds, ensuring the formation of household related shadow price.

The existence of numerous direct and indirect effect, several markets and prices and multiple linkages on local markets all call for general equilibrium approach to village model. General equilibrium approach also has an advantage that it offers the accounting consistency. All flows of goods and factors are systematically accounted for in general equilibrium framework covering the whole village economy in economically sound way. Thus, the village model nests the rural household model in a general equilibrium framework.

Computable general equilibrium models are based on classical models of competitive equilibrium of the Arrow-Debreu spirit. Three fundamental conditions construct together an equilibrium model framework (Kuiper, 2005).

1) Producers maximize their profit:

$$\pi(p^*) = \max_y \{p^* y \mid y \in Y\} \quad (2.19)$$

The firm maximizes profit π for exogenous equilibrium prices p by choosing a production plan y from the production set Y

2) Consumers maximize their utility:

$$\max_x \{u(x) \mid p^* x \le I^*\}, \quad I^* = p^* e + \theta\pi^* + t \quad (2.20)$$

Al consumers maximize their utility u defined over consumption of x subject to income constraint I consisting of consumer endowment e, profit from firms weighted by consumer's share $\theta\pi$ and taxes/subsidies t.

3) All markets clear and there are not excess demand in all markets:

$$\sum x - \sum y^* - \sum e \le 0 \quad (2.21)$$

Viewing from the point of integration of production and consumption decision, the household models are also a small CGE models. CGE type models can be constructed for different level of aggregation starting from household, to regional and whole world

models. For the village general equilibrium model we specify that household behavior (production and consumption) is defined within the framework of the village, where the additional- interaction component/ layer is overlapped.

Therefore in order to derive a general equilibrium solution to a village/household model, additional set of general equilibrium conditions must be satisfied.
First condition is called material balance constraint, which clears the goods market for all goods and determine prices: $Q_i = C_i + G_i + ID_i + MVS_i$, (2.22)
where C_i is total consumption for *i*, G_i and ID_i are government and investment demand respectively and MVS_i is a net village marketed surplus.
The village material balance for factors and goods requires balance between village factors and goods supply and village demand: $VS_i = VD_i$ which determines a village endogenous price.

The second general equilibrium condition posits equilibrium in saving investment, i.e. local capital market: $ID_i = \sum_{h=1} S_h(Y_h)$, (2.23)
where $S_h(Y_h)$ is a household savings rate. This essentially states that village investment demand is met by saving from village households i.e. self financed and there is no rest of the world borrowing.

Finally, the village model needs to meet balance of payments for trade with rest of the world:

$$\sum p_i VMS_i^m = \sum p_i VMS_i^r + \overline{Y} \quad (2.24)$$

The balance of payments does not allow current account deficit. Marketed surplus for export which includes household marketed surplus and village marketed surplus plus an exogenous income/transfers should finance the marketed surplus of import. Actually this equality is implied by other equations of the model, i.e. cash/income constraint and as such is redundant for a model specification, but can be used for checking the consistency of the model.

One of the features of the village model is that there might be several rests of the world for a village model. Rest of the world in the village context means rest of the village-whole country and rest of the world, which means the whole world. Depending on specification of the rest of the world changes the role of the exchange rate. For the most of the model specifications the exchange rate is not important as import and export already specified in local currency, but if village has important links with the rest of the world in terms of foreign migration or foreign export import then exchange rate should be properly specified.

Like other CGE models the village model consists of two types of equations which define the model. These are behavior type equations and accounting equations. In the central block of the model, which is household block, the model specifies the production equations for each of its household and each of its activity. Also each household, the

model specifies consumption for subsistence and marketed goods. For household non tradables, internal household demand –supply equality determines endogenous prices. For the village layer of the model, the village supply is a sum of household surpluses. The general equilibrium closures at the village level define village marketed surplus as difference between village supply and demand. Prices for tradables are exogenous and for village non tradables are endogenous derived from equality condition of village supply and demand.

There are numerous studies that use household models or country CGE models for agricultural policy analysis. However, there is little research work that looked at households' behavior from the village model perspective. In part, this could be explained by the novelty of this approach, one of the first models was built in 1996 by Taylor and Adelman. At the same time the village approach to household analysis is not on periphery. A lot of studies used the village SAM for limited fixed price/village multiplier analysis of village households. However in village SAM multiplier analysis the prices are absent, analysis is based on assumption that supply is perfectly elastic and production technology is simplistic represented by linear fixed proportion technology.
It could be argued that in response to these limitations of the village SAM the village general equilibrium models were developed and motivated. In pioneering work of Taylor and Adelman (1996), they developed theoretical model of village CGE that we adopt in this study. At the heart of their model is household optimizing utility with cash income, production technology, family time constraint and remittances function. Two accounting identities ensures the village equilibrium, one at household another for village level. Family labor is household non tradable and village non tradable is hired labor.
They used five village SAMs from different countries of Africa and Asia and for different policy simulations, like: price changes for staple and export, income subsidies, and remittances. They concluded that general equilibrium effects as well as local markets are important factors that affect the household behavior. In addition, the responses of the household and impact of the shocks significantly vary for each taken village. This reflects such factors as: a state of the development of the village, openness, commercialization, importance of the local markets. Thus ignoring these conditions would bias the understanding of the household behavior. In their work, Taylor and Adelman (1996) accounted only for village labor endogenous price, but production remained separated from household consumption decision, i.e. production remained activity specific but not household specific.

Subsequent work by Loefgren and Robinson (1999) using the framework of household model with transaction costs modeled the production decision to be household specific that integrated the production and consumption decision. The endogenous household prices in their model also include the transaction cost component. In their model, capital and land are also a household non tradables and thus the household endogenous prices affect the specific household activity level and not the general activity level. They found that non separability originating from transaction costs produce specific market response by households. Initially households are not responsive to shocks, and only large shocks induce changes in household production behavior.
Work by Holden and Loefgren (2003) used the village framework to study the environmental impact of policy changes. For the Ethiopian village they built a village

model that incorporated land degradation equations and livestock-crop production interrelations. The empirical model used in this study is inspired and follows their model. Finally, a comprehensive study was done by Kuiper (2005). She described the steps and insights of village CGEM. Also she built a rich village CGE model focusing on the impacts of migration on village production and consumption. Again the importance of village markets was underlined and local interaction deemed highly relevant for household behavior.

2.3 Concept of agricultural household model and implication of non separability

Apart from the fact that rural households are main decision making units in rural areas, they also represent the core of the village model as we have seen above. As such the concept of rural/ agricultural household needs thorough review in order to properly apply this concept for purposes of the research. So next we make an attempt to review the origins of the agricultural household model (AHM) and present the basic AHM with transaction costs for the analytical purposes (Taylor, 2003).

Chayanov's work in late 20s of the past century laid the framework to explain the behavior of the farmers, pointing to important interactions between external labor markets (off-farm labor markets), the on-farm production and household consumption/demography.

Later in 1960s, Becker's theory of "Family economics", based on unitary household model provided foundation for agricultural household models. Since then, Becker's approach of integrating microeconomic theory in every aspect of family economic activities in one inclusive model to interpret economic and social-economic phenomena, has been pervasive in the various fields of the social science.

It is believed that one of the first agricultural household models in the spirit of Chayanov and Becker is attributed to the work of Kuroda and Yotopoulos (1978). By studying the supply response of staple producers in Japan, they stumbled upon theoretically puzzling fact, that increase in staple price does not significantly increase the marketed supply. Only by integrating joint production-consumption decision, authors were able to explain this counterintuitive fact of positive own price elasticity. Being also a consumer, a supplier of the staple good in Japan allocated more of their increased production to own consumption. By pursuing the goal of self-sufficiency, the agricultural households implicitly buy all or part of their own production/output. Similarly, by allocating time for leisure, they implicitly buy their own endowment of time/labor. In such situation, an agricultural household is a worker, a producer and a consumer all combined in one economic entity.

More comprehensive agricultural modeling framework was later developed by Singh, Squire and Strauss (1986) in "Agricultural Household Models: Extensions, Applications, and Policy", an all-inclusive book about the AHM model specification, comparative statics, applications in empirical estimation and policy analysis, under important assumption that the markets exist for all commodities and no transaction cost interfere.

Rural household is simultaneously both consumer and producer, and these two sides inevitably interact. In that sense, the rural household is very complex economic agent, who instantly calculates and takes numerous economic decisions on labor supply, purchases and use of inputs, consumption and sale of outputs. Analytical derivation of rural household response to various shocks is very difficult and in many cases is impossible, as different forces may counteract each other.

From the microeconomic theory point of view, the AHM seeks to maximize utility derived from consumption of self produced, purchased goods including a leisure given the constraints it faces. Factor endowments of land, family time and other assets constitute the first set of constraints. Cash income from sale of marketed goods, prices of inputs, sold and consumed goods is a second set of constraints. Third constraint is production technology available to household. Solving this utility maximization problem produces the solution of endogenous variables as function of exogenous variables (prices, household endowments, and household characteristics) for outputs, input and consumption demands, and marketed surplus for traded goods.

Although, the AHM is utility maximizer as a consumer, there is important aspect of AHM that easily can be confused. In the consumer utility maximization the budget constraint is generally given, whereas in AHM the budget constraint in addition incorporates the profit effect of the production side of the AHM. Thus, exogenous increase in food price would lead to decrease in the demand for a consumer, but increase in demand for the food as a producer since the household budget would be relaxed allowing for more consumption.

Household operates in markets and the market conditions are thus crucial in explaining the behavior and response of agricultural households. Understanding this prompted Sadoulet and de Janvry (1995) to further extend AHM framework and include market failures, due to transaction costs, shallow local markets, or price risk and risk aversion, and their empirical implications for farm household behavior.

Here we follow Taylor and Adelman (2002) approach to demonstrate the workings of the AHM under different market environment.
Algebraically, the simple model is postulated as follows:

$$\underset{C_a, C_l, L_f, L_h}{Max} \; U(C_a, C_l) \tag{2.25}$$

subject to:

production function: $Q_a = f(L_f, L_h, \overline{q})$ (2.26)

time endowment: $L_f + L_o + C_l = \overline{T}$ (2.27)

and cash constraint: $pQ_a + wL_o = pC_a + wL_h$ (2.28)

where:
C_a - food crop; C_l -leisure; L_f -family labor; L_h -hired labor; $\overline{q}$ -fixed input; L_o -off farm labor work; p - price of food crop; w - wage rate.

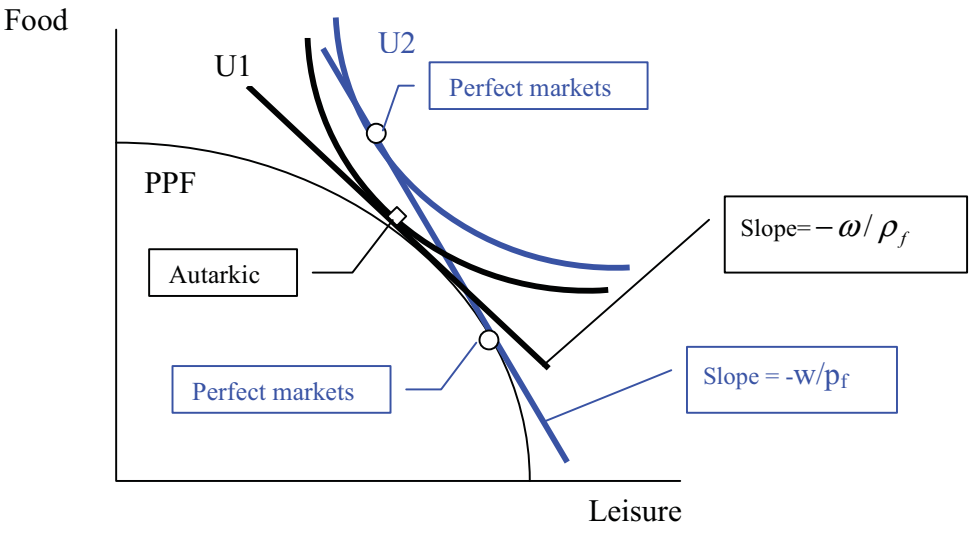
All three constraints stacked into one full income constraint as follows:

$$p\left(f(L_f, L_h, \bar{q})\right) - C_a = wL_h - (\bar{T} - L_f - C_l) \qquad (2.29)$$

So the maximization of utility function subject to full income constraint yields output supply, input demand and consumption of household. For three different market conditions the budget constraint faced by household will be also different, producing different results.

Let us theoretically consider the behavior of rural household with three different market conditions: first the autarkic/no possibility of trade case. As such we assume no labor, no food markets. Figure 11 illustrates the household behavior in the extreme case. Constraint in the technology is illustrated by the production possibility frontier (PPF). The household produces a certain bundle of two goods. Under this situation, the agricultural household consumes all of its own-produced products. Thus, its optimal choice of production and consumption should be at the point *A*, where the marginal rate of substitution is equal to the marginal rate of transformation: $MRT = MRS = -\omega / \rho_f$, where simultaneous production and consumption decision produced unobservable (by definition of no markets) prices for food - ρ_f and household labor - ω.

Figure 11: Rural household behavior with and without markets



Source: Adapted from Kuiper, 2005

The neoclassical economics would present the opposite case, i.e. the condition of perfect markets. Under perfect markets prices are no longer endogenous. Market prices are opportunity costs of labor and food. And rational consumer would equate marginal rate of substitution to the ratio of market (exogenous) prices of labor and food. With functioning markets, labor can be hired and household is not constrained to be self sufficient and trade off work for leisure. As a producer, the household chooses the point, where the marginal rate of transformation is equal to price ratio for labor and food. In terms of the graphic, this translates into replacing the shadow prices ratio by the market prices ratio: - w/p_f. In essence, the market is used to achieve the optimal point of production and

consumption, in a recursive way: first production decision is taken, by touching price ratio to *PPF* line and then consumption is determined by touching the price ratio to the highest possible indifference curve, as shown in the figure above.

At this stage it is important to highlight two important points pertinent to rural household behavior with missing and perfect markets. First, the microeconomic theory of producer and consumer side behavior yielded that differences between two cases (perfect versus no markets) are in prices that are pertinent to household decision making. With missing markets the decision is taken based on endogenous prices, whereas with perfect markets the prices are exogenous. Second, and in some sense equivalent is that with missing markets the decision making is simultaneous, whereas with perfect markets the household decides in stepwise (non simultaneous) fashion. In other words, with perfect markets, the production and consumption decision of the same rural household can be viewed as independent of each other.

In non simultaneous models, the households maximize profit and then with earned income maximize the utility. So when, consumption demand influences the input and output prices used for profit maximization, these prices are no longer exogenous (given) and the household is no longer recursive. The essence of non separable household is thus in endogenous prices used for making production and consumption decisions. Economic decision making is economically optimal but instead of exogenous (given, perfect market) prices the household uses the endogenous, shadow (unobservable, imperfect market) household specific prices.

In many cases, the land and family labor market constraints are sufficient to render the agricultural household non separable. Non separability leads to analytical intractability of agricultural household models and thus necessitates the construction of quantitative empirical models. These models help us understand the implications of missing markets for household welfare and policy response.

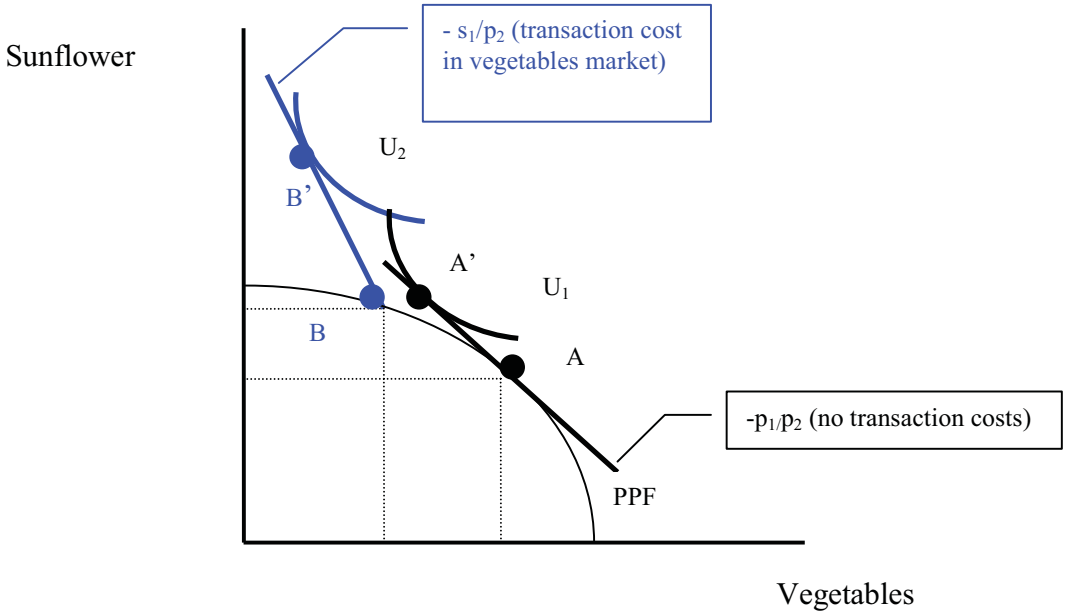
The defining features of rural areas where rural household reside, especially in developing countries is that villages are often isolated and markets are thin. High transaction cost due to market failures and remoteness of villages lead to missing markets and the price differences of buying and selling of products and factors. This, in turn, makes it optimal for the household to remain autarkic and/or semi commercialized.

Transaction costs lower the selling price of a commodity for a producer and increase the price for a consumer, thus forming a gap or a "band" between producer and consumer price. Using our graphical approach we try to depict this situation (Kuiper, 2005).

Again, we consider two goods case since this is amenable to graphical exposition. Related to our village households we choose vegetables (food crop 1) and sunflower (cash crop 2). The purchasing price for vegetables is p_1 and the sale price is s_1 where sales price is less than purchase price $s_1 < p_1$ due to and amounting to transaction cost. Similarly, for sunflower prices: purchasing is p_2 and the sale price is s_2 where $s_2 < p_2$. With equal purchase and sale prices (no transaction costs) the household may choose the point A in production and point A' for consumption of both goods using the price line

ratio $-p_1/p_2$. However, if we account for transaction costs in vegetables market which steepens the line of price ratio due to the fact that $s_1 < p_1$, the household may choose the different position.

Figure 12: Rural household behavior with transaction costs



Source: Author's interpretation

As we discussed above, when the effective purchase price is higher than effective sale price ($p_1/s_2 > s_1/p_2$) then household shadow price, in relative terms, is between effective sale and purchase price and thus household has no incentive to trade. Accordingly, the production and consumption plans for two commodities coincide (point *A* in our figure 12). Since the shadow price falls between sale and purchase price, and there is no motivation to engage in the market the household is self-sufficient, i.e. autarkic for commodities, vegetables and sunflower.
However, if there is transaction cost precluding the household to participate in vegetables market then for the household it is optimal to produce at point *B*. By trading away sunflower for vegetables the household will be able to achieve the utility level corresponding to point *B'*. The household is self sufficient in vegetables, partially sufficient in sunflower, while seller in vegetable market and buyer in sunflower market.

So, depending on household preferences and utility function, we demonstrated how household's optimal joint production-consumption decision yields the market position of the household in the presence of transaction costs.

Equipped with all necessary information we now can algebraically present the general model of rural household behavior facing transaction cost. Following Sadoulet and de Janvry (1995) we specify a general rural household model in order to gain insights on its working and examine the comparative statics. This model serves as a stylized and idealized blueprint for the empirical model of rural household in the village model and

incorporates the joint production-consumption decision making and transaction costs in unifying framework.

As stated earlier, the decision price for the farmer normally differs from the observable price, due to the existence of transaction costs. The transaction costs can vary with amount exchanged (variable transaction costs, TVC) or can be fixed regardless of amount exchanged (fixed transaction costs, TFC) (Key et al., 2000). Transaction costs in rural farming arise from a household's differential access to assets and information asymmetries, and different households confronted with different level of transaction costs. For example, education and contact with extension service provider might serve as proxies for information access, representing fixed transaction costs, while ownership of land, livestock and transport facilities might represent variable transaction costs.

Let rural households have preferences and the utility function U (**c, z**), where **c**=$(c_1, c_2 ... c_N)$ is a vector of N consumed commodities, **p**=$(p_1, p_2 ... p_N)$ is a vector of corresponding prices and **z** is a vector of utility shifting household characteristics, e.g. demographic variables. Further let $m_i (i = 1,2...N)$ to be the total amount of the *i*th commodity traded on the market, when positive it is amount sold , and when negative-amount of purchased, with **m**= $(m_1, m_2 ... m_N)$ being a vector of traded commodities. Fixed transaction cost of T_i^p and proportional transaction costs are involved when purchasing *i*th from the market with a final price of $p_i(1+t_i^p)$. Similarly, when selling the commodity rural household pays a fixed transaction cost of T_i^s as well as proportional costs, getting only $p_i/(1+t_i^s)$ from unit of sold commodity. Assuming that households are "small", $T_i^p, T_i^s, t_i^p, t_i^s$ are not influenced by rural household' behavior and these magnitudes are positive.

Further, we assume that G(**q, x, K, z**)= 0 to describe a production function of the household, where **q** = $(q_1, q_2 ... q_N)$ is a vector of production outputs, **x** = $(x_1, x_2 ... x_N)$ is a vector of production inputs, **K** is a vector of household endowments (fixed), and as usual **z** is a vector of production function shift variables, such as household characteristics.

With that, the household resource allocation, production and consumption plan, trade flows is chosen such that to maximize its utility given, prices and exogenous income.

$$\underset{q,x,m,c}{Max} \quad U(\mathbf{c}, \mathbf{z}), \tag{2.30}$$

Subject to:
for all $i = 1,2...N$

$$\sum_{i=1}^{N} \left[\left(\delta_i^p p_i (1+t_i^p) + \delta_i^s p_i/(1+t_i^s) \right) m_i - \delta_i^p T_i^p - \delta_i^s T_i^s \right] + E = 0 \tag{2.31}$$

for all $i = 1,2...N$

The latter equation states the budgetary constraint, where, δ_i^p is an indicator of commodity purchase if it equals 1 and 0 otherwise. Similarly, δ_i^s is a sales dummy, being equal to 1 if commodity is sold and vice versa. Budget constraint states that cash income from sales plus exogenous income *E* should be equal to cash expenses for the bought production inputs and consumption goods. These conditions imply that when the household is not participating in the market, the proportional transaction costs will not factor in, and the fixed transaction costs will entirely determine whether the household participates in market or not. In other words, the household's response to transaction costs involves either switching from participating in one market to the other and/or from participation in the market to non participation.

$$q_i - c_i - x_i - m_i = 0 \qquad (2.32)$$

This equation is the first constraint which specifies the equilibrium of the commodities market: Amount of commodities available from production and purchase should be matched by uses of the commodities as inputs, for consumption and sales.

$$G(\mathbf{q}, \mathbf{x}, \mathbf{K}, \mathbf{z}) = 0 \qquad (2.33)$$

This function relates the inputs, household fixed productive endowments and production in a production function.

$$c_i \geq 0, \quad q_i \geq 0, \quad \text{and } x_i \geq 0$$

The last constraint is a non negativity constraint for consumption, production and inputs.

As with any optimization problem with constraints we construct the Lagrangian function of the following form:

$$\begin{aligned} L &= U(\mathbf{c}, \mathbf{z}) \\ &+ \mu\left\{\sum_{i=1}^{N}\left[\left(\delta_i^p p_i(1+t_i^p) + \delta_i^s p_i/(1+t_i^s)\right)m_i - \delta_i^p T_i^p - \delta_i^s T_i^s\right] + E\right\} \qquad (2.34) \\ &+ \sum_{i=1}^{N}\gamma_i(q_i - c_i - x_i - m_i) \\ &+ \theta\, G(\mathbf{q}, \mathbf{x}, \mathbf{K}, \mathbf{z}) \end{aligned}$$

where μ, γ, θ are Lagrangian multipliers associated with full income constraint, resource balance and technology constraint, respectively.

The optimal consumption, production, input use and market participation then have to satisfy the following first-order conditions (FOC), after solving which the optimal supply and demand can be derived. However, the solution requires two steps as indicated in Key et al (2000). That is, first one solves for the optimal solution on condition of market participation, and only then chooses the participation level leading to the highest level of utility.

For consumption, the FOC is:

$$\partial L / \partial c_i = \partial U / \partial c_i - \gamma_i = 0 \qquad (2.35)$$

For output, the FOC with respect to q_i:

$$\partial L / \partial q_i = \gamma_i + \theta \partial G / \partial q_i = 0 \quad (2.36)$$

For inputs, the FOC with respect to x_i is:

$$\partial L / \partial x_i = -\gamma_i + \theta \partial G / \partial x_i = 0 \quad (2.37)$$

For marketed goods, the FOC with respect to m_i is:

$$\partial L / \partial m_i = \mu(\delta_i^p p_i (1 + t_i^p) + \delta_i^s p_i / (1 + t_i^s)) - \gamma_i = 0 \quad (2.38)$$

If $m_i \neq 0$

As a result let us assume that optimization yielded the utility maximizing choice of resource allocation, production, trade, and consumption plans (**x*, q*, m*** and **c***).
For each commodity market, for net buyer household, the opportunity cost of consumption is the effective purchase price (market price plus the proportional transaction cost); for a net seller household, the opportunity cost of consumption is the effective sale price (market price discounted by proportional transaction cost); and if the household consumes only from its own production, the opportunity cost of consumption is equal to the marginal cost of production, which is unobserved shadow price.
i.e.

$$\partial U / \partial c_i \mid_{c_i = c_i^*} = \mu(\delta_i^p p_i (1 + t_i^p) + \delta_i^s p_i / (1 + t_i^s)) \text{ if } m_i^* \neq 0 \text{ and} \quad (2.39)$$

$$\partial U / \partial c_i \mid_{c_i = c_i^*} = -\theta \partial G / \partial q_i \mid_{q_i = q_i^*} \text{ if } m^* = 0 \quad (2.40)$$

Likewise, as a producer, the rural household's marginal cost of production should be equal to the effective price at the maximization choice.
i.e.

$$-\theta \partial G / \partial q_i \mid_{q_i = q_i^*} = \mu(\delta_i^p p_i (1 + t_i^p) + \delta_i^s p_i / (1 + t_i^s)) \text{ if } m^* \neq 0 \quad (2.41)$$

$$-\theta \partial G / \partial q_i \mid_{q_i = q_i^*} = \partial U / \partial c_i \mid_{c_i = c_i^*} \text{ if } m^* = 0 \quad (2.42)$$

The effective price vector for rural household is **p*** = $(p_1^*, p_2^* \ldots p_N^*)$ then the opportunity cost for consumption is:

$$p_i^* = p_i (1 + t_i^p) \text{ if } m_i < 0 \quad (2.43)$$

$$p_i^* = p_{sh,i} \text{ if } m_i = 0, \quad (2.44)$$

where $p_{sh,i}$ denotes the household shadow price for *i*th good

$$p_i^* = p_i / (1 + t_i^s) \text{ if } m_i > 0 \quad (2.45)$$

Also, we can define a full income Y^*:

$$Y^* = \sum_{i=1}^{N} \left(p_i^* (p_i^* - x_i^*) - \delta_i^{p^*} T_i^p - \delta_i^{s^*} T_i^s \right) + E \quad (2.46)$$

which is the sum of profit and external income less sum of fixed transaction cost to enter the market.

Finally, with information on exogenous variables we can then solve for:
-system of demand equations under transaction costs as function of:

$$c_i = c_i(p_i^*, Y^*, z) \tag{2.47}$$

-system of output supply equations under transaction costs as function of:

$$q_i = q_i(p_i^*, z) \tag{2.48}$$

-system of input equations as function of:

$$x_i = x_i(p_i^*, z) \tag{2.49}$$

- and system of market participation equations as function of:

$$m_i = m_i(p_i^*, z), \tag{2.50}$$

depending on whether $m \neq 0$ or $m = 0$.

Thus, one of the implications of the model is that transaction cost affects all system of equations, by modifying the prices that household as producer and consumer face. In presence of transaction costs more of the own production will be consumed since household will be economizing on transaction cost. Fixed cost, which affects the threshold level of market participation, together with proportional cost affects the supply magnitude. Some level of transaction cost by increasing the purchase price for consumer and/or reducing the sale price for a producer will render the rural household autarkic i.e. there would be no incentive for household to produce or use the market. Lastly, price change might affect the position of the household in the market and also induce a different response by different rural households: e.g. net sellers versus net buyers, while autarkic households might not respond at all.

Analysis of household behavior with transaction cost was motivated by the fact that transaction cost lead to missing /imperfect markets for some or most commodities and factors. In many cases the high transaction cost is the main cause for markets to fail. However, for empirical purposes we are more interested in how markets (both perfect and imperfect) affect the households and what the modeling/empirical implications are.

With enabling perfect markets the household first decides on its production function and then decides on consumption decision with full income obtained. By having the same commodity in production and consumption and thus in the utility function of rural household the link between production and consumption is created. Theoretically, it is not important whether household is both producer and consumer of the same good if only household takes decisions based on exogenous prices-prices that are the same for household in terms of sale and purchase. In this case, the household in a stepwise fashion maximizes profits, as a producer, based on exogenous output and input prices, resource endowments and relevant household characteristics. Maximization of profits at the same time feeds into maximizing income. In turn (full) income, along with prices, household characteristics and time endowments, is used to maximize the utility, as a consumer. So, here the relation between production and consumption is recursive or separable (in the sense of independence of each other).

On the other hand, when markets are imperfect or missing (due to prohibitive transaction costs) rural household is not able to make decision recursively. If rural household views the sale/purchase prices, for input and output goods that are both produced and consumed within the household, differing from household shadow prices, then solution to the household problem cannot be derived recursively. Household production and consumption decision is non recursive (and in this sense non separable) whenever household (shadow) price is derived from interaction of household endogenous supply and demand functions. When consumption decision influences the prices of goods used in production function then profit is not just fed into consumption decision but simultaneously influenced by that decision. As a result the production and consumption decisions are simultaneous outcomes of each other and become non separable from each other. Household is then forced to make production and consumption decision simultaneously. So in this case, factors that affect the demand function at the same time affect the supply function of the household.

Thus, the difference between separable and non separable is in interaction between production and consumption. More precisely the issue is whether household is confronted with difference between market prices of production-consumption goods and "household shadow prices" of those goods determined within the household.

To capture the non separability of the household decisions, we follow the approach of Loefgren and Robinson (2003), namely that the direct link is created between specific household and activity (or sectors in the SAM). In conventional CGE models, households are usually related to activities only as consumers of the activity outputs and recipients of the value-added that activity allocates to households. In the model, which is to account for non separability, every activity (production decision) is directly associated with the household consumption decision. In addition, the prices that are used for village SAM estimation related to family labor allocation (household non tradables) are household specific prices. So each activity is household specific and this household embedded activity strikes the specific balance between supply and demand of factors and intermediate inputs which are household tradables and non tradables. Moreover, the institutions/households linked to the activities make their decisions on the basis of the institutional (household specific) prices that clear these balances. Thus the simultaneity of household decision making is ensured by specifying the activities as pertaining only to specific household, embedding the household specific prices and solving the system of equations related to household behavior simultaneously.

Proper modeling of the household behavior requires the full understanding of the factors that drive household decision making. Thus, the knowledge of whether the household can be viewed as taking decision in recursive way or otherwise is of central importance for understanding and modeling the household behavior. The comparative statics of separable households is completely different than comparative statics of non separable households. Model parameters for separable and non separable households differ substantially (Vakis et al. 2004). Therefore in later chapters we will have to empirically test the separability hypothesis for the households that will enter in our village model.

2.4 Specific structure of the village model

The general village model structure discussed above provides a framework within which to describe the behavior of the rural households and integrate the possibility of inter household interactions on a theoretical level. The empirical village model closely follows the structure of the village model by Holden and Loefgren (2005) and is implemented by deriving the supply and demand equations as FOCs of household utility maximization problem. This means that household decision making can be defined and described by two sets of equations: related to production and consumption behavior. Then the difference between the two would yield household surplus for household tradables. Village markets then translate household tradables to village tradables and non tradables with the former generating village surplus as difference between village level demand and supply, eventually forming export and import.

2.4.1 Production

In line with assumption of non separability of household decision making, we will construct our village SAM activities as household specific. By imposing the balance of supply and demand for factors and commodities in household specific activities, the households make decisions for production based on household specific prices which emerge via clearance of the household specific balance of factors and commodities (but allowing for trade for household tradables, which balance outside of household market). Thus, the feature of the village CGE model is that the set of production equations are not just equal to the number of activities, but multiplied by activity per household group i.e. one equation per activity and per household.

In dual formulation, the set of production equations can be defined by production function and set of factor/input demand equations. Production technologies traditionally specified as Cobb Douglas, Leontief or Constant Elasticity of Substitution functions (Shoven and Whalley, 1992). As for the household activities, which at the same time represent the sectors of the village model, we have to follow the SAM structure that we will be explicitly outlined in chapter 4. Namely household activities are on farm activities: crop and livestock; off farm village activities are: renting labor, land, work horse power, tractor and non agricultural sector; and migration for seasonal work outside the village. Crop activities are: potato, wheat, vegetables and fruits, sunflower, and combined maize and fodder, whereas livestock activities are large livestock and small livestock. Inputs into production activities include: household specific, village traded and external (imported) commodities. The set of inputs include factors as well as commodities, which allow for inputs to be produced either by household itself, by other household group or from outside. Thus outputs produced by activities consist of commodities that are used by the same household, consumed in the village by the other households, or sold outside of village in export markets. For external inputs, there are no counterparts in the household and village markets, and thus they are imported to the village to be used as inputs. Export and import markets is the rest of the world (in relation to village) market, which generally implies the rest of the country.

So, the next step is to specify the functional form and structure of production in terms of different activities. In general, the function chosen should be continuous and homogeneous of degree zero and result in a system of demand in conformity with the Walras Law (Shoven and Whalley, 1984). These conditions are needed to ensure equilibrium and simplify the analysis of variations in the prices resulting from exogenous shocks. Generally, we model all household activities with Constant Elasticity of Substitution function (CES) as CES is constant returns to scale function and allows for more flexibility comparing to Leontief and Cobb Douglas functions in terms of choice of the elasticities. In fact, all activities are modeled using the nesting approach, i.e. inputs are nested within some aggregates to form the intermediary input, which subsequently used in production function. This way, the flexibility of CES is enhanced and allows for more realistic production behavior as substitution between different inputs made possible (Löfgren, 2002). This elasticity of substitution is the choice of the modeler and could be varied for various activities and nests. The generic CES function looks as follows (for multiple inputs case x_i) :

$$Q = A\left[\sum_i^n \delta_i x_i^{-\rho}\right]^{-\frac{\varepsilon}{\rho}} \tag{2.51}$$

where:
A is a shift parameter ($A>0$)
δ is a share parameter $(0 \le \delta \le 1)$, which allows for importance of input to vary

ρ is a substitution parameter $(\rho \neq 0, \quad -1 \le \rho \le \infty)$

ε shows the degree of homogeneity of the function. Since only linear homogenous function is modeled in CGE model we have to impose $\varepsilon = 1$.
Final piece of information that we need in order to make this function operational is the relationship between elasticity of substitution (σ) and substitution parameter (ρ), which is:

$$\sigma = \frac{1}{1+\rho}, \quad and \quad 0 \le \sigma \le \infty \tag{2.52}$$

So the CES function is undefined for $\rho = 0$, but as $\rho \to 0$, we can say that CES transforms into Cobb Douglas function. It is this flexibility that makes the CES the most popular function used in CGEM.
The FOC for profit maximization would then yield the input demand:

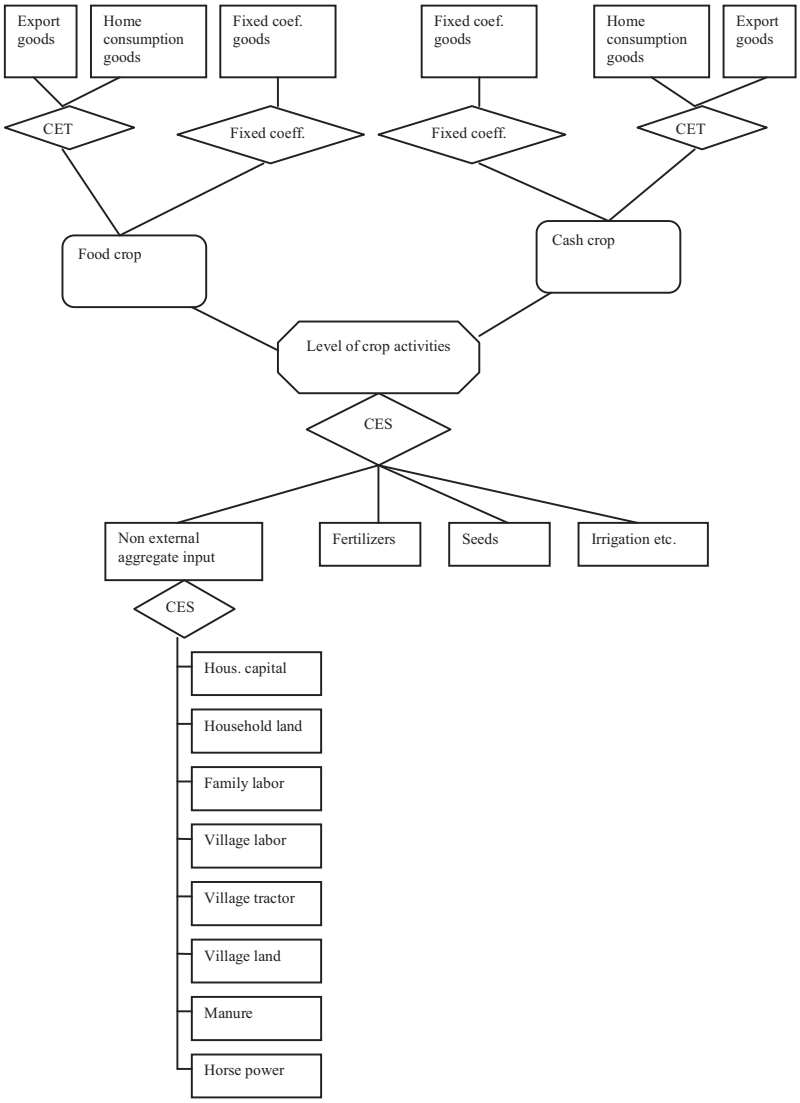
$$W_{x_j} = P * A\left[\sum_i^n \delta_i x_i^{-\rho}\right]^{-\frac{1}{\rho}-1}\left[\delta_j x_j^{-\rho-1}\right] \tag{2.53}$$

where, in addition identified variables:
W_{x_j} is a price of specific input j
P is a price of output Q
i.e. in equilibrium the input is paid its marginal value product.
Closely related and used in our village model is a Constant Elasticity of Transformation function (CET), which is employed for household decision making between home (own) production and production (sale) for export. The difference with CES is in absence of

negative sign before substitution parameter, which make the function concave to the origin.

We start with specifying agricultural crop production activities.
At the top level the CES function combines one composite input and separate external inputs into a composite activity output. As activity produces the multiple commodities, activity is linked with produced goods via two mechanisms. First is simply using a fixed coefficients and second via constant elasticity of transformation function, which define the share of the commodity to be directed for self consumption or for export. Similarly, the aggregate of non external input is put together using the CES function. The structure of agricultural production is shown in Figure 13.

Figure 13: Nesting structure of the inputs and outputs of agricultural crop production



Source: Author's view

That kind of nesting of the inputs is designed to provide an additional flexibility of the production function. The observation of the household production activities in the village points to the fact that there is clear division of inputs as being domestic and external ones. Spatial location of the village on the periphery contributed over time that inputs are viewed through the lens of the geographical origins. The degree of substitutability is greater between domestic inputs (including factors) rather than between domestic and external inputs. The direct transaction costs play not a least role in different levels substitutability between domestic –village and imported- rest of the country inputs. In traditional CGE models the factors are separately aggregated into the value added aggregate and the intermediate inputs. For our production specification we find it more appropriate to separate the nests into domestic and external as this separation reflects the conditions of village. The defining feature of our subject village is its remoteness and marginal location, which definitely impacts the choice of the inputs depending on the origin of the inputs (own produced, village rented or imported from the outside of the village). Again, for the sake of flexibility we do not aggregate the external inputs into one aggregate as it is appropriate to treat them separately.
According to two nests structure the input demand functions derived separately for the two levels of production process. The demand for aggregated non external input is determined by:

$$W_{x_j,a} = P_a^{AGG} * A_a^{AGG}\left[\sum_i^n \delta_{i,a}^{AGG} x_{i,a}^{-\rho_a^{AGG}}\right]^{-\frac{1}{\rho_a^{AGG}}-1}\left[\delta_{j,a}^{AGG} x_{j,a}^{-\rho_a^{AGG}-1}\right] \quad (2.54)$$

Where we added a subscript *a* to specify the activity set and superscript *AGG* to emphasize that we referring to aggregated non external input. This equation according to the solution of the cost minimization problem states that demand for inputs is at the point where the marginal cost of each input is equal to the marginal value product of that input. This also allows aggregating into the combined input from the individual inputs. Accordingly the quantity of the aggregate input is a CES function of disaggregated inputs entering into non external aggregate input (Q_a^{AGG}):

$$Q_a^{AGG} = A_a^{AGG}\left[\sum_i^n \delta_{i,a}^{AGG} x_{i,a}^{-\rho_a^{AGG}}\right]^{-\frac{1}{\rho_a^{AGG}}} \quad (2.55)$$

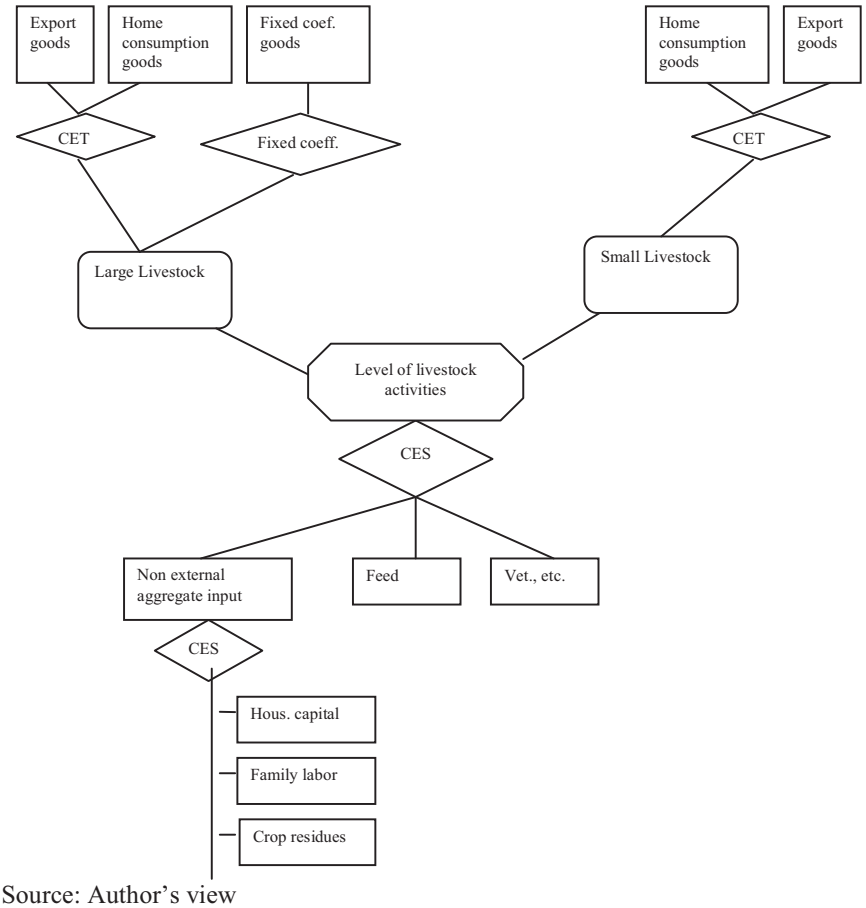
Recalling that in our village model the activities are household specific our input demand equations are also derived separately for different household groups. In addition share parameters are also household specific which allows for difference in production function of different household groups. Similarly, not all households use the same set of inputs. For example, small and medium households are not using the village land and labor, or only medium households use tractor services while smaller households do not need the tractor as their land holding is small. In such cases the inputs not used by household specific activity will simply have a zero amount, while preserving the production specification general for all households.

The top level of production function is similar to the lower level of nest aggregation i.e. it is also CES function. The only difference is that inputs in the top level activity output are different, i.e. external inputs enter individually and non external inputs enter as one

aggregated input, as can be seen in figure 13. The input demand and output quantity equations like for aggregate input case is used, but instead of *AGG* superscript we will define the parameters, prices and outputs as related to crop activity level.

The same principle is applied to the production process of livestock activities. The inputs however, are different i.e. livestock specific. The most illustrative way to show this, is by employing the figure below.

Figure 14: Nesting structure of input and output in livestock production



Source: Author's view

As it can be seen, the livestock activities use less number of inputs compared to the crop activities.

Another important feature of production process of agricultural activities of our village households is the decision to allocate the produce. We refer to our empirical village SAM where households pursue three goals in the course of on farm production. First is self consumption (self sufficiency), second is sale of produce on external markets and third is derive by product in terms of by-product livestock feed in crop production and by-product of manure in livestock production. The by-products are modeled using the fixed shares, calibrated at initial (base) equilibrium, which is reasonable given the nature of the by-products (i.e. feed for livestock). The more evolved case is with other produce. With perfect markets all goods would be tradable and thus substitutable with exogenous prices. However, we established that households in the village treat the goods as specifically for

home consumption and market sale, thus distinguishing them as non tradables and tradables. Therefore, it is necessary to introduce some assumptions regarding the substitutability between export and home consumed goods. Constant Elasticity of Transformation function of output destination takes care of this problem. As we mentioned CET is a CES family function but without negative sing in front of substitution parameter i.e.:

$$Q = A \cdot \left[\delta \cdot QE^{\rho} + (1-\delta) \cdot QH^{\rho}\right]^{\frac{1}{\rho}} \qquad (2.56)$$

where:
A is CET shift parameter ($A>0$)
δ is CET share parameter $(0 \le \delta \le 1)$, which allows for importance of goods to vary
ρ is CET transformation parameter $(\rho \neq 0, \quad -1 \le \rho \le \infty)$, which reflects the imperfect transformability between two destinations
QE is quantity for market sale (eventually directed for outside market -export)
QH is quantity of home (self) consumption

Profit maximizing level of production for home and market sale can be derived by defining a profit of a household (Π) as difference between total revenue (TR) and total cost (TC) or exhaustion of outputs in terms of destination, i.e.:

$$\Pi = P \cdot A\left[\delta \cdot QE^{-\rho} + (1-\delta) \cdot QH^{-\rho}\right]^{-\frac{1}{\rho}} - PE \cdot QE - PH \cdot QH \qquad (2.57)$$

where PE and PH are export and home specific prices respectively and P is a composite price of commodity.

Taking the first order conditions for profit maximization with respect to QE and QH given the two prices (on export and household markets) and subject to the CET function would yield the following profit equilibrium condition:

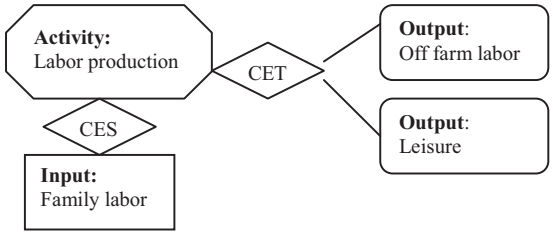
$$\frac{QE}{QH} = \left[\frac{PE}{PH} \cdot \frac{1-\delta}{\delta}\right]^{\frac{1}{\rho-1}} \qquad (2.58)$$

This then allocates the household specific output to two alternative markets: export and home. Similar to CES the elasticity of transformation, ω and parameter ρ is related by $\omega = \frac{1}{1+\rho}$ and as ω is between 0 and 1, the ρ varies from 1 to ∞. This is to ensure that, associated with transformation function, isoquant is concave to the origin and the problem of sharp "corner solutions" is avoided.

As we outlined, the main principles of on farm agricultural production, the task of defining the production process of remaining activities is straightforward. In addition, since in our survey we focused more on agricultural activities, the off farm activities are simpler to model given the less complex structure of input use. First we provide a graphical structure of the village renting activities (which the first off farm activity that household engage in). The feature of renting activities is that households use their factor endowments as their inputs in order to rent them out. For village labor renting activity the households use, in addition to family labor, their off farm labor which is output of

specific activity called (off farm) labor producing activity. In turn, the off farm labor producing activity uses the family labor and trades off the off farm labor with leisure.

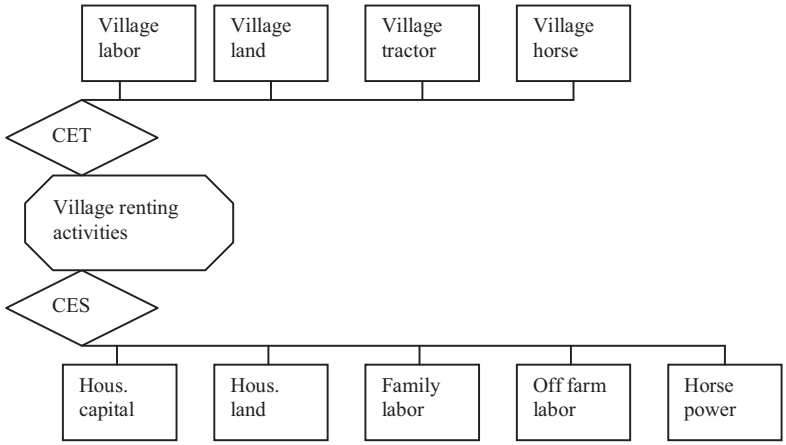
Figure 15: Nesting structure of the off farm labor production



Source: Author's view

For sake of saving on space, the structure of different village renting activities (village non tradables) is aggregated into one figure 16.

Figure 16: Nesting structure of input and output of village activities

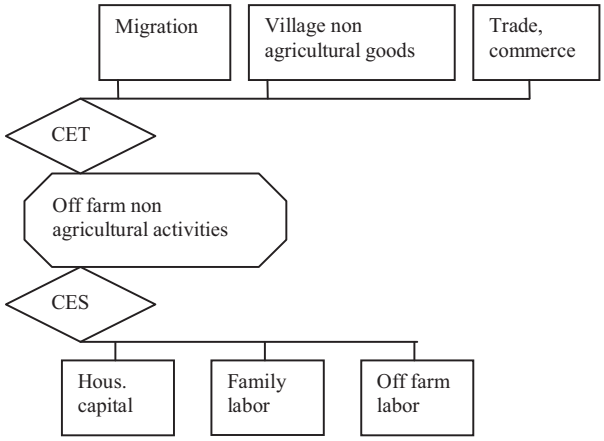


Source: Author's view

This is general structure of village activities, and it has to be noted that not all activities use all inputs. For example, village labor does not use the household land and thus this input for this activity is zero. Similarly, each activity produces only one output and thus the CET function plays a nominal role as output is equal to activity level. When the SAM is constructed, we will see that village labor and land is provided only by small and medium land holders, whereas the demand for these inputs comes from large land holders. Thus demand for village land and labor is a sum of demand by large household derived from its agricultural activities. We also assumed that share of small and medium holders in that demand is given as in the base year. On the other hand, large land holders provide village tractor services and horse power which are used by small and medium holders. These services come with labor and demanded according to activities' demand of these households, which implies that production decision determines the amount of these village services needed and then supply adjusts.

Finally, for the sake of completeness we outline the structure of the off farm non agricultural employment activities of the village households, which in many aspects looks the same as for off farm village activities.

Figure 17: Nesting structure of the off farm/off village activities



Source: Author's view

2.4.2 Consumption

To conclude on behavior of rural households within the village model, we need to define the consumption decision making of our villagers. The utility maximization problem subject to utility function and income constraint of households provides a framework for describing the consumption behavior. As McDonald (2003) points out the CES functions are rarely applied for defining the utility function. The Cobb Douglas function is in many cases the convenient choice as the unobservable nature of utility concept can be avoided. The flexible nature of CES function does not allow for the assumption that consumers consume a fixed proportion of their disposable income to each good. On the other hand the fixed shares of expenditures in the Cobb Douglas function are not a realistic specification. With changes in income, one would expect the changes in expenditures shares on different goods. For example, with higher income the household may demand more of better quality and luxuries goods. In Sadoulet and de Janvry (1995) different demand systems are described, among them Almost Ideal Demand System (AIDS) and Linear Expenditure System (LES). AIDS is flexible but demanding system, in terms of parameter calibration and may lack the global regularity. On the other hand the LES is flexible, amenable to welfare calculation and allows for subsistence minimum, which is important for rural households; as such the LES is our choice of demand system.

As Sadoulet and de Janvry (1995) indicate the LES is derived from Stone –Geary utility function:

$$u = \prod_{i}^{n} (q_i - c_i)^{\mu_i} \qquad (2.59)$$

Where: q_i is quantity of good i, c_i is minimum subsistence level of consumption of good i, and μ_i is marginal budget shares, which show the change in expenditure with change in income. Also $(q_i - c_i) > 0$, the consumption cannot be lower than subsistence level,

and $0 < \mu_i < 1$, *while* $\sum_i \mu_i = 1$, i.e. budget shares are restricted to be positive and does not allow for inferior goods. Using the full income constraint *y*, forming the Lagrangian and differentiating the latter we can derive the demand functions which enter our linear expenditure system (see Sadoulet and de Janvry, 1995):

$$p_i q_i = p_i c_i + \mu_i \cdot \left(y - \sum_j p_j c_j \right) \tag{2.60}$$

where p_i denotes the price of good *i,* and *y* is full income

So the expenditure for good *i*, is split into two terms. The $p_i c_i$ term is the minimum expenditure for good *i*, which the household is committed in order to obtain a minimum subsistence level of consumption, i.e. household purchase this first. Then the term $\sum_j p_j c_j$ indicates the amount of minimum expenditure on good *j*, while term $\left(y - \sum_j p_j c_j \right)$ defines the so called supernumerary income which is left after purchases of minimum amount of required goods *i* and *j*. Then this supernumerary income is by fixed shares μ_i spent on the same commodities. This way the subsistence goods which have large budget shares and smaller marginal shares would be allocated the smaller share of total expenditures as income increases and thus confirm to the realistic behavior by household.

In case $c_i = 0$ for all goods, we end up with usual Cobb Douglas specification. By manipulating the LES demand functions we can derive that income elasticity is positive, whereas own price and cross price elasticities are negative with magnitude depending on μ_i. This is in contrast to Cobb Douglas specification where income elasticity is unitary, own price elasticity is equal to minus one and cross price elasticity is zero, which are very limiting assumptions for consumption behavior.

The main disadvantage of the LES is that it implies a linear Engel curves which is not holding in large intervals of income change, but for smaller income changes we still can use this framework.

With available data on our village households we calculated the total consumption expenditures, so we need to be able to define the subsistence and beyond subsistence expenditures in order to calibrate the demand functions. Thus the choice of specifying the parameters for subsistence consumption and marginal budget shares have to be made, in other words we need to calibrate the parameters μ_i and c_i. In practice the frequent choice is to use some ideas about income elasticities and derive μ_i (given as a product of income elasticity and share of expenditure on commodity *i*). For c_i the so called Frisch parameter is used, which on a general note establishes a relationship between own-price and income elasticities. To illustrate the calibrated subsistence consumption levels of each household and demonstrate the set of goods which household consume we provide the following table.

Table 3: Subsistence consumption of goods (as share of output by households)

	H1	H2	H3
Potato	0.43	0.36	0.28
Wheat	0.35	0.29	0.21
Maize	0.38	0.31	0.21
Sunflower	0.42	0.33	0.29
Veggies and fruits	0.50	0.38	0.45
Large livestock	0.22	0.20	0.18
Small livestock	0.27	0.26	0.19
Non agric. goods	0.03	0.02	0.02
Village non agric. goods	0.08	0.15	0.28
Leisure	0.50	0.62	0.64
Processed food	0.08	0.27	0.18
Non food (manufactured)	0.07	0.27	0.19

Source: Author's estimation

Since the utility function is specified we might use that information to see the changes in the welfare resulting from some exogenous shocks. Comparing the impacts to the base run equilibrium which is reflected by base SAM we will be able to measure the welfare changes in terms of equivalent variations. Following Sadoulet and de Janvry 1995 the equivalent variation represents the willingness to accept the change on the part of households:

$$EV = y^1 - y^0 - \left[e(p^1, u^1) - e(p^0, u^1)\right] \quad (2.61)$$

Where e is expenditure, y is income level, p is price level and u is utility and superscript indicate the change from 0 to 1 (period). For base run level of prices, utility and income the equivalent variation simplifies (Kuiper, 2005) to:

$$EV = \left[e(p^0, u^1)\right] - y^0 \quad (2.62)$$

With the Stone Geary utility function the expenditure function is estimated (Sadoulet and de Janvry 1995, Kuiper, 2005):

$$e = \sum_j p_j c_j + v \prod_{ji} p_j^{\mu_j} / \mu_0 \quad (2.63)$$

Where v is indirect utility and :

$$v = (y - \sum_j p_j c_j)\lambda, \quad with \quad \lambda = \mu_0 / \prod_j p_j^{\mu_j} \quad and \quad \mu_0 = \prod \mu_i^{\mu_i} \quad (2.64)$$

with this information we then might compute changes in welfare for comparison.

The final note is on how village model is balanced. The prices of export and import goods are exogenous and thus fixed outside the model, i.e. we use small village assumption for externally sold and bought goods. For the goods that are consumed by households themselves and in the village the prices are modeled such that they balance the specific household and village supply and demand.

Factor endowments that are used for on farm and off farm activities are fixed at the base level. Thus the prices for factors adjust so as to balance the fixed supply to the demand, imposing the full employment.
On the consumption side the budget constraint is a constraining factor. All income comes from factor income, except for transfers from government and rest of the world. The transfers are fixed shares of income and thus are not behaviorally modeled.
Saving investment account plays a passive role in our village model which is of static and not dynamic nature. Saving rates are fixed shares of income and saving is made to match the investment.
Finally, the local government and rest of the world account both impose equality between expenditure and income and import and export respectively. As we noted earlier the village model does not have the exchange rate and no trade deficit with rest of the world is allowed.

Like other CGE models, our village model is based on SAM, but constructed for the village. Base SAM exactly represents the equilibrium. The functioning of general equilibrium model relies on the concept of calibration, given that behavior of household in the model is characterized by specific functional forms such as CES that illustrate consumption and production-related behaviors. Generally, the calibration involves determining the numerical values of the various parameters of functions compatible with the equilibrium of the initial SAM. So the base run of the model with imposed model parameters should match the base SAM. For the less flexible forms like Cobb Douglass the information contained in SAM is sufficient to derive the values of parameters. In the case of CES the information contained in the SAM is inadequate for the calibration of all parameters. Thus the estimates of some parameters, called free parameters, such as the elasticity of substitution, the income elasticity, Frisch parameters are required for calibration. There are two ways for these parameters to be defined: first is to estimate econometrically, second is to postulate based on previous studies or countries. Since this is first survey we conducted for our village and thus we do not have sufficient time series we are not able to estimate the needed parameters econometrically. As such we follow the second approach, i.e. we impose the parameters derived from similar studies on village CGE, which is a standard way in many CGE studies. As there are no many village general equilibrium models and every village CGE is highly regional specific in terms of activities, households we use the studies by Holden and Loefgren (2003), and Kuiper, (2005) as base studies for the choice of elasticities.

3 Description and spatial aspects of the subject village; Empirical analysis of the rural household data

3.1 Case village "Sarytalaa" and the spatial context

Before embarking on the village SAM construction, we provide a review of the subject village in a descriptive way, as this would provide a basis to define the specific content of the village SAM and place the village in the regional context.

The specific choice of the village (out of dozen other villages in the region) was based on multiple criteria: geographic-representativeness, logistic access, attitude of local authorities and households etc. The village Sarytalaa was then chosen as meeting all the criteria. The rural economy in rural sector of Kyrgyzstan is centered around rural households who are in turn clustered in the villages. Assessing the impact of policy or other exogenous changes therefore calls for understanding the linkages between rural households in the village setting. Thus the village SAM and village model enable us to capture the complex inter linkages among village production activities, village institutions and outside world. The additional aspect of focusing on a specific village rather than only on rural households across the country is derived from regional perspective to rural development. It could be argued that, in the literature the spatial dimension to economic activities, decisions and characteristics of households has been largely overlooked. The economic activities, especially in periphery, have distinct local bounds. The village isolated from rest of the country/economy by geographical distance and higher transaction cost should be viewed as important and intermediate link-unit between households and markets. The large number of the villages (as economic units) in the rural area is geographically distinct entities. Low standards of living in those areas is not just attributed to the differences in household characteristics, but arguably in big part is explained by geographical dimensions and related lower quality of public services and infrastructural development. These factors in turn affect the rural infrastructure and lead to higher likelihood of rural households remaining in poverty. Accordingly, the present study in contrast to other studies takes the spatial aspect explicitly and focuses on the village as unit of analysis.

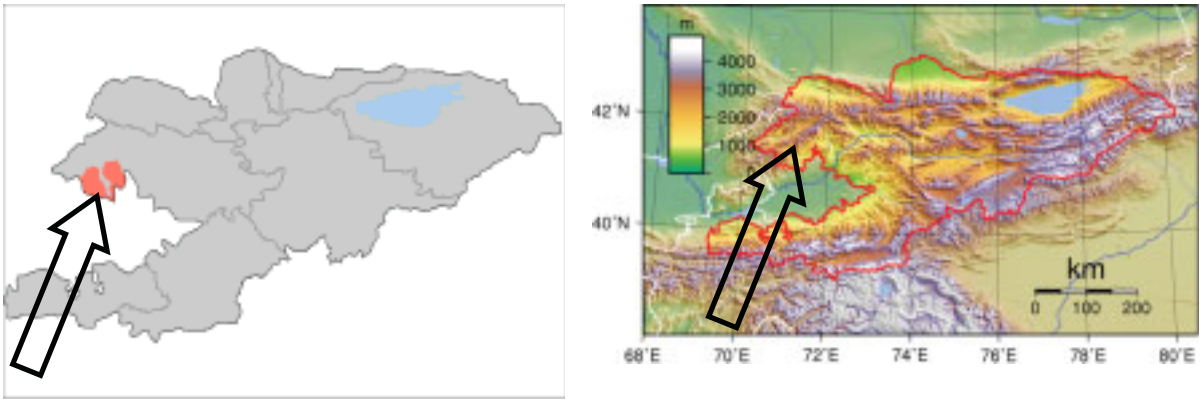
The present research is entirely based on household data collected by the author in the Djalalabad province of the Kyrgyz Republic in the village called Sarytalaa (loosely translated as "Yellow field") in February 2008, covering the year 2007. Data collection in the subject village was an integral part of the present research project. Stratified random sampling produced the sample of more than 300 households, after processing the household questionnaires the data of 281 households were accepted as valid.

For the village survey, the enumerators were hired and trained from the local base but not from the same village. Households were selected randomly from the list of village households from the village data provided by local authorities. Interviews were structured and head of households were informed in advance on possible interview. Primarily head of households were surveyed, but on many occasions the other members of the household were asked on particular sections of questionnaire.

On the household side detailed data was collected including demographics, production, consumption and incomes. Household production data on all aspects of agricultural production was gathered including cost structure and produce sale as well on farm consumption or use. Household budget expenditures on main items were surveyed including the collection of data on education and social activities. Incomes from primary and secondary sources were recorded. To calculate values the quantities and prices were included in the questionnaires. All data is location-village specific and together with quantities and prices the location/destination of sale or purchase was identified. This is one of the main features of the village survey, which make it different from typical rural household surveys. In addition to the survey, in order to support information obtained at household level and other village level data, an expert group discussions has been carried out with participation of knowledgeable local experts.

The district where the subject village located is the most western part of the Kyrgyzstan, bordering Uzbekistan and Fergana valley (see maps below). Djalalabad region covers 33,647 square kilometers in the south-west of the Kyrgyzstan. The southern edge of the region is part of the Fergana Valley, however the borders of the region are the inter country borders and region is almost entirely land of mountains (i.e. Fergana Valley is on the Uzbekistan's territory, which is difficult to access given the strict border control).

Figure 18: Map of Kyrgyzstan and location of the study village



Source: Wiki map

The village is highland village and elevated at 1900 meters above the sea level, on the south hills of Chatkal Mountains. The climate in the village as in the rest of the country is typical continental; however, due to proximity to mountains the village enjoys more rainfall than average norm. Mean rainfall in the region is over 100 millimeters and there are two rainy periods first from April through June and from October till November.
Average summer temperature rises to the level of 28 Celsius degree and in the winter it gets to minus 20 C degrees. Vegetation period starts in early April and stretches up until end of October (7 months). The agricultural lands are dominated by clayey type soils, which are laborious to cultivate.

Figure 19: Landscape and road connection of the village

Source: Google map

Sarytalaa village is remote village; it is located more than 200 km from province center (Djalalabad). Village Sarytalaa is not very well served in terms of transportation system. It is connected by gravel road with district center (15 km) and from there the most important connections are the asphalt roads leading to Uzbekistan border and central cities. The borders are frequently closed and the only road that connects the village and district with the rest of the world is through the mountains, which are on high elevation and inaccessible most of the time during the year. Village and district inherited from the Soviet era the well established social infrastructure (1 health care center, 2 schools, 2 kindergartens, 1 cultural establishment, electricity grid network etc). The village is fully electricified, though the electricity is not always available due to frequent blackouts. The village also has couple of retail shops. On the other hand, it is reported that only 32% of households are provided with clean water, the rest is using the water from small canals running through the village from the nearby mountains.

It is quite populous village consisting of 3 412 persons living in 796 households. Ethnically, the village is quite homogenous, consisting of Kyrgyz, unlike other southern parts of the country. As observation established, the population of area is mainly comprised of farm households. The region is densely inhabited and main activity of people is agriculture. As a result of reform and privatization the land is in private hands of independent household farmers. Villagers report low soil quality. The main reason for declining fertility is high prices for fertilizers and thus low application of fertilizers as well as malpractice of agronomic principles of land cultivation (e.g. cultivation of the same plant over and over).

In terms of incomes, all farm households earn livelihood from the on farm production and at least from one more source of nonagricultural and non farm activity. The province of Djalalabad where our study village located is among the poorest provinces in the country. In large it represents the south rural region of the country, as is located on the hills of the mountains on the one side and Fergana valley on the other side. Interestingly, the well-known spring uprising of 2005 which resulted in fleeing of then President Akaev and was

provoked by poverty and corruption, was originated in the district where the subject village is located and many residents of the village took active part in that so called Tulip revolution in 2005. The Djalalabad region is predominantly agricultural region. Private farmers in the region grow and specialize in wheat, fruit, vegetables, maize, nuts, tobacco and silk-worm cocoons. From the Soviet era, the region inherited few textile plants which constitute the industrial base of the province. The region authority's report of having some deposits of natural resources like minerals, natural gas, coal, metals and oil, but the extraction of these resources demands capital intensive investments. In the post liberalization era, most of the extraction of minerals, natural gas, coal, metals and oil of the Soviet era has ceased completely, making the region solely agricultural.

Land in the village is a midland - the transition land from high land to low land. Most of the land is rated as medium potential land for agriculture and is on the flat side of the hills, which is intensively farmed. The higher elevations are covered by pastures and mostly clear from forest. There are many small streams which run from highlands and in large provide source of potable as well as irrigated water. Agriculture was always the main livelihood of the region and village. In terms of market access, the village is relatively isolated, lacking direct access to big markets and suffering from high transportation costs.

The village was officially established in 1928 with the onset of the Soviet rule in Kyrgyzstan. By 1985 the village was set to specialize in small ruminant breeding and tobacco growing activities in form of soviet farm. As majority of soviet farms in the republic, the village was operating exclusively on donation from central republican budget amounting to 35 % of collective farm budget.

As it was the case in the rest of the country agricultural reforms "hit" the village starting from 1995, when soviet farm was reorganized into joint stock company, which later was dissolved into private farms and 2 farmers associations.

The independence of farmers from state control and plan led to mixed results. One notable change that many observe is income differentiation, from relative equality during the soviet period, the after reform period brought notable divergence in income among population. According to estimates of local authorities, 7 % of the households are very rich, 20 % is upper rich, 60 % is middle and 13 % is poor group of households. This is according to local benchmark which is very low compared to country benchmark. It is believed that those who are well off are those who used to be soviet farm elite managers: well educated and well connected management, technical staff. On the other hand, the rest of the population, although received the land and some assets could not make the profit out of privatized assets. Many report the difficulty to access the inputs and high prices for inputs as the main reasons for low profitability (most cited inputs: fertilizers, seeds, fuel, tractor/combine etc).

In terms of market access, the village is isolated and thus agriculture serves mainly for growing subsistence crops (food crops) and only limited part of crop production goes for sale. Farm production in village is mostly irrigation based. In terms of irrigation, the farmers report plenty of water supply and canal infrastructure for crop production. Thus one of the threats to agricultural production comes not from shortages of water or draught

but from unexpected and late (into spring and summer) air freezing. Farm sizes vary but majority is small, 70 % of farms are under 1 ha of land. The population in village is occupied by both livestock and crop production, to the ratio of 40 % to 60 % respectively. The main agricultural crops for the village are: potatoes wheat, maize, fodder, sunflower. Reform years resulted in reorientation toward food crop away from tobacco. Some village produce of fruits is sold (conditional on border situation) to closest cities Namangan and Kasansai in Uzbekistan, or sold in the village and then exported by traders. The majority of vegetable produce goes to household consumption. The same is true for domestic livestock which is held for subsistence and as investment asset. Land as is the case for the south of Kyrgyzstan is scarce averaging 0.12 Ha per person. In fact, the privatization of land was carried out based on estimation that per member of rural family receives the 0.12 ha of land. Taking the average farm household which would consist of 5 member family the rural household possesses 0.62 Ha of irrigated land. Further the average household would own 1-2 cows and up to 10-15 sheep.

Keeping the cows, sheep and chicken is most important strategy and occupation for villagers. Almost every household raise livestock and more than half gain some income from livestock in some form. As authorities report, there is shortage of grazing land and the limit for more livestock to have. In the spring, the majority of cattle are sent to the mountains, where the main pasture lands are. The cattle come back to villages in late spring to weather the winter with households. Unlike crop output, livestock is more marketable product. Traditionally and more so in transition period the wealth is stored and measured in livestock numbers. The more livestock is held by household the more land is needed to provide for feed.

Not long ago, tobacco was the main cash crop in the subject village, however due to input intensity, and low prices for raw tobacco, which villager relate to monopolistic position of trader (when only one trader was buying the whole output) the tobacco was crowded out by other crops.

In addition to the village agricultural employment households in the village engage into village non agricultural work. Non agricultural activities are derived from agriculture, such as sunflower oil pressing and processing, wheat milling, agricultural machinery services and repair. Non agricultural activity also aggregates a great deal of variety of work that villagers produce for their fellow villagers like construction, trade and retail, transportation and all kind of village non tradable services, crafting, souvenir etc. All those local businesses are mostly family owned and operated, as well as of small scale. Small number households run capital intensive processing equipment, including processing, tractor services and transportation.

Limited processing is done within the village and no large storage premises available there. Seeds for agriculture mainly come from both retained harvest and from traders/ markets. And bulk of manufactured inputs (fuel, mineral fertilizers, spare parts, livestock vaccine etc) are imported from outside village - from the rest of the country by traders. Traders also import food stuff and other commodities not produced by households.

Another important activity for local households is the seasonal migration to work outside of the village, mainly work in capital, province center and on some cases abroad. We do

not have information on permanent migration and in fact permanent migration is not an activity. All village households engage in that type of activity, but to a different degree.

Local authorities note the steady move of labor from agriculture to non farm and mostly migration to capital cities or abroad, reflecting lower employment opportunities and constraints in agriculture, thus pushing the labor out. Seasonal agricultural wage, construction work, government work are the only alternatives to farm work and migration. Migration and remittances that migrant send home are becoming the important feature of the subject village economy. Remittances from internal and external migrants account for sizable share or more often the only source of household monetary income. On average, 1 person per household in every 5th household migrated either to the capital or abroad (Kazakhstan, Russia), reflecting the changes occurring in rural economy in transition and in aftermath of opening up of rural sector due to agricultural reforms.

Since the reported cost of machinery, spare parts for machinery and fuel are prohibitively high for local farmers, crop production is increasingly carried out by man and animal power. Horses are the dominant draft power for agricultural operation, although tractors are also used, but due to high demand in peak seasons, tractors are not always available. Majority of work is done by family labor, but hired labor is also important factor in production stages like: plowing, cultivating and harvesting.

The private land property rights were just recently introduced in Kyrgyzstan, in 2005, with imposed moratorium to sell and purchase the land until 2007. Moratorium was imposed to reflect fears that poor private farmers would sell their land right away to richer people (especially of foreign origin) ending up with land inequality. However, even after the moratorium was expired, there was no functioning land market. In part this attributed to general poverty and financial unattractiveness/unprofitability of the agricultural sector. It did not make any sense for any investor to buy land as an asset which is not producing the acceptable rate of return. On the other hand the embryonic stage of the land market is explained by low level of development of the legislation base to support the land market. Procedures to register the property rights and securing the property rights at the nascent level and as such land in many cases is not sold but rented out on unofficial basis.
In our village, the small and medium land holders are the ones who are asset constrained. For households, ensuring self sufficiency is their primary goal, the remaining land which mainly the land on the field is normally rented out. About third of the land of the small holders are rented out, whereas only 10 % is rented out by medium households.
Due to relative remoteness of the village, land is rented to the households of the same village, as villagers have better information on who and what land can be rented in. On a net trade basis, the net renters of the land are large households, and the small and medium households are those who rent out the land. Thus land rental market is village specific and represents of the ways of interactions occurring within the village.

Another example of local interactions between households is animal draft power rental market. Observations revealed that different households own horse power differently. Again, the larger households tend to have more asset and own larger livestock, which allows them to rent the horse power to the net demanders – small and medium households. The price of rent normally includes the services of the owner, since owner of

the horse, fearing the improper treatment of his animal, views the horse rental service non separable from his service of accompanying the animal. Thus the price of this service reflects the price of two factors. The size of this market is not large but could not be ignored.

Much more important local market is the market for hired agricultural labor. Villagers reported that all hired labor comes from the same village. Net providers of the village agricultural labor are small and medium households. Additional in depth study is needed to find out why some households prefer to rent out land and rent their labor instead of retaining land and their labor for their own production. As villagers reported, reasons like: the lack of experience, general inability to sustain the commercial agricultural production leave some households better off by just renting out their factors on the seasonal basis. It is less risky strategy and also the strategy allowing of cash earnings.

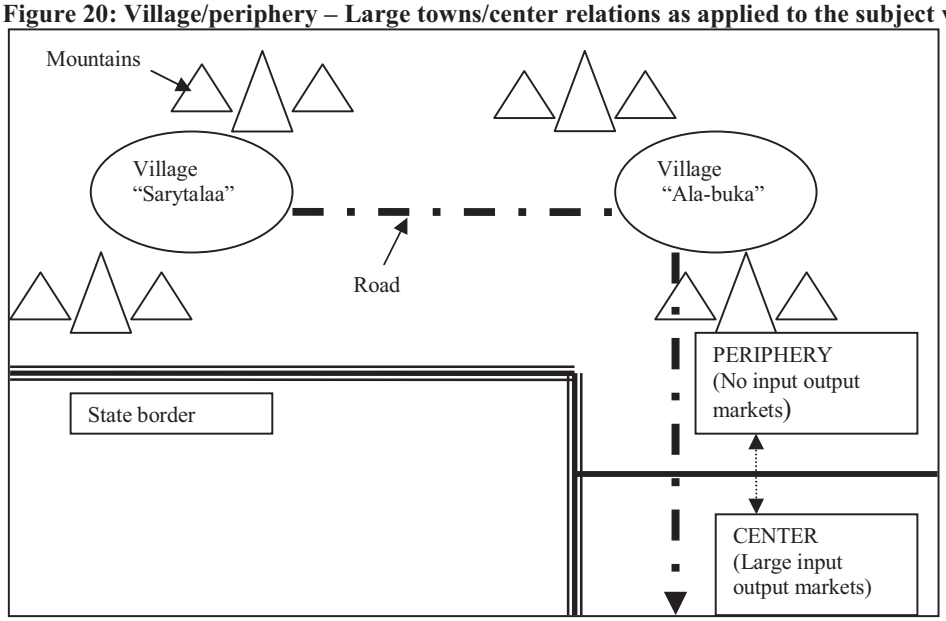
Thus, the main intra village interactions between households take the form of providing agricultural labor, renting land, production of village consumption goods and services. These market interactions within village could create local linkages and feedbacks that influence the impact of economic and environmental policies. In any village community, differences among households are obvious due to difference in ownership of resources mainly of land and labor, and this influences household's participation in different markets which ultimately generates heterogeneous responses to policy-induced and exogenous shocks.

Looking at the village and its condition one could conclude that the village incorporates many features of the rural sector of the south of Kyrgyzstan. The south region of Kyrgyzstan was always dominated by agricultural activities. Compared to the urban north of the republic, the south had few industrial sectors. These were the processing factories of cotton, tobacco, oil seeds and fruits. Thus even in Soviet times, the South was considered to be the lagging region with undeveloped infrastructure, high population and poverty. Moreover, within the regions itself the spatial structure of the center-periphery type was maintained. The center of region was industrialized and promoted whereas the peripheries (villages) had to be reliant on centers. As the supply of the necessary inputs and materials to the peripheries was carried via regional centers, which in turn relied on central (republic center) funds, the collapse of the system resulted in worsening conditions for the villages. In the aftermath of the economic reforms of 1991-1998, the regional economies are still undergoing the structural transition. The current spatial structure is such that capital city and few others are the main recipients of the investment, which reflect the attractiveness of the regions/industrial base and perhaps economies of scale. Thus the problems of the economic development of the regions and peripheral areas are not only related to the collapsed economic linkages with the center, but hindered by lack of capital long term investments on the local level.
This geographic context is of high importance and of direct relevance for our village. The lack of economic base (infrastructure, skilled labor), barriers in accessing the centers create the gloomy future for the remote rural areas. Out migration, which is the natural response of the most young and skilled individuals is not going to resolve the problem. In many respects, the rural households are the ones who are poor with low human capital. These factors restrict their capacity to migrate. Moreover, migration is risky and not costless strategy, which further limits its feasibility. This highlights the importance of

geography of the subject village for the economic analysis of the growth options. The village analysis gives the center stage to the evaluation of the effects of the "access improving" on the economic development. This underlines the critical role of the distances, relating the village with the sources of supply and demand, transport facilities and population centers, in the analysis of the comparative advantages of the village.

Distance, access to markets, the local economic conditions are the primary factors that might explain the current situation and options of the subject village. The regional context of the village is such that it is at quite distance from the sources of agricultural inputs and energy on the one hand, and to the population and demand centers on the other hand. Access to the main transport roads and thus to the public services and industrial center is not easy, due to mountainous relief and lack of infrastructural investment. This isolation from regional demand centers limits the growth potential of the agricultural sector of the village. The village remoteness also creates problems for the diffusion of the new better technologies as well as access to the investment and credits.

Figure 20: Village/periphery – Large towns/center relations as applied to the subject village



Source: Author's view

The description of the spatial dimension of the village underdevelopment points that village relation with the rest of the region and country can be conceptualized with the periphery-center type of relations, inherited from centrally planned economy. The relationships in the south of the country was characterized by strong centers located in Djalalabad (200 km) and neighboring Uzbek city (40 km), where the processing (tobacco, cotton) and higher value manufactured goods (textile) were done. So over the years and especially after the collapse of the planned economy, the main infrastructure remained in those centers, whereas the rural and remote areas witnessed decline in the availability of the infrastructure. Rural areas used to be simply the highly specialized suppliers of the raw materials. In the post soviet framework, similar concept could be applied to the predominantly agricultural regions as the Djalalabad region in Kyrgyzstan. Broadly speaking the province has two types of the rural areas: those located close to transport infrastructure and more on valley and those that are remote and located on hills, isolated

by mountains or by border. The first type of villages is more wealthy and commercialized, growing cotton, tobacco, veggies and fruits. The peripheral villages are less mechanized, with less land holding and less sales for market. In terms of distances the more distant the village is from the mountains the better access to various services and inputs the village has. Thus the existing spatial and economic situation of our subject village is a result of the mountainous location and legacy of the planned economy practiced in the region before.

The understanding of these village characteristics should be of importance to policy makers thus allowing them to promote local development of the periphery and increase regional integration. The point is not just to support the periphery but to benefit the region and country as a whole. From a spatial perspective, it is derived that unified strategy (one policy fits all regions) is not necessarily the best way of achieving the regional development in the rural areas. Substantial differences between the local economies of the periphery call for different policies, and for more resources to be directed to the periphery that is disadvantaged, so that it may 'catch up' with the centre and more wealthy counterparts.

For the agricultural sector to achieve its potential, investments in rural infrastructure are necessary. Since agriculture is the backbone of the rural sector, effective links need to be established between this sector and the larger regional economy, through investments. However the investment needs are different in different peripheral areas. For example in the subject village irrigation is not an issue, but the lack of mechanization greatly constraint the production. The same with the technology package, and agricultural research and extension are more in need in remote villages. What we derive from center-periphery concept is that better access to capital/credit, input and output marketing, agricultural extension and transportation can lead to increased productivity in the periphery-village.

3.2 Empirical test of (non) separability of rural households in the subject village

The natural extension of the descriptive overview of the village in the context of the region is a presentation of the empirical test of non separability of the rural households in subject Kyrgyz village. The test of non separability is presented to manifest the market circumstances that rural households in remote village face. In other words, the discussion of non separability is a way to point to market environment. So, indirectly the test would help us to determine that factor markets for village households are imperfect. Econometric test based on real data of households is an important step in understanding the market conditions in which Kyrgyz independent farmers operate and provides vital information for subsequent SAM and village model construction. Since we need to know how household make decision and based on which prices. In this regard, the test points whether shadow/household specific prices for family labor, household land and other household non tradables should be used instead of alternative prices (which would be the market prices of the close substitutes).

One can identify several leading studies that empirically tested the issue of separability for developed and developing countries using different econometric model specifications.

Benjamin (1992), Bowlus and Sicular (2003) used the reduced form test of separability assuming homogeneity in households and concluded on non separability of subject households in Java and China.
Jacoby (1993) for Peruvian households, Skoufias (1994) for India employed structural form to estimate the shadow prices of inputs and comparing them to observable/related prices concluded on separability / efficient market assumption.
Vakis et al. (2004) estimated the probability of households to behave as if they were separable or non separable and then verifying that indeed ex post classified non separable households take simultaneous decisions on production and consumption.

In many cases, including the present study the empirical studies of non separability used the same theoretical framework, initially developed by Lopez (1984) and latter extended by Jakoby (1993).

3.2.1 Non separability and imperfect labor market

Assuming utility maximization behavior we consider the rural household whose utility is derived from consumption c and leisure time l. Household's total time could be allocated to leisure, on farm work L^F, and off farm work L^O which pays wage rate w.
Algebraically a household solves:

$$\max \; u(c,l;a) \quad w.r.t. \quad c,l,L^O,L^H,L^F \; ; \tag{3.1}$$

s.t.

$$cP = P * F(L;A) - wL^H + wL^O + y, \tag{3.2}$$

$$T(a) = l + L^F + L^O, \tag{3.3}$$

$$L = L^F + L^H; \tag{3.4}$$

where, a is a vector of household characteristics related to consumption, P is price level, A is land endowment, L^H is a hired labor, y is exogenous income.
Rearranging above, the full income is $M \equiv c + wl = y + \rho(w;A) + wT(a)$, (3.5)
where $\rho(\cdot)$ is a profit function.
Standard assumptions also hold: $U(\cdot)$ is increasing quasi-concave function and production function $F(\cdot)$ is increasing and concave.

Let us define household labor supply:

$$T(a) - l(w, y + \pi + wT(a); a) = L^S(w, M; a) \tag{3.6}$$

When the off farm labor opportunities are limited $(\overline{O})$ at given market (exogenous) wages (w), then: $L^D(w,A) + (\overline{O}) < L^S(w,M;a)$ i.e. on farm labor demand and off farm labor opportunities are less than household labor supply. In this context equilibrium is achieved only with household specific (endogenous) wage (w^*): $L^D(w^*,A) + (\overline{O}) = L^S(w^*,M;a)$ where the endogenous wage (w^*) is derived from FOC of household production function. In other words household supply off farm labor up to

$\overline{O}$ on the labor market and supply the on farm labor up to the point where marginal value product of labor is equal marginal utility from leisure.

Now, the household faces different budget constraint with endogenous wage (w^*):

$$M^* \equiv c + w^* l = y + w\overline{O} + \rho(w^*; A) + w^* T(a) - \overline{O} \qquad (3.7)$$

The main point here is that with perfect labor market and separability the households take the wage as exogenous, whereas with failing labor markets and non separability the wage is no more exogenously given. Then the decision price is a shadow/endogenous price which is lower than market price. With incomplete and imperfect markets the separation property of household decision making collapses. If in the labor market (being one of the most important rural factor markets) there are binding constraints for off farm employment then the household can be classified as non separable with huge policy and modeling implications.

On farm labor demand in situation of unconstrained / perfect market in reduced form looks as follows:

$$L^D = f(w, A) \qquad (3.8)$$

Under constrained market the on farm labor demand is:

$$L^D = f(w, A, T(a), \overline{O}) \qquad (3.9)$$

which states that on farm labor allocation also function of consumption side variables, $T(a)$ and off farm labor constraint.

We would like to know whether the production decision (labor demand) is affected by consumption side variables (household size, demographic variables). Since in separable household the production decision will not be affected by the consumption side the analysis of labor demand being dependent on farm household size will provide us with the means of testing of whether the decision taken by household is separable or not.

In particular we are interested in knowing what is dL^D / da .

On farm labor demand is given by: $L^D = -\dfrac{d\pi(w^*; A)}{dw^*}$, (3.10)

thus $\dfrac{dL^D}{da} = \dfrac{d\pi(w^*; A)}{dw^*} * \dfrac{dw^*}{da}$ (3.11)

On farm labor demand changes with changes in shadow wage, with latter responds to changes in demographic characteristics.

Accordingly, the empirical hypothesis is that agricultural households determine the on-farm labor based on market wages. Alternatively, households set on farm labor according to shadow wages and the latter is a function of household demographic composition.

For empirical implementation let us take the simple log –linear demand function:

$$\log L^D = \alpha + \beta \log w^* + \gamma \log A \qquad (3.12)$$

For our specification we would like to have a correlation between shadow wage and household composition, let: $w^* = m(a) \cdot w$ (3.13)

where $m(a) = 1 + \sum \delta_i a_i = 1 + \delta(a)$ i.e. $m(a) = 1$ if there is no demographic effect i.e. $\delta_i = 0$.

Putting together all elements we get:

$$\log L^D = \alpha + \beta \log m(a) + \beta \log w + \gamma \log A, \quad (3.14)$$

assuming $\log m(a) = \log(1 + \delta(a)) \approx \delta(a)$ the empirically testable form is derived:

$$\log L^D = \alpha + \beta \log w + \gamma \log A + \beta \sum \delta_i a_i \quad (3.15)$$

As in other similar papers we impose the simple functional form:

$$\delta(a) = \delta_0 \log n + \sum_{i=1}^{D-1} \delta_i \, {}^{n_i}\!/_{n} \quad (3.16)$$

n_i= number of members of demographic category (adult males and females, children, teenagers, elderly members etc).

The variable of interest is whether $\delta(a) = 0$. This captures the effect of consumption side (household size and composition) variables on production side variables (on farm labor demand). In turn, from this result we conclude on the separability if $\delta(a) = 0$ or non separability if $\delta(a) \neq 0$ is significant.

3.2.2 The data used for non separability test

In this section, we will briefly review the characteristics of the households that comprise our data. More elaborated quantitative description of the village and village economy will be provided later at sections on social accounting matrix (SAM) and the village CGE model.

One of the main distinct features of the data is that it was collected from one village only. The desired characteristic of such sample is that unobserved effects related to geographical location of household or some other regionally specific influence (e.g. soil types, climatic conditions, infrastructure, isolation etc.), that might be omitted by geographically disperse sample is automatically accounted for in village sample as villagers normally face similar conditions.

The on farm labor demand averages 70 man/days per year, which comparing to other studies is on the lower side. One source of bias might be due to calculation of labor demand for livestock, which many households do not count as requiring labor. In fact the livestock requires labor everyday and as such many households do not see this as labor demanding.

The primary focus of the non separability test is variation in household size and demographic structure so we start the discussion of these variables. First the household is defined as a group of relatives/persons that reside in one house/dwelling and generally share meal and budget. In practice, that means that household is a family of (grand) parents and their children including in-laws. The average family size of 5.3 persons is

rather on a higher side comparing to the country average of 4.7 and the dependency ratio is around 0.3, which is close to country level of the same indictor.

As in many cases the non separability originates from imperfect factor markets, so we now look at the land and labor markets in our village. The average size of the cultivated land area for household is 86.27 *sotka* or 0.8627 Ha. This size is smaller comparing to the country average but is characterizing the land size of the south region, where land is relatively scarce. Under land reform the land was allocated to households on private ownership basis conditioned that land is used for agricultural purposes. The sale or purchase of land was just recently allowed and thus the actual land under operation of household also includes informal land renting in or out. For example, the households who for some reasons do not want to cultivate land, but are not willing or able to sell land may transfer land to those who willing to take and pay the rent. So the informal renting occurs and this can be viewed as initial level of land market development. However, the land rental is predominantly local and only 20 % of households report land rentals.

Comparing to the underdeveloped land market the local hired labor is more demanded. Close to 30 % of households use hired local labor for agricultural production. Although, hired labor is used more seasonally and in small amount. Some of the labor is provided as an exchange labor but paid with meal or other services.

Other off farm work opportunities is limited. Not much of local processing of agro products occur in the village. The possible way to engage in off farm job is to migrate off village but this entails non trivial transaction costs, risks and requires the existence of network. In this regard, the village faces the same conditions as other rural remote villages of the country. The average off farm wage rate is about 48 *soms* per hour, which is about 1 USD. This also includes the reported self employment and imputed wage of self employers. So the total income from off farm is divided by hours worked. This also implies that all income occurs to labor as other inputs were not accounted for, which might lead to over appreciation of true off farm wage.

So, based on our observations and statistics we can state that factor markets for our households are underdeveloped. Land market is in its infancy and only informal rental occurs. A limited off farm constraint imply that household not necessarily equalize the market and shadow wage in deciding on labor supply. Undeveloped hired labor market also point that there is imperfect substitutability between family and non family labor. Imperfect sustainability combined with limited off farm labor market might imply the surplus of village labor that is not used is ultimately absorbed by own farm employment and lead to non separability.

It is worth noting that neither data nor observations of the households in the village provide *a priori* case for assuming separability or otherwise.
The descriptive statistics of the data is presented in table below, where in addition to discussed variables new variables are described for more elaborated regression.

Table 4: Household data used for non separability test

Variable	Unit of measurement	Description	Mean	St. Dev.
Labor demand	Man per day	Quantity of on farm labor (both hired and own) used in agricultural production	69.07	32.80
Off farm wage	Soms per hour	Wage rate for off farm labor (includes self employment)	48.09	12.30
Land Total	Sotka	Total land area cultivated/operated by household	86.27	53.45
Size of household	Person	Total number of household members	5.33	1.76
Ratio of children	Ratio	Number of children aged 0-10 divided by total number of household members	0.30	0.13
Ratio of teens	Ratio	Number of teens aged 10-15 divided by total number of household members	0.20	0.07
Ratio of females	Ratio	Number of adult females aged 15-65 divided by total number of household members	0.35	0.16
Ratio of elders	Ratio	Number of elderly household members aged 65 and higher divided by total number of household members	0.28	0.19
Average age of adults	Years	Average age of all adult household members, both male and female	34.12	5.98
Education level of household head	Years of schooling	Highest education level of household head	9.17	1.42
Expenditures on mechanical services	Soms per day	Monetary expenditures of a household for tractor and related services	784.90	645.94
Share of house land	Ratio	Share of land next to the house	0.17	0.21

Source: Survey of households

3.3.3 Results of testing (non) separability of village households

The first estimated regression model is basic specification of the following form:

$$\ln Labor\quad demand = \alpha + \beta_1 \ln Off\quad farm\quad wage + \beta_2 \ln Land\quad total + \delta_1 \ln Size\,of\ household \tag{3.17}$$

$$+\delta_2 Ratio\quad of\quad children + \delta_3 Ratio\quad of\ teens + \delta_4 Ratio\quad of\quad females + \delta_5 Ratio\quad of\quad elders + \varepsilon$$

The OLS regression yielded somewhat expected result of significant effect of the household size on household labor demand. Table below presents the first regression run.

Table 5: First run of the regression test of non separability

Dep. Var : Ln Labor demand	Coef.	Std. Err.	P>t
Ln Off farm wage**	-0.1011	0.0482	0.038
Ln Land total*	0.2760	0.0406	0.000
Ln Size of household***	0.2073	0.1074	0.055
Ratio of children	-0.2899	0.2291	0.208
Ratio of teens	-0.4298	0.3607	0.235
Ratio of females	0.1736	0.2841	0.542
Ratio of elders**	0.7257	0.3550	0.043
Constant	4.1078	0.2667	0.000

Note: *** indicates the significance at 10 %
** indicates the significance at 5 %,
* indicates the significance at 1 %

The result shows that larger households use more labor for agricultural production, indicated by positive sign of coefficient. Adding more to the household size increases the labor used and also reduces the shadow price of labor. As we have variables in natural logarithmic (ln) form we can interpret the coefficient as elasticities, e.g. size variable, which is 0.2 means that 10 % increase in household size, would lead to 2 % increase in on farm labor use.

In addition demographic variable such as elderly ratio also significantly affect the on farm labor demand. This states that not only the size but the demographic composition is related to the labor use in agricultural production. Similarly, the sign of the elderly ratio indicates that the more elderly aged household members, the more labor is used. This is not difficult to explain, as off farm work requires more travel and flexibility, whereas the on farm work is often routine, which makes on farm work more suitable for female and older household members.

In the basic specification we do not find significant effects of gender and younger age compositions to influence the labor demand. Although the negative sign of kids ratio might imply that additional kid to the household reduces the labor use by the need to take care of children.

Resonating with similar other studies the off farm wage rate is significant and the elasticity is negative: -0.10. Households respond to the limited opportunities to work off farm, reducing the on farm labor use by 1% for a 10 % increase in off farm wage rate, which is not elastic by all means.

As expected, the labor use is firmly connected to the land operated. Although the elasticity is not 1 it is quite significant 0.27. The land area variable is of more control variable. And for more rigorous test of separability we would need more control variable. The labor use for on farm could be influenced by human capital of households. Thus to account for human capital of household and some other unobservable household characteristics we introduce two new variables: average age of adults in household and years of education of head of household.

In addition, the on farm labor use is influenced by technologies used by households. Assuming separability the households who have access to tractors or some other mechanization tools would be requiring less labor. So we account for technological differences between households by controlling for expenditures on tractor and related services.

Finally, in the initial regression specification all land was lumped together without differentiation. However, land is not homogenous, e.g. land is of major two types. House land, which is located next to the house building and where the crop for home consumption is grown. And the field land, which is located on field at some distance from house and where the marketed crop is cultivated. These two land types have different labor requirements, crop composition and land quality which needs to be accounted for. We, thus introduce the new variable called *Share of house land*, which is share of the next to the house land in total land.

The findings from first regression support the rejection of the null hypothesis of separability. Let us run the more elaborated model controlling for additional factors that might be part of the on farm labor demand equation, of the following form:

$$\ln Labor\ \ demand = \alpha + \beta_1 \ln Off\ \ farm\ \ wage + \beta_2 \ln Land\ \ total + \delta_1 \ln Size\ \ of\ household$$
$$+\delta_2 Ratio\ \ of\ \ children + \delta_3 Ratio\ \ of\ teens + \delta_4 Ratio\ \ of\ females + \delta_5 Ratio\ \ of\ \ elders +$$
$$+\varphi_1 Average\ \ age\ \ of\ \ adults + \varphi_2 Education\ \ level\ \ of\ \ household\ \ head +$$
$$+\varphi_3 \ln Expenditures\ \ on\ \ mechanical\ \ services + \varphi_4 Share\ \ of\ \ house\ \ land + \varepsilon \quad (3.18)$$

The regression output for the model above is reported in the following table.

Table 6: Second run of the regression test of non separability

Dep Var: Ln Labor demand	Coef.	Std. Err.	P>t
Ln Off farm wage*	-0.187	0.063	0.004
Ln Land total**	0.197	0.090	0.032
Ln Size of household***	0.295	0.174	0.093
Ratio of children	-0.329	0.308	0.288
Ratio of teens	-0.054	0.448	0.904
Ratio of females	0.211	0.336	0.530
Ratio of elders	0.609	0.399	0.130
Average age of adults	0.007	0.008	0.374
Education level of household head	0.006	0.006	0.300
Ln Expenditures on mechanical services	0.128	0.079	0.110
Share of house land	0.058	0.436	0.894
Constant	2.992	0.761	0.000

Note: *** indicates the significance at 10 %,
** indicates the significance at 5 %
* indicates the significance at 1 %

The F statistic indicate that variables jointly significant at 1 % level. The coefficient of interest variable, namely the household size is also significant bordering the 10 % level of significance. In light of previous regression result, we tend to interpret the present result also indicating non separability (rejecting the null hypothesis of separability). Households with more household members tend to use more on farm labor, which is in accord with the observations that household face limited off farm work access and produce labor surplus.

The results for demographic composition variables have not changed, they are still not significant. However, the signs of these variables might provide us with some information. For example the positive sign for elderly and female ratio point that agricultural work is generally performed by female and older members. The negative sign on children ratio might implicate that families with kids are less involved in agriculture.

Similarly, the more tractor expenditures by household the more labor is required, possibly due to the fact that tractor expenditure are associated with large land holding and thus more labor needed. The human capital and technology variables are not significant. The explanation for human capital insignificance could be that education level in the village is fairly uniform due to mandatory education rule during the soviet period. As for technology, it could be that technology is not substituting for labor but rather complements it.

Other results confirm the initial conclusions. The area of cultivated land is determining factor of labor use, regardless the share of the next to house land. Off farm job market influence the on farm labor use and indicates the labor surplus.

Thus the overall results from two regressions conclude that we deal with the case of non separable decision making for a sample of village households. Although we did not test for the source of non separability, in all likelihood the non separability is related to the undeveloped factor markets like land and labor. With constraints on off farm work the households might still provide on farm labor not equalizing the marginal return. Consumption and production decisions of household are intertwined and households thus bound to use the shadow prices in making the decision.

The final note is needed to qualify the test conclusion. The conclusion was based on regression estimates of the household size and demographic coefficients. Econometrically the problems of coefficients might relate to endogenous explanatory variables and correlation between labor demand and household size and composition. The problem of endogeneity is likely to lead to rejection of separation while not being necessary consistent with such result. One way to account for such potential problem would be to use instrumental variables. However lacking the rich data to be able to derive a credible set of instruments for household structure and having only cross sectional data we hoped that we significantly minimized the problem by controlling for important characteristics of households as education, age and technology. So we strongly used assumption that demographic variables are at least weakly exogenous. Under such plausible condition in the separable household the demographic variables related to consumption should not influence production side i.e. on farm labor demand.

4 Shadow Prices and Village SAM construction

This is important chapter as here we construct the village social accounting matrix (SAM) for our subject village, which serves as a data base for the village general equilibrium model. Village SAM is also indispensable tool ensuring that we have a consistent data set which describes in full the functioning of the village economy. In line with findings of the previous chapter of non separability of our households, we need to find a way to incorporate the non separability in the village SAM and in subsequent model. Before we start with SAM exercise, we recall that one of the main implications of the non separability is that some markets are imperfect. So, for household non tradables we need to estimate the household specific, shadow prices, as appropriate prices based on which households make decision. In short, our goal here is to compile a consistent village SAM properly accounting for non separability of households with shadow prices of non tradables.

4.1 Estimating household specific, shadow prices for household non tradables

The basis of any multi sectoral applied general equilibrium model is a SAM. Generally, village SAM is the comprehensive data set covering all transactions among sectors and institutions within village (Löfgren, 2002). SAM accounts are organized in matrix format and inter account transaction flows must be calculated based on market or imputed prices, since SAM is constructed in terms of values i.e. price multiplied by quantities. However, not all entries in SAM might have the observable prices. Especially, in the village SAM which is based on the household data, and where the accounts include the household specific entries (i.e. pertaining only to specific group of households). We will elaborate more on the village SAM and its accounts later in this chapter. For now it is suffice to state that most prominent accounts of our village SAM that lack the market/observable prices are: household or family labor, manure from own livestock used on farm, crop residues from own crop production used for own livestock, and household land. By definition these inputs of on farm production cannot have market prices, because they are non tradables, with no explicit markets.

One of the main implications of non separability is that households take decisions regarding production and consumption not with regard to market i.e. exogenous prices. Based on the empirical test, we concluded that for labor allocation the decision price comes from within the household itself i.e. they use the endogenous, household specific prices. These prices are not observable and in this sense they are shadow.

Thus to properly model the non separability and use consistent set of prices we need to find out shadow, household specific prices in estimating the value of flows of household non tradables (Kuiper, 2005).

4.1.1 Empirical approach to shadow price estimation

The estimation of shadow prices relies on production theory. There is large body of literature that estimates the shadow price -endogenous wage for household's labor. In this paper, we follow the same empirical approach as in other studies to estimate the shadow price for family labor from production function (Skoufias, 1994). Moreover, applying the same logic (Kuiper, 2005), namely that household optimally allocates family labor until marginal value product of labor equals wage rate, we derive the shadow prices for other household non tradables (land, manure, residues): the marginal value product of the input is equal to its price, which is shadow price for household non tradables.

The shadow wage (prices) estimation includes two steps. First, the production function for households is specified and estimated with family labor, land, manure and feed defined as production inputs/factors. Then the parameters of the production function are used for calculation of marginal value products of inputs, which theoretically assumed to be the shadow prices of inputs.

Theoretical model is closely related to the model presented in Skoufias (1994). As with the case of testing non separability, it is believed that rural households face labor market constraints. Nevertheless, the same logic is applicable regardless of any reason for which non separability may occur.

Rural household's time endowment (T) is used for leisure (L), on farm work (F), off farm work (M) and household production (N). The off farm work yields (with market wage (W)) monetary income which might be used for purchase of non agricultural goods (X_M).

As in any household, rural household produces the household commodity with its N and production function: $Z = Z(N;K)$, (4.1)

where K represents other inputs.

Agricultural commodity is produced with quasi-concave agricultural production function: $\Gamma(F,H;A)$, (4.2)

where H stands for hired labor and A is a vector of other inputs (land etc.). Hired labor gets wage W^H. With this set up, household can be represented as follows:

$\max\ U(C,L;B)$ (4.3)

with respect to X_M, F, M, H, N subject to budget, production technology and time constraints, respectively:

$C = X_M + Z$ (4.4)

$Z = Z(N;K)$ (4.5)

$X_M = \Gamma(F,H;A) - W^H H + WM + V$ (4.6)

$L + N + F + M = T$ (4.7)

$M \geq 0$ (4.8)

Where, in addition to already defined variables, we added: C is total consumption, B is a vector of household characteristics and V is non labor income (exogenous).

We proceed as usual to form Lagrangian:

$$Y\begin{bmatrix} X_M + Z(N;K), T - M - F - N; B \\ +\lambda\left(\Gamma(F,H;A) - W^H H + WM + V - X_M\right) \\ +\mu M \end{bmatrix} \quad (4.9)$$

where λ is Lagrangian multiplier related to the income constraint inequality and μ is multiplier related to the market work participation inequality.

The solution to this maximization problem with respect to X_M, N, F, M, H leads to FOCs:

$$\partial U/\partial L \Big/ \partial U/\partial C = W^* = W + \mu/\lambda \quad (4.10)$$

which states that household will equate the marginal rate of substitution (MRS) between consumption and leisure and wage rate.
The shadow wage of labor is in turn derived from:

$$\begin{aligned} \partial\Gamma/\partial F &= W^* \\ \partial\Gamma/\partial N &= W^* \\ \partial\Gamma/\partial H &= W^H \end{aligned} \quad (4.11)$$

These generally state that family (hired) labor for farm will be used to the point where the marginal value product of labor is equal to the respective wage rate. With perfect markets the wage comes exogenously from market, which is then effective wage. With imperfect markets and for households who constrained in off farm work opportunities the effective wage is at optimum where the MRS between consumption and leisure is equal to marginal value product of family labor.
Analogously, for the other production inputs for which there is no market. In our case this includes the household non tradables: land, manure, crop residues. The shadow prices are also derived from FOC, i.e. marginal value product of inputs lead to shadow (unobservable) prices.

An empirical marginal productivity function of household non observables can be developed by taking derivatives of a production function of a specific form. It has to be noted that estimation of the production function should be carried in primal form as opposed to dual form which relies on prices and for which we do not have exogenous prices.
Our empirical production function is formed as follows:

$$P * Y = f(A, L^F, L^H, M, F, E)$$

where P is price of agricultural output, Y is quantity of agricultural output, A is land cultivated, L^F is family labor used, L^H is labor hired, M is manure applied, F is crop feed/residues, E is other external inputs. According to our specification, the aggregate agricultural output is in monetary units, while inputs are measured in natural units.

But first, we have to postulate the specific form of a production function. As Sadoulet and de Janvry (1995) point, there is wide choice of the possible specifications, starting from Cobb Douglas to Quadratic, Translog etc. functions. It is widely accepted that main advantage of Translog specification is its flexibility and representation of second order approximation of unknown functional form, which however involves trading off the regularity conditions (Sauer et al., 2006). On the other hand Cobb Douglas specification is parsimonious but restrictive. The additivity and homotheticity assumptions of Cobb Douglas function result that the factor shares are constant and the elasticity of substitution are limited to unity. One of the empirical drawbacks of the Translog model is its requirements for richer data set to estimate a greater number of parameters.

To implement the marginal productivity approach to estimating shadow prices we adopt both the Translog and Cobb Douglas specification.
The general form of the Translog function looks as follows:

$$\ln Y_i = \beta_0 + \sum_i \beta_i \ln X_i + 0.5 \sum_i \beta_i \ln X_i^2 + \sum_i \sum_k \beta_{i,k} \ln X_i \ln X_k + \varepsilon_i \qquad (4.12)$$

For our empirical specification this would translate to:

$$\begin{aligned} \ln Y = {} & \beta_0 + \beta_1 \ln A + \beta_2 \ln L^F + \beta_3 \ln L^H + \beta_4 \ln M + \beta_5 \ln F + \beta_6 \ln E \\ & + \beta_7 0.5 * \ln A^2 + \beta_8 0.5 * \ln(L^F)^2 + \beta_9 0.5 * \ln(L^H)^2 + \beta_{10} 0.5 * \ln(M)^2 \\ & + \beta_{11} 0.5 * \ln(F)^2 + \beta_{12} 0.5 * \ln(E)^2 \\ & + \beta_{13} \ln A \ln L^F + \beta_{14} \ln A \ln L^H + \beta_{15} \ln A \ln M + \beta_{16} \ln A \ln F + \beta_{17} \ln A \ln E \\ & + \beta_{18} \ln L^F \ln L^H + \beta_{19} \ln L^F \ln M + \beta_{20} \ln L^F \ln F + \beta_{21} \ln L^F \ln E \\ & + \beta_{22} \ln L^H \ln M + \beta_{23} \ln L^H \ln F \\ & + \beta_{24} \ln M \ln F + \varepsilon \end{aligned} \qquad (4.13)$$

The elasticity of production with respect to each input of production is estimated by deriving the partial derivative of the output function with respect to input.
For family labor we get:

$$\sigma = \frac{\partial \ln Y}{\partial \ln L^F} = \beta_2 + \beta_8 \ln L^F + \beta_{13} \ln A + \beta_{18} \ln L^H + \beta_{19} \ln M + \beta_{20} \ln F + \beta_{21} \ln E \qquad (4.14)$$

Finally the marginal productivity of family labor in agricultural production is then:

$$\rho = \frac{\partial Y}{\partial L^F} = \frac{\partial \ln Y}{\partial \ln L^F} * \frac{Y}{L^F} \qquad (4.15)$$

With estimated parameters, the formula for shadow prices is based on estimated marginal value product as follows (Skoufias, 1994):

$$\hat{P}_i^* = \hat{Y} \Big/ Q_i * \sigma, \qquad (4.16)$$

where $\hat{Y}$ is estimated/predicted value for output, derived with estimated elasticity σ for input *i* and Q_i is quantity of input *i*.
The Cobb Douglas function is less involved and could be presented as:

$$\ln Y_i = \beta_0 + \beta_1 L^F + \beta_2 L^H + \beta_3 M + \beta_4 M + \beta_5 E + \varepsilon_i \qquad (4.17)$$

4.1.2 Data and results of shadow price estimation

We use the same cross sectional data of 281 village households that we collected in village "Sarytalaa" and used for testing the non separability. We keep in mind, that one potential problem with such data is that it is difficult to control for fixed effects, such as for example unobservable like managerial abilities etc., that might interfere with production function disturbances, ε. However, we could mitigate the potential bias by including some variables which might take care of unobservable variables and also we have advantage of having the data from the single village, thus in many respects the villagers face the same conditions.

The survey revealed, that there are inputs/commodities which are important to household production, but markets for those inputs are either non existent or imperfect. Drawing from survey results, we established that family labor, manure and crop residues are the inputs for which no market exists, except the household shadow market itself. For land there is imperfect market: field land is rented out locally and on occasion, and in this sense the land rental market not necessarily producing the correct price to estimate factor remuneration of land.

For other remaining inputs that enter the production function of village households we observe markets and prices. These are mainly external inputs representing irrigation, transport expenses, purchased seeds, fertilizers, and veterinary expenses for livestock.

The table below describes the data used for running the production function.

The output is in monetary terms and aggregated into crop and livestock production measured by average village prices. Whereas, all the inputs are in natural terms i.e. measured using the unit of measurement appropriate for each input.

Land is the area for disposal at household level, which was cultivated in the pre-survey agricultural year. Own and hired labor is in man/days spent on agricultural production. Manure is total manure derived from livestock (mainly large livestock) applied to crop in kilograms. Crop residues are used as feed for livestock and comprise the residues that are utilized by household, which is left from crop growing.

Finally, given that we have relatively small data set, and large number of external inputs, and at the same time, we need to save on number of observations, we lump together the monetary expenditures on external inputs into the one variable, called external inputs.

Table 7: Household data used for estimating the shadow/household specific prices of household non tradables

Variable	Unit of measurement	Description	Mean	St.Dev.
Agricultural output	Soms	Value of agricultural output (both livestock and plant production), used for sale and own consumption	24933.2	13423.9
Land total	Sotka (1/100 Ha)	Total land area cultivated/operated by household	86.27	53.45
Labor hired	Man per day	Hired, male and female labor used in agricultural production	7	12.23
Labor own	Man per day	Family labor (of all household members) used in agricultural production	64.13	29.38
Manure	Kg	Manure applied to crops as fertilizer	636.97	346.93
Crop residues	Kg	Crop residues (not fodder) used as feed for livestock	2819.35	2436.80
External inputs	Soms	Monetary expenditures on external inputs such as seeds, fertilizers, medicine, water, transport services	9695.03	5556.01
Average age of adults	Years of schooling	Average age of all adult members of household both male and female	34.12	5.98
Education of household head	Years of schooling	Highest educational level obtained by household head	9.17	1.42

Some of the households reported zero values for some of the inputs, and we cannot take the log of zero values, but we need to keep all observations. So, we resort to a commonly used trick. We add a small value equal to 0.1 to zero values, which by all means should not change much our results as all real values are greater than 0.1.
Finally, we control for household unobservables and differences in human capital by including two control variables: education of household head and average age of adult members of the households.

Table 8 below reports the results of the two regression models, Cobb Douglas and Translog, coefficients show the value of elasticities, assuming that all inputs are exogenous:

Table 8: Results of the regression estimation of production function with Cobb Douglas and Translog specification

Dependent variable: *Ln* value of agricultural output

Independent variables	**Coefficients**	
	Cobb Douglas (OLS)	**Translog (OLS)**
Ln land	0.030***	0.641
Ln labor hired	0.038**	-0.456***
Ln labor own	0.317*	1.111
Ln manure	-0.002	0.158
Ln crop residues	0.015**	0.005
Ln external inputs	0.392*	-0.995
Ln land squared		0.011
Ln labor hired squared		-0.005
Ln labor own squared		0.313**
Ln manure squared		0.111*
Ln crop residues squared		0.026*
Ln external inputs squared		0.239
Ln land*labor hired		0.008
Ln land*labor own		-0.073**
Ln land*manure		0.000
Ln land*crop residues		0.008
Ln land*external inputs		-0.045
Ln labor hired*labor own		0.013
Ln labor hired*manure		-0.008**
Ln labor hired*crop residues		-0.006**
Ln labor hired*external inputs		0.050***
Ln labor own*manure		-0.053*
Ln labor own*crop residues		-0.024**
Ln labor own*external inputs		-0.182
Ln manure*crop residues		0.000
Ln manure*external inputs		-0.017
Ln crop residues*external inputs		0.000
Average age of adults	0.001	0.007***
Years of education of household head	0.019	0.022
Constant	4.749	7.407

Note: *** - coefficient significant at 10 % level of significance
** - coefficient significant at 5 % level of significance
* - coefficient significant at 1 % level of significance

The Translog specification produced some problematic results. Apart from known problem of severe multicollinearity, many coefficients/ elasticities are not significant and also negative, which contradicts our assumptions and observations.

On the contrary, the Cobb Douglas specification yielded some consistent results with positive elasticities (except for manure) and significant coefficients. To decide between the two specifications, we conducted a Ramsey test to detect the presence of misspecifications in Cobb Douglas model. The test result revealed that we cannot reject the null hypothesis of no omitted variables in Cobb Douglas model specification. As such we proceeded to estimate the shadow prices using elasticities from parsimonious Cobb Douglas production function.

In our village SAM, we distinguish three types of households. As in any SAM related studies, the modeling requires grouping of household based on some solid criteria. As land disposition by household represents important asset and indication of household income opportunities and activity occupations, we grouped our village households based on this criterion. Accordingly, we estimated the shadow prices for the three groups of households, which we named as follows: small, medium and large land holders.

Table 9: Estimated shadow/household specific prices of household non tradables

Input /commodity	Unit of measurement	Estimated shadow prices (in *soms*)			Price on the village market for locally/village traded inputs or price of the closest substitute (in *soms*)
		Small holders, H1	Medium holders, H2	Large holders, H3	
Land	Soms per sotka	38.53	9.42	5.25	5-7
Hired labor	Soms per man per day	*397.93*	*368.61*	280.04	200-300
Household own labour	Soms per man per day	127.72	125.18	132.4	
Crop residues	Soms per kg	0.31	0.29	0.37	3-4

Source: Author's estimation

Some comparative discussion of the derived prices is in order. There are differences between shadow prices of household land. The difference is less between medium and large holders. One explanation of this is that the land of small holders is mostly next to the house land, which is used predominantly for high value crops like vegetables and fruits. The medium and large holders cultivate more of field land (located outside of the village). Interestingly, the price of the village leased land 5-7 *soms* per *sotka* is consistent with the shadow price of the land of large holders 5 *soms* per *sotka* who are major land renters in the village.

A somewhat similar picture emerges for the price for hired labor. The price range for a hired labor observed on the village labor market is between 200-300 *soms* and the price of the hired labor for large holders is 280 *soms*. This is consistent with the fact that main employers of the agricultural labor land in the village are large land holders, whereas small and medium holders are net providers of the village labor.

Another interesting finding of our estimation is that family labor is cheaper than hired labor. On the one hand, it might be that household did not report the exchange labor as hired labor since exchange labor is very specific (i.e. very subtle to discern). Yet, another

plausible reason for this could be the fact that hired labor is mostly male agriculturally skilled labor, whereas the family labor consists mainly of females and children, who are less productive. Unfortunately, the data does not allow for testing this hypothesis, but observation of the households and other studies on gender work division indirectly confirm our assumption (Jacoby, 1992).

Finally, crop residues valued much cheaper than alternative fodder and inter household differences are not significant. It makes sense for crop residues which are of lower quality compared to more nutrition rich fodder.

In summary, for household non tradables and village tradable inputs we estimated the shadow prices, using production (revenue) function approach. This approach has several advantages against alternative of guessing or using prices of market substitutes. Foremost it is consistent with economic theory – the price of input is equal to the marginal value product of input. Second, this approach is straightforward to use with data at hand. Third it allowed comparing the prices across the groups and alternatives, thus ensuring some consistency. With such imputed prices, other observable prices and quantities derived from household survey we possess all information to construct a village SAM.

4.2 Village SAM

The flows of intra and out of village transactions are best represented by village SAM. Generally, SAM can be viewed as comprehensive, disaggregated, accounting for inter linkages data base reflecting the given socio economic system. SAM approach is rooted in Stone's (1978) (Taylor and Adelman, 1996) attempt to combine the national accounts with Leontief input output tables. The SAM is assumed to capture the linkages among the different sectors in the village economy and provide a static picture of the flows and structure of the village transactions between and within village institutions and outside world. The SAM is a snapshot of the economy, compiled in a matrix form, that represents the expenditures (columns) and revenues (rows) for each production activity, commodity, value-added, institutions, capital market, and the rest of the world.

At the center of the village SAM is household behavior and their interactions among themselves, with government, and rest of the world. Thus SAM as an accounting entity depicts the actions and inter linkages between production activities, commodities, production factors, and institutions, government, firms. Generally, within SAM one can distinguish an input-output table representing intermediate input use between production sectors, a value-added matrix of payment by sectors to factor inputs of labor, land and capital, a distribution matrix of factor payments to different types of households, expenditures demand of households on consumption of locally produced and imported goods, trade flows of imports and exports of goods, a government behavior which collects taxes from activities and institutions, and later distributes income through its consumption of goods and transfers, a capital account for savings and investment, a rest of the world account for trade flows and taxes. Incomes generated from each of the accounts in the SAM are redistributed throughout the economy, and is mirrored by the expenditures via imposing accounting identity stating that income should be equal to expenditures. As such, the SAM follows double-entry accounting principles.

It is illustrative to follow the flow in the stylized SAM. The production activities require factors of production in order to produce goods. Factors of production obtain income from the services they provide. The income from renting/selling the factor services is directed to institutions mainly households according to their factor endowments shares. Then institutions allocate their income to final consumption of goods locally and externally produced, make transfers within and outside village, and save.
Production activities earn income by selling their produce to other sectors or activities (as intermediate goods), to institutions (for final consumption expenditure), or by exporting to the external sector (external demand). It is from theses proceeds the sectors pay to the factors of production for factor rental. With it, the flow circle is closed and it is said that SAM is consistent because for every receipt there is a corresponding outlay whereby both the receiver and the sender of each and every transaction is clearly identified (Sadoulet and de Janvry, 1995).

The structure of the stylized SAM, which we follow in building our SAM, is presented in the table 10.

Table 10: Stylized SAM

	ACTIVITIES	COMMODITIES	FACTORS	INSTITUTIONS		CAPITAL ACCOUNT	REST OF THE WORLD	TOTAL (INCOME)
				Households	Government			
Activities		Outputs						Gross output
Commodities	Intermediate inputs			Household consumption	Government consumption	Investment	Export	Domestic demand
Factor inputs	Value added						Factor incomes from abroad	Gross Domestic Product at factor cost
Households			Factor income	Inter-household transfers	Transfers to household		Transfers from abroad	Household Income
Government	Value-added, producer taxes	Sale taxes	Factor taxes or income	Direct taxes			Transfers to Gov't	Gov't in-come
Capital Account				Household savings	Government savings		Net capital inflow	Total savings
Transaction costs		Transaction cost						Transaction cost
Rest of the World		Imports	Factor payments	Transfers abroad	Gov't transfers			Imports (Outflow)
TOTAL (Expenditure)	Production (Act. Expend.)	Domestic Supply	Factor Outlay	Household Expenditures	Government expenditures	Total Investment	Inflow from RoW	

Source: Adapted from Holden and Loefgren (2005)

The activity account i.e. the production aspect of economy describes the values of the intermediate inputs used in the production of goods and payments to factors of production (columns) and market sales of goods (rows).

The commodities account provides information on product markets and household consumption. It records the value of total supply, including the value of domestic production marketed and imports after taxes and marketing margins (columns), and total demand, including demand for intermediary input by activities, consumption of goods and services by institutions, investment demand, and exports (rows). Together these two accounts describe production, sales and purchase of commodities.

The factors accounts depict the source of factor income of usually labor, capital and land, i.e. value added in each village activity and from the rest-of-village, outlining how factor payments are directed to the various institutions, including the different household groups and the rest of the village according to their factor endowments shares (columns).

The institution account covers households' and government's income and expenditures. The household accounts include both the value of domestic village factor income of households, transfer payments from the government, and remittances from the rest of the village (row), as well as transfer payments made by households. Households use income for consumption of home-consumed output of the village activities they engage in, consumption expenditures of marketed goods, transfers to other village households, payment of taxes, private savings, and remittances to the rest of the village (column). As we stated earlier, we distinguished three groups of household using the land holding size as a differentiation criteria, which captures the livelihood strategy of households.

The government role in the village is rather passive, government account collects taxes on income from activities, commodities, factors, and receives transfers from the rest of the village from the central government (row). A government has to pay for government consumption of goods and services, transfers to households in form of pensions and to the rest of the village (column). Income sources for the local government mainly consist of payment from land tax and transfers from the central government.

The saving-investment account reports the savings made by all the institutions (rows) and the way how investment is spent by purchasing the goods (columns).
The remaining transactions, linking village with the rest of the village is recorded in the rest of the village account. It is unlikely that the village is completely isolated, so this account largely describes domestic (country) or/and international trade. The income of this account (row) comprises of factor income received from the rest of the country or abroad, income from exports of goods, and transfer or remittance received from institutions from outside the village. The outlays of this account (column) include payment for imports of goods and services, transfer payments to village institutions, factor income transfers to the village, and savings.

As we can see there is little difference between national/country and village SAM, in both cases the same principles are applied. However, two points are important for village SAM. First, in the country SAM, all entries have specific monetary value and as we already touched upon in village SAM some entries would not have the monetary values but have to be imputed. The second is that village SAM does not have rest of the world, namely it accounts for rest of the village only, meaning that the exchange rate and foreign currency might not need to play a role for village, which is smaller part of the country.

More important feature of our village SAM however is in presenting the activities, inputs and commodities to be household specific. As we established that our households are non separable we have to incorporate this type of behavior in our SAM. There are growing numbers of studies that use household specific accounts: Kuiper (2005) and Taylor (2003), Lofgren and Holden (2005). They suggested that by making the activities and commodities household specific i.e. relevant only to specific household (groups), the non separability can be accounted for. Indeed, the production side has to be linked to

consumption side of the household and by making (linking) the production (activity) accounts household specific then we simultaneously relate the household consumption and production decisions, which is by definition is non separability.

With this knowledge, we are now ready to build our village SAM using the information from household survey of 281 households. As the table above shows the SAM could be partitioned in smaller parts, which facilitate the exposition of our applied SAM and allow for discussion of village and household characteristics.

4.2.1 Input – output structure of the applied village SAM

Our village SAM is rich in agricultural activities. We distinguished five crop activities: potato, wheat, combined maize and fodder, sunflower and combined vegetables and fruits, as well as two livestock activities: large livestock that include cattle and small livestock that also includes domestic birds. Apart from agriculture the village households engage in non agricultural off farm activities, like village production activities (e.g. construction, milling, carpenting, repairing, provision of village health, educational, etc services), retail trade and import/export, transport activities and migration activities outside village. In addition, we also specify the village activities to account for village markets. These are agricultural labor renting out, land renting out, workhorse power and tractor renting out activities, representing closed village labor, land, and workhorse and tractor markets respectively. These activities are not that important as other activities but they represent the core of the village interactions and as such they are critical for our analysis.

It is not feasible to present the whole input make matrix of our village SAM, so we have to aggregate the crop activities into two groups. The aggregation is based on differences in input use and output destination: food (potato, wheat, veggies and fruits) and sale (maize, fodder and sunflower) crops. Although the differentiation is not strong, since even the cash crops are not entirely marketed. It is just cash crops are proportionally more for sale than food crops while share for market sale is still not high.

Table 11: The input matrix of the crop production in the village SAM (in 000 soms)

Inputs	Food crop			Cash crop		
	H1	H2	H3	H1	H2	H3
Horse power	3.4	11.2	10.3	2.4	2.8	2.9
Manure	3.3	22.1	12.5			
Village land			5.9			18.8
Village tractor		25.8			65.9	
Village labor			22.8			28.5
Fertilizers	5.9	25.7	15.7	9.2	68.6	25.3
Seed	19.7	118.1	39.4	9.5	129.3	26.6
Irrigation etc	1.3	3.7	2.8	1.9	9.9	3.3
Family labor	21.8	98.7	29.5	9.9	52.7	22.3
Household land	44.3	229.4	90.8	40.3	339.3	132.6
Household capital	9.1	49.0	20.2	21.9	137.7	38.3
TOTAL	108.8	583.9	249.9	95.1	806.2	298.5

As we can see, the small holders (H1) are less involved in both types of crops; the large numbers of medium holders (H2) are explained by the fact that they represent the majority in the sample. Four types of inputs are used by households for crop production. 1) Own intermediate commodities like manure, and horse power only for medium and large holders. 2) Village factors like land, tractor services, and most importantly labor. 3) External inputs: fertilizers/pesticides, purchased seed and irrigation expenses (which also aggregate other inputs, like fuel, transport etc.). 4) Own factors of production: family labor, household land and capital (equipment, buildings etc.). As we are separating hired (village) factors from own we are allowing for local village markets of hired labor. Large land holders on a net trade basis use more of village factors, while renting out tractor and workhorse power to small and medium land holders. They also tend to use more of external inputs, imported to village. In fact the observation revealed that large land holders are elite of the village, who were able to benefit from privatization of soviet collective farms. Share of cash crop for large and medium land holders are larger whereas small holders tend to cultivate the food crop for own consumption.
Apart from village interaction that is captured here, our SAM also makes provision for crop-livestock intersectoral interaction as crop production use manure and workhorse power that comes from livestock activities.

Table 12: The input matrix of livestock production in the village SAM (in 000 soms)

Inputs	Large livestock			Small livestock		
	H1	H2	H3	H1	H2	H3
Crop residues	3.1	43.4	19.6	0.7	8.4	10.9
Vet., other external	9.2	66.5	21.7	4.0	16.1	10.3
Purchased feed	4.3	16.7	9.7	3.1	16.0	8.1
Family labor	14.9	105.4	48.0	10.7	51.8	25.4
Household capital	51.3	322.4	140.9	30.1	135.7	47.1
TOTAL	82.7	554.4	240.0	48.6	228.0	101.8

Similarly, for livestock activities, we witness mutual dependency between livestock and crop production: the by-product of crop activities are used in form of crop residues as inputs in livestock production. There is no much of difference between households in input use in livestock activities, except for input intensities. Large and medium households tend to use more of its own crop feed. One of the larger items is veterinary and other expenditures, which records not only vet services but other expenditures, that household reported, which combine payments for livestock summer pasturing. We do not have data on grazing land, since pasture land is of free use- common land with no prices. So, the capital and other expenses were used as residual accounts.
Owing to more use of land and better capital endowment and access, the large land holders tend to hold more of livestock. With less livestock, the medium and small holders on a net basis rent in workhorse power, while large holders provide this service.

It has to be pointed that in estimating the raw village SAM, especially for agricultural activities we used the estimated household specific prices for family labor, land and crop by products reflecting on the fact the our households are non separable. While village and external inputs have observable prices we used the capital account to balance the column.

Before presenting output matrix, we briefly note that, since the focus of the survey was on agricultural activities the off farm activities only use limited set of inputs consisting of family labor and household capital as only inputs. This involves both migration and non agricultural village activities. Other studies (e.g. Kuiper, 2005) allow for gender differentiation of family labor, but our survey did not account for gender or age aspects of family labor. As we note from the table 13, all household diversify their employment opportunities by engaging in seasonal migration work outside village, village non agricultural activities and in trading. Small holders are more represented in village non agricultural activities, whereas large and medium holders tend to find work outside of village or in trading.

Table 13: The input matrix of off farm activities in the village SAM (in 000 soms)

Off farm activities		Inputs			
		Off -farm family labor	Family labor	Household capital	Total
Migration work	H1	12.9	5.6		18.6
	H2	59.2	19.9		79.1
	H3	16.9	6.4		23.3
Non agric. activity	H1	20.6	12.5	8.4	41.5
	H2	49.9	25.6	19.0	94.5
	H3	16.5	7.7	6.2	30.4
Trade/Commerce	H1		12.1	18.1	30.2
	H2		20.9	25.5	46.3
	H3		28.1	34.3	62.4

Naturally, the village activities related to land and labor renting out use as inputs household factor endowments of land and off farm labor. We note that the main village labor providers are small and medium land holders, latter having a larger share. Similarly, land is rented out by same households, as many respondents reporting that lacking assets and more importantly access to outside markets prevent them from more engagement in agricultural activities. On the other hand the elite large land holders by virtue of having more productive assets and opportunities/networks to externally market their produce tend to use more of village rented land and labor, as shown in crop input use matrix, above.

Table 14: The input matrix of village activities in the village SAM (in 000 soms)

Village activities		Inputs					
		Off -farm family labor	Family labor	Household land	Household capital	Horse powerH3	Total
Village labor renting out	H1	11.7	3.9				15.6
	H2	29.0	6.6				35.6
Village land renting out	H1			8.6			8.6
	H2			14.9			14.9
Village tractor renting out	H3		23.9		61.4		85.3
Village horse power renting out	H3		2.8			6.0	8.9

Next we look at the activities output, which report on amount and destination of produce from cropping and livestock production. In general, each household produce for

themselves, which they use for consumption or as intermediate input for production and for market sale, which essentially is exported (no village market) by traders.

Table 15: The output matrix of agricultural production in the village SAM (in 000 soms)

Activities	Output destination				
		Market sale	Home consumption	By product-intermediate use	Total
Cash crop	H1	18.6	74.1	2.4	95.1
	H2	250.4	538.3	17.4	806.2
	H3	122.1	157.5	18.9	298.5
Food crop	H1	16.8	90.6	1.4	108.8
	H2	141.1	408.4	34.4	583.9
	H3	91.1	147.1	11.6	249.9
Large livestock	H1	46.9	32.5	3.3	82.7
	H2	309.9	214.7	29.9	554.4
	H3	127.3	81.0	31.8	240.0
Small livestock	H1	25.2	23.4		48.6
	H2	115.9	112.1		228.0
	H3	64.3	37.6		101.8

As we alluded earlier the cash crop consist of maize, fodder and sunflower. Maize and fodder crops are combined into one group, which reflects the common use of these crops as a livestock feed. Maize and fodder take the largest share of domestic crop production. Villagers report the external demand for these crops and consider maize and fodder as cash crops. At the same time the maize and fodder are used for household consumption as well: the residues for a livestock are mainly from maize production. Due to demand for this crop the medium households sell third of their output and large land holders market close 45 % of their outputs. Small holder remain mainly self sufficient.

The main use of sun flower is to derive the cooking oil. As there is stable external demand for this crop, sunflower is thought as a cash crop. The sunflower and maize /fodder are the crops that have external demand and domestic use. As such they represent the crops that are safer to grow. In times of non favorable crop prices, crops of this category retained for household consumption/use. When the prices and demand increase the household prefer selling more of these crops. Again, smaller household are less engaged in the marketing and medium and larger households are more market oriented with 31 % and 39 % of commercialization rate for the sunflower.

As we see the differentiation of two types of crops based on destination of produce is blurred since both crops are marketed and consumed at own household. It is clearly seen by looking at food crop that include potato, wheat, vegetables and fruits.

The largest producer of potatoes is medium households due to the largest number of households in this group. In relative terms, the large land holders produce more for sale 38% of their output of potatoes is commercially oriented. Only 20 % and 29 % is oriented for sale by small and medium land holders.

Similarly with wheat, the large land holders are able to sell more of their output 37 % whereas the small and medium holders generally produce for self consumption and sell only close to 15 % of their output.
Vegetables and fruits are predominantly produced for home consumption. Most of the sales are the sales of fruits for which there is a demand. Medium holders are the ones who own the orchard in the village and thus able to sell more of its production for market 24 %, the small and large land holders own little of trees and produce for own consumption.

Large livestock mainly consists of horses and cows. Cows produce milk and younger livestock for sale and cash savings. Horses used as draft power and also in Kyrgyz tradition horses are meat animals. The triple role of a livestock as meat/milk animals, cash/insurance tool and as production input ensures that large livestock is owned virtually by all households. Large holders own more of horses. There is external demand for meat and livestock, so that is why livestock has a high rate of market sale, which is mostly sale of younger livestock.

Small livestock is another more affordable way of ensuring cash savings and meeting demand for meat. The distinct feature of small livestock is that in the spring summer and autumn they are sent to pastures. As with the large livestock small livestock has stable external demand local and external traders buy livestock for export and the marketing rate of the livestock is high, not less than 50 %. Larger households in relative terms sell more of its livestock production.

Concluding section on output destination, we only left to state that all produce of village non agricultural activity (including services and goods for fellow villagers) are destined to village market only. As opposed to the case with agricultural activities, the small and medium holders represent proportionally larger share of involvement in non agricultural, off farm work, which underlines the internal division of labor between village households.

4.2.2 Income and expenditures of the village households

Following the convention of standard SAM, the village households receive an income by virtue of being the owner of the factors of production. In the village SAM the factors are rented out to agricultural on farm and off farm activities. Off farm activities use factors for village and out the village markets, whereas on farm activities employ the same factors for home and external market production. So households are endowed with factors, which include: family labor, household land and household capital. Let us now see, how households earn their income in terms of activities they are engaged in.

Table 16: Factor and activity sources of the household income (in 000 soms)

Factor	Activities	H1	H2	H3
Family labor	**Food crop**	21.8	98.7	29.5
	Cash crop	9.9	52.7	22.3
	Large livestock	14.9	105.4	48.0
	Small livestock	10.7	51.8	25.4
	Village renting	15.7	35.7	26.8
	Non agricultural	33.1	75.5	24.2
	Migration	18.6	79.1	23.3
	Trade	12.1	20.9	28.1
Sum		**136.7**	**519.7**	**227.7**
Household land	**Food crop**	44.3	229.4	90.8
	Cash crop	40.3	339.3	132.6
	Village renting	8.6	15.0	
Sum		**93.2**	**583.7**	**223.3**
Household capital	**Food crop**	9.1	49.0	20.2
	Cash crop	21.9	137.7	38.3
	Large livestock	51.3	322.4	140.9
	Small livestock	30.1	135.7	47.1
	Non agricultural	8.4	19.0	6.2
	Trade	18.1	25.5	34.3
Sum		**138.8**	**689.3**	**348.5**
Total		**368.6**	**1792.7**	**799.5**

The family labor which we recall is valued by household specific price for labor in agriculture is an important factor income for all households. At the same time we expected that family labor would be more important than it is reported. Since family labor is one of the endowments which is in abundance in rural areas. We speculate that, household capital, which has the largest share in factor income, absorbed some additional labor income, since capital (equipment, machinery, etc) is always used in combination with labor, making it hard to distinguish between the two.

In terms of inter household comparison; we see that small holders' income is the smallest one, with little income coming from land factor payments. Non agricultural activities are essential for small land holders, whereas for large holders agricultural activities dominate their source of income. In fact, income from agricultural activities is the dominant source of income for all household when comparing it to non agricultural off farm activities.
The income from village markets is not that large comparing to other sources, however not absolute values but its mere presence calls for need to account for village markets.

As we already stated, in any SAM the income should be balanced by corresponding expenditures. Table 17 below reports on the use of income by the rural households i.e. the destination of expenditure spending of villagers.

Table 17: Expenditure structure of the households (in 000 soms)

Commodities	H1	H2	H3
Food crop	87.4	389.7	139.0
Cash crop	67.9	492.4	142.7
Large livestock	32.5	214.7	81.0
Small livestock	23.4	112.1	37.6
Non agricultural goods	2.3	4.0	1.1
Village non agricultural goods	24.0	47.7	87.2
Imported processed food	81.4	276.5	184.3
Imported durable commodities	99.5	414.7	300.5
Leisure	140.1	861.9	414.7
Transfers	7.0	-	-
Savings	7.9	34.9	54.1
Total	**573.5**	**2848.6**	**1442.0**

The observation and survey indicate that our village is not entirely closed. Apart from consumption of own agricultural produce household buy imported goods. Imported processed food includes the great variety of stuff that cannot be self produced: salt, sugar, noodles, beverages etc., i.e. processed food items that brought in village by traders or otherwise. Part of the imported goods could have substitutes in local village markets, but still regarded as different or imperfectly substitutable goods. Similarly is with the case of durable commodities, which include clothing, furniture, and the whole variety of manufactured products. Aggregation of the imported goods reduces the unnecessary detalization of the SAM and also underlines that these commodities have no substitutes in the local market.

The survey attempted to record the social expenditures such as education, social events, health but they seem to be not significant and were included in the category of village non agricultural products. This account represents the local village market of consumption goods. By itself the local market might not be important because the main village interactions occur via village factor markets.

The largest item in table 17, for all households is the consumption of family leisure. Like in other studies related to rural households, by leisure it is implied the time of household spent on household chores, caring for children and other members of household, social and recreational activities. In a sense leisure is a residual time after deducting from the total time endowments (360 days by 16 hours per day, per working age household member) the time spent on productive activities.

Finally, savings here does not represent the financial asset holding or deposit by villagers. The model we will be using in this study is of static nature and thus the saving and investment do not play an important role for our model. However households reported the amount or share of crop that they retain as seeds, which in a way represent the savings made by household to be used for productive investment in the next year. Despite the insignificant amount of that kind of savings the decision was to include them rather than to ignore.

Generally we covered all the main parts of the village SAM. Input output tables of the household specific production activities and income and expenditure schedules related to households represent the core of the village SAM which indicates that village SAM and subsequent village model is rooted and built on the base of the household model. However the full SAM also contains additional accounts such as government, taxes, rest of the world import, export, and transaction cost. These accounts are secondary and we discuss them in relation to the model description.

Summary remarks

We started this chapter by estimating the shadow/household specific prices for household non tradables. This was needed to calculate in value terms the entries to our village SAM in line with the fact that our households are non separable. Additionally, we indirectly concluded that households face imperfect markets as prices for labor and land are not equal across markets. Subsequent construction of the village SAM provided the information on the village flows and the position of each of three types of households in the local economy. Small holders tend to be self sufficient and employed more in off farm sector. The opposite is large landholders who mainly occupied in the agricultural activities and represent the group with more of productive assets. The medium holders are the largest group in terms of the number of households and represent the mix of characteristics of small and large land holders. The most important feature of our applied village SAM is that production activities are not activity/sector specific, but household group specific, where the household/family factors are valued at household specific prices. This in combination with simultaneous consumption decision of the same group of households ensures the incorporation of the non separability of the household decision making. Next based on our SAM we will be able to build a village model of general equilibrium type, which should behaviorally describe the transaction flow of our village SAM.

5 Development policy experiments in the village context and model results

In this chapter, we explicitly conduct some policy simulations to provide insights of the workings of the model and to derive the conclusions on household behavior in the vilage and rural development policy impacts.
In line with our objectives, we focus on agricultural and regionally/access oriented policies. As a result of growing food dependence from import sources, the government of the Kyrgyz Republic and local experts argue for more extensive support of local farmers. Another aspect of policy intervention is that remote rural areas represent the pockets of poverty in the country. So, it is imperative for policy makers to formulate the options for stimulating the growth and development, accounting for spatial aspect, i.e. looking at the specificities of the local economy. We measure the impact of policies and shocks focusing on agricultural production, marketed surplus and income, which provides a basis for judging the appropriateness of policies and welfare impact.

The core element of our analysis is rural households, thus the policies that we aim are to influence the context of agricultural production specifically affecting the agricultural household production in remote areas. Among the variety of policy interventions, in this chapter we delineate the choice of the policies to the ones mainly concerning regional/access enabling policies as directly applicable and amenable to analysis within the village model. These are state interventions that explicitly and spatially target the farmers' environment related to constraints attributed to geographical remoteness and marginal environment of the village households.

Thus, in line with discussions in chapter one and two, we assume that government policies are appropriate and effective in remedying the coordination and pervasive market failures present in transition countries. It is the assumption that market failures are worse than state failures during the transition process that ultimately might have shifted the thinking in Kyrgyzstan away from minimalist state interventions towards more active government role. The topic of state versus market failures is not further pursued here since it is beyond the scope of this research, although seems very relevant for transition countries.

As we witnessed, the rural households cannot be simply viewed as just producers or consumers. The duality of the nature of rural household makes the outcome of agricultural policies not a trivial exercise (Dyer et al, 2003). Different extent of market engagement, the goal of self sufficiency and imperfect markets all affect differently or make no impact on different households. This heterogeneity of rural households, like commercial versus less commercial household, etc., allow for differential response, and result in differential outcomes of the policies. In addition, the reaction of rural household to the same policy measure greatly dependent on local specificities, like: local conditions, level of local development and integration, remoteness etc. In this regard, the policy experiments allow gaining insights into the direction and magnitude of changes accounting for localities.

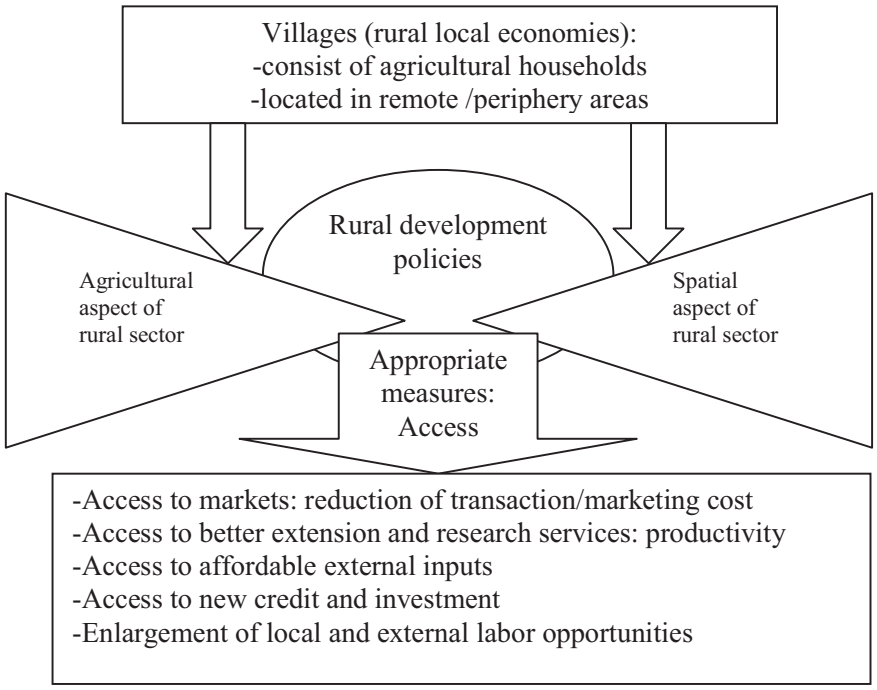
With respect to the goals that government is aiming to achieve, it is generally assumed that interventions seek to maximize the social welfare, given the constraints and possible side effects. The central concept of welfare is a Pareto criterion which states that the appropriateness of policy that lead to changes is adequate when nobody is worse off as a result of change. In addition, the compensation concept adds that the potential gain from change should be sufficient enough to compensate the potential losers from the change (Ellis, 1992). Although these are clear criteria, their operationability is very weak. In many studies (e.g. Taylor and Adelman, 1996), the impact is assessed against changes of quantity produced, quantity sold, and level of income. It is important to define how the consumer and producer welfare of farmer would change since the policy changes entail the multiple effects, among them are: direct (price) effects, production change effects, consumption effects, balance of trade effects, budget and income effects. Generally, to see the welfare impacts, it would be useful to employ the concept of producer and consumer surplus within the framework of partial analysis. This would allow examining the direct effect of policies within the partial analytical scope and looking at efficiency and distributional consequences for farmer as a rural producer and consumer.

Poverty in Kyrgyzstan, as in other developing countries, is rural phenomenon. As poverty statistics show the poor households are concentrated in rural areas. In many instances, it could be argued that persistent rural poverty is attributed, among other things, to imperfect markets which are the result of remoteness, lack of access to markets and poor state of rural infrastructure. In that respect, the remote rural regions are viewed as marginal regions which face unfavorable conditions and thus are less competitive and disadvantaged. Due to socio economic constraints in such unfavorable regions, the poverty rates are disproportionally high, productivity is low and land quality is declining. Because of these problems some sort of policy and regional targeting is of high relevance and is advocated in order to mitigate the local poverty and local adverse geographical conditions. Also, it could be that due to local specificities and household heterogeneity the standard tools of enhancing rural development might not be the right approach as localities modify the policy impacts. Clearly the diversity of rural areas makes the one-size-fits-all development approach not appropriate, whereas the targeted regional approach accounts for importance of localities. The policy focus should be on those areas that target the farmers' incentives that stimulate farmers to increase their production and improve livelihoods. Identifying the right public investment efforts targeted both towards sustainable intensification of farming production and rural livelihoods and on the other hands towards the disadvantaged regions is of fundamental importance for ensuring egalitarian rural development.

Access to markets, roads and other infrastructure determine the market opportunities available to farmers. Access to urban markets and roads is relatively unfavorable for the region where our subject village is located which is similar to other poor parts of the country. Agricultural opportunities are also influenced by other factors, especially, access to science and technology, development of human capital, access to cheap inputs (Dixon et al 2001). Given this, the special type of public investment is particularly required in marginal rural regions and in fact might have the larger impact on poverty and development than comparable policies in more developed areas, i.e. areas with good access to markets and proximity to centers.

The regional specific factors like geographical conditions and localities demand the specific types of development policy interventions. In the present context of the village modeling and disadvantaged (marginal remote) rural areas the policy measures should be regionally focused. In this regard, the policies include improving regional access to roads and markets (i.e. the reduction in marketing and transaction cost, making the external inputs more affordable, providing the credit/investment support that otherwise is not accessible), improving access to better technology via better advisory and extension services or provision of better seeds variety (i.e. improving the technology and productivity of agricultural production) in villages/regions far from centers and main infrastructure. It is important for policy makers to identify strategic options for agricultural and rural development in less-favored areas and policy instruments that enhance rural household's livelihoods. Given this policy focus, it is appropriate to simulate these specific policy measures targeting the village households and employing the village model that particularly suited for these types of policy experiments. The model accounts for asymmetric access to factor and output markets and can thus be used to identify production and consumptive responses and within-village interactions of different types of our village households in a manner that is consistent with specific public polices targeting the disadvantaged rural regions.

Figure 21: Relevant aspects of rural economies for development policies



Source: Author's view

5.1 Policies to affect the transaction/marketing cost of marketed supply

In chapter one, we discussed the notion of transaction costs in relation to market failures. In line with the views of the New Institutional Economics that institutions are important

to reduce transaction cost, the general notion of transaction cost was defined. The presence of high transaction costs, via cost of doing agricultural business, is a reason for imperfect markets which discourages the participation in the marketed sale. The occurrence of transaction costs makes the analysis of household behavior more complex and results in household specific market behavior, i.e. markets fail for those who have prohibitively high costs of transaction (De Janvry et. al, 1991). The notion of transaction cost is very wide, i.e. these are the cost of running the system. As such the transaction cost includes not just transportation cost, but potentially also information, negotiation, monitoring and enforcement costs. For the purposes of economic analysis, the main problem is in measuring the transaction costs. Virtually no empirical estimation of transaction cost is found in the current literature, in many cases, direct transportation cost, distance to the market or some other related indicator is taken as proxy for transaction cost. Empirical examples of impact of transaction cost include Goetz (1992) who concluded that better information raises the probability of market participation in Senegal. Also, Gabre-Madhin (1999) studied the effects of transaction costs on grain trading in Ethiopia and found that search costs can considerably limit grain traders.

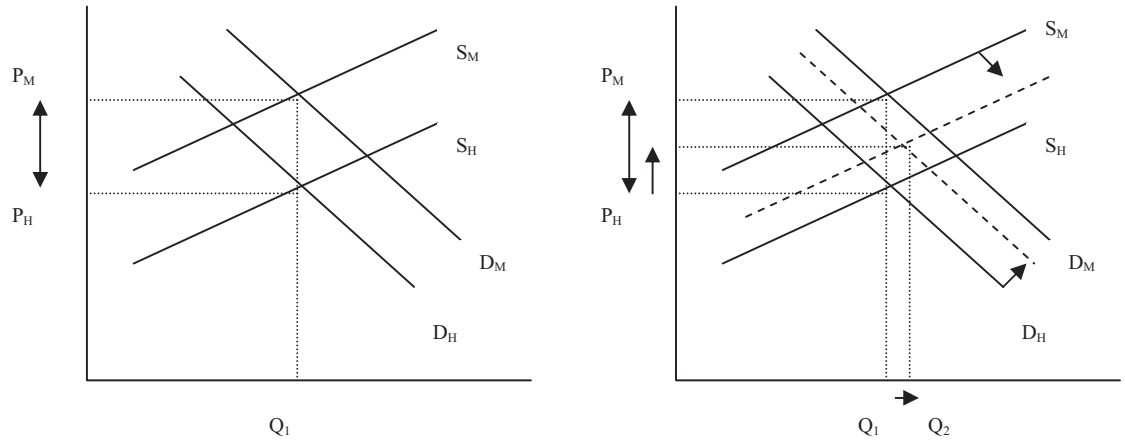
The marketing of agricultural output by rural farmers could be viewed from two perspectives. On the one hand, the marketing system transmits the price signals between farmers who act as producers and rest of the village which represents traders or consumers. On the other hand, the market sale by farmers involves the physical movement of output from farmers to the rest of the village. For empirical purposes, we have to narrow down the very broad definition of transaction cost. One way to do so is to define transaction cost as a cost or a margin that differentiate the purchase price of the commodity for consumer from that of selling price of the producer. This transaction margin therefore could be viewed as a sum or proxy of all transaction cost, given that the transaction cost is unobservable. From this point of view, transaction cost is thought of as part of volume of commodity sold, which is melted, via so called the iceberg coefficient (Kuiper, 2005). For illustration purposes, we assume that transaction costs are equal for consumers and producers and that transaction cost is proportional to volume. The transaction costs (t) wield a wedge between the exogenous market price (P_m) and the household specific price (P_h). Thus for our village households, who are all net sellers in the market the $P_h = P_m - t$. In terms of volume the transaction cost (t, which is positive but less than 1) is a coefficient which reduces the sale of produced and marketed output, by the value of the coefficient. In our village model, the recipient of the transaction cost are in large part not local households, but from the rest of the village, which reflects the fact that transaction cost melts down the quantity of the marketed sale. This way of presenting the transaction cost seems relevant for our subject village. Remoteness, few external traders, information and infrastructural constraints result in rather significant transaction cost, which eats away the part of the marketed output and price not benefiting the village households.

So, in line with the advocated need for policy intervention, it would be legitimate to implement the policies that lead to narrowing down the transaction cost. The particular objectives of the policies are multifold. First is to stabilize and increase the farm gate prices for village farmers. By reducing the transaction margin via introducing the marketing boards, the intervention might reduce the gap between farm specific price and external market price and thus increase (benefit) the farmers (versus traders) share in

final market price. The second objective, which is not less important, is to increase the domestic agricultural surplus. Weak competitiveness of village farmers in non favored areas and erratic domestic supply are the main justifications for more active state interventions and now at the forefront of the policy agenda in Kyrgyzstan.

Public policies that reduce transaction costs consist of institutions that support market exchange, provide training for farmers in contract management, promote institutions for dispute resolution, and support the establishment and strengthening of producer organizations. In addition, policies that support the provision of market information and improve the market "infrastructures" and services (transport, storage, financial services) also reduce the transaction costs that rural farmers face in markets (Ellis, 1992).
The specific instruments of such policies are numerous, starting from introducing state marketing agencies, building roads and infrastructure, stimulating the competition among private traders, ensuring better informational flows. So the impact of policies that target transaction costs might be operating via prices or/and direct transportation cost. Let us graphically consider the changes in transaction costs.

Figure 22: Effect of transaction cost on prices

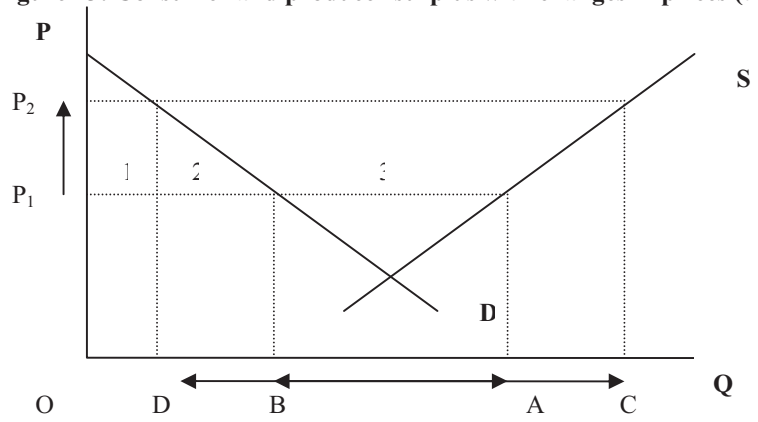


Source: Ellis, 1992

In the left side of figure 22, the supply and demand of a particular rural farmer is different than that of market (market supply is a sum of all household supply and demand is rest of the village demand). The transaction margin is represented by the difference between market and household prices. The effect and goal of policies is to narrow down the transaction cost, which could be represented by moving the market supply curve closer to the one of the farmer and household demand curve closer to market demand schedule, which is depicted in the second figure (right side of figure 22). Noting that the result depends on the elasticities, we observe that reduction of transaction cost is likely to increase marketed surplus, which is the objective of the policy makers. At the same time the domestic (farmer producer) prices are also increased, which will entail additional round of effects.

The rise in domestic (farmers') prices, increases returns to all inputs and factors stimulating the rise in incomes and production. Before we present the results of simulation it is important to make attempts of describing the theoretical effects of such changes with the use of different concepts and using the notion of producer and consumer surplus.

Figure 23: Consumer and producer surplus with changes in prices (transaction cost)



Source: Ellis, 1992

The rural households supply curve is denoted by *S* and represents the marginal cost curve of the farmer as producer. The other side of the rural household is that it is also a consumer of the same agricultural produce. The household demand curve is given by *D*. Like before we assume the case of agricultural products which are produced for export (market sale) and for home consumption. The rise in price level of the agricultural crop as a result of reduction in transaction cost (which as we showed is viewed as ad valorem tax on marketed output) leads to production increase from original *OA* to new level of *OC* as a result of favorable prices. This is accompanied by increase in marketed surplus from initial *BA* to the new level of *DC*. However, household consumption is negatively affected and declined from *OB* to *OD*. In terms of welfare, the household losses area 1 as consumer, but gains area 2 and 3 as producer. It is important to remember that all results critically depend on the elasticities of demand and supply, which define the slope of the respective curves. With this qualification and assuming linear behavior, it seems that rural household would be better off from price increase and would raise their production and marketed output.

Nevertheless, as Dyer et al, (2003) indicate the actual comparative statics is more complex than above. One can distinguish three effects of price changes for rural farm household. First is direct effect such as "Slutsky effect" of a price change on demand, second is indirect effect of rural farm profit (i.e. rural farmer being not just a consumer but the producer too) and finally a third indirect effect that influences the endogenous village prices and household shadow prices. These three effect might be counteracting and thus produce analytically intractable comparative statics. It is exactly for this reason the programming approach is required to derive the sign and magnitude of the exogenous impacts.

So, we might try to break down the impact in a partial model type and see how the impact works out through the model.
Within the framework of the agricultural household model, consider the household demand for agricultural crop as a function of:

$$D_A = D_A(P_A, P_{NA}, W, Y)$$

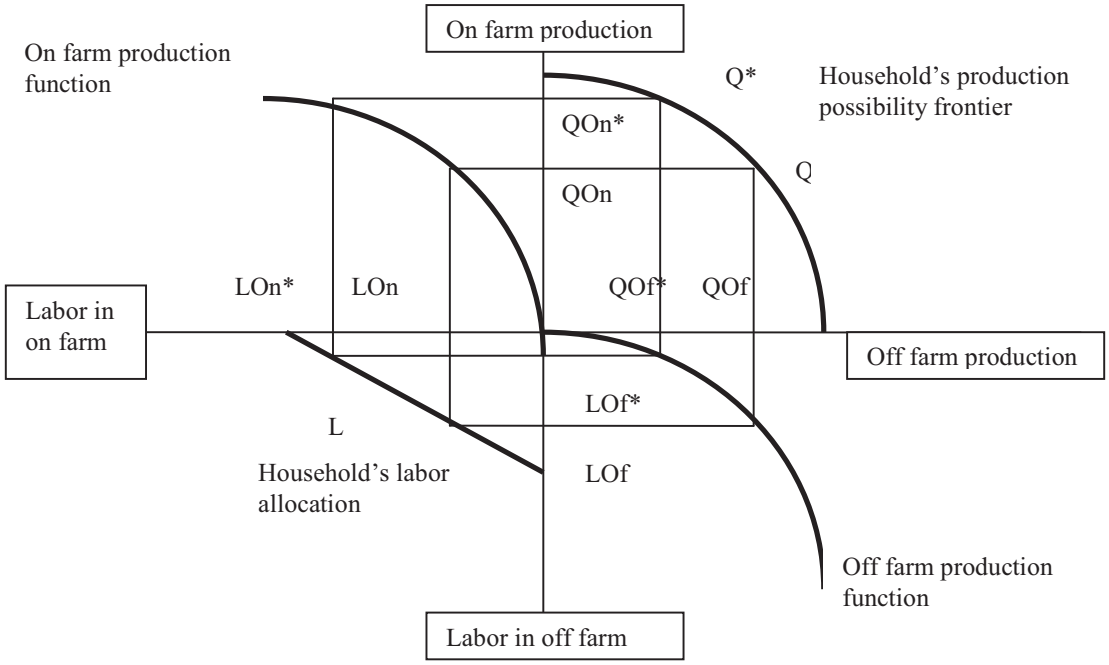
Where: P_A and P_{NA} are the prices of agricultural crop and non agricultural good, W is wage rate and Y is income. The effect of the price change on demand is therefore:

$$\frac{\partial D_A}{\partial P_A} = \left.\frac{\partial D_A}{\partial P_A}\right|_{\pi} + \frac{\partial D_A}{\partial Y} \cdot \frac{\partial Y}{\partial P_A}$$

The first term on the left hand side indicates the standard Slutsky negative effect of the price increase (i.e. price received by farmer) holding profit constant, whereas the second term points to profit effect of higher prices which stem from fact that our village households also produce for market sale. As the share of market sale of our households are not that high ranging from 13% to 46 % the profit effect could be not that large too.
So taking into account these two effects we would assume that price increase (stemming from reduction of transaction cost) would not affect the household demand as it is likely that direct and profit effects would cancel each other. Moreover, the agricultural marketed supply would change a little as higher price incentives would be outweighed by consumption effects.

However, in addition to within household effects the village model accounts for household sectoral effects. Let us take the village factor market like labor. We observed that off farm labor market is local and seasonal. To see how the price increase might impact the labor market for household sectors we resort to use of the following figure.

Figure 24: Relationship between household production and labor allocation

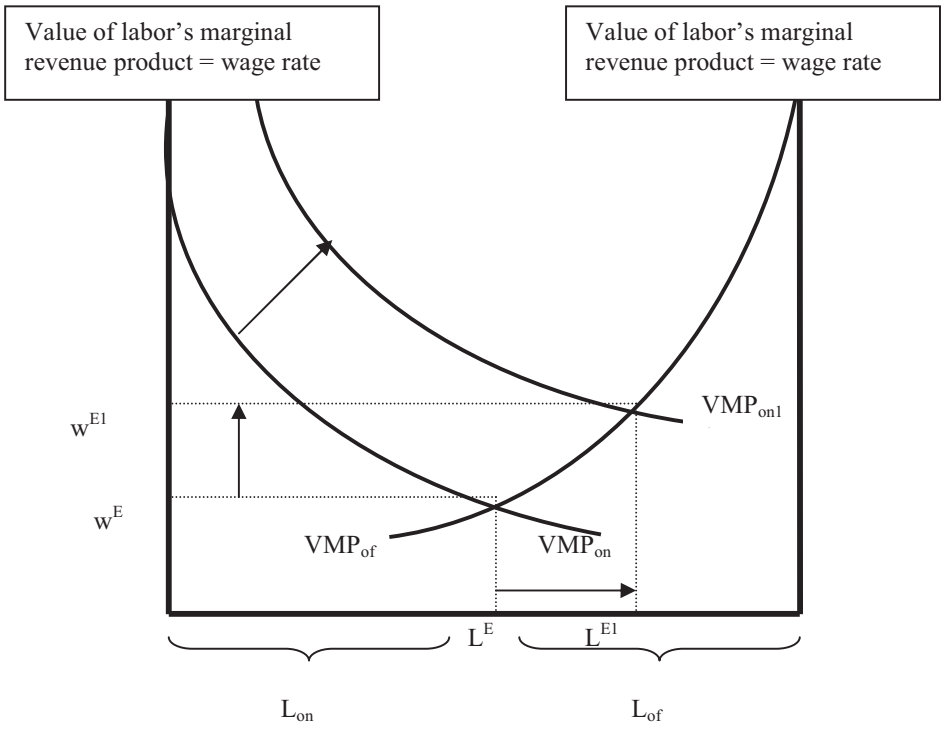


Source: Modified from Krugman and Obstfeld, 1994

As Figure 24 makes it clear the household is involved in on farm and off farm production depicted in upper right quadrant, where the household's *PPF* curve lies. The household's labor is allocated to on farm and off farm production which is mapped via the production function lines to the line *L*. The sum of labor used in on farm and off farm constitutes family labor endowments. For the base period, the household produces the *QOn* and *QOf* amount of on farm and off farm produce respectively, which by way of respective production function allocates the household labor to on and off farm labor in the amount of *LOn* and *LOf*, respectively. Now we assume like above that agricultural policies resulted in increase in farm gate prices and rise in agricultural output and accordingly the decrease in off farm production from *QOn* to *QOn** and *QOf* and *QOf** respectively. Since, the production function shows that the household would supply more labor on farm (from *LOn* to *LOn**) versus off farm sector.

The important thing is that the household labor and other factor valuation in on farm sector changes. This is demonstrated by Ricardo-Viner trade model (Vousden, 1990), which assumes that taking the case of two factors, one factor is fixed (sector specific) whereas the second factor is mobile. This assumption is relevant for rural household which uses its mobile (and homogenous) labor in on farm and off farm, but its land is only employed in on farm production (specific to on farm agricultural production only). To see this and to provide a graphical representation of changes, we present the following Figure 25.

Figure 25: Mechanism of labor allocation in household



Source: Vousden, 1990

The down sloping curves VMP_{on} and VMP_{of} represent the value of marginal value products of labor in on and off farm production. The profit maximizing choice of labor allocation by the household to two sectors is determined at level L^E on the horizontal axis where the wage w^E is equal to the value of the marginal value product for two sectors. At point L^E the two curves VMP_{on} and VMP_{of} intersect thus $VMP_{on} = VMP_{of}$, determining the unique wage rate w^E. The sum of L_{on} and L_{of} define the household labor endowment with specific labor allocation for equilibrium wage w^E. Now suppose that there is a policy induced reduction in transaction cost and concurrent net price increase for agricultural products. The immediate effect will be to raise the value of marginal value product in on farm agriculture, shifting up VMP_{on} to VMP_{on1}. The new equilibrium is given at point L^{E1}. At L^{E1}, labor allocated to on farm agriculture production increased while labor used in off farm fell. The equilibrium wage increases to w^{E1}. This dynamics follows the profit maximization behavior of the household. However, the more important is the effect of the price change on real wages. Due to the presence of the fixed factors, the wage rate increase is less than the increase in price level, i.e. $\Delta w < \Delta P_A$. This implies that the real wage, w / P_A , in terms of agricultural purchases (equivalently real income), decreases. In other words, household will be able to buy less agricultural products after the crop price increase than before. However, given that the price of off farm produce did not change, this implies that the real wage w / P_{Of} in terms of off farm produce purchases increases. This means households will be able to buy more off farm produce after the increase of the farm gate prices of agricultural goods. In terms of overall well-being, household will lose in total if they tend to consume more of agricultural products and fewer off farm products, which is the case for smaller and medium land holders in our village. However, the opposite effect is for the rent rates for the fixed land factor. The increase in the price (as a result of less transaction cost) will be less than the increase in the rent rate of land thus increasing the real income in terms of agricultural purchases versus off farm sector. The price increase effect thus works in different direction for different household groups, who endowed differently with fixed factor- land and mobile factor- labor.

In addition to these direct effects, in the village model the internal indirect effects take place. In our village economy, the village markets mainly consist of agricultural factor markets such as village labor, land, and input market like work horse and tractor services. As three household groups are differently represented by their shares in the marketed sale, we would assume that more commercial oriented (large land holders) households would increase their demand for these factors driving the village factor wage up. In turn this is likely to increase the opportunity cost of working on farm. The production of agricultural output in less commercialized households could fall whereas in more market oriented household the production and sale could increase. In other words, the village markets alter the household specific prices of agricultural commodities and factors which lead to the multi-vector response. In the end, the reduction in transaction cost and associated farm gate price increase for agricultural output in our village could result in less than perfect increase in marketed sale, or even to backward bending supply akin to backward bending labor supply with differential impact on household income.

Experiment 1: 10% decrease in marketing /transaction cost of all village export

Table below reports the results of reduction in transaction cost in marketing of export by 10 %, in terms of activity levels.

Table 18: Changes in production level, experiment 1

Sectors		Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	108.8	109.6	0.70
	H2	583.9	590.4	1.12
	H3	249.9	253.0	1.26
Cash crop	H1	95.1	95.3	0.21
	H2	806.2	806.7	0.06
	H3	298.5	298.4	-0.05
Large livestock	H1	82.7	84.1	1.58
	H2	554.4	559.7	0.96
	H3	240.0	242.8	1.18
Small livestock	H1	48.6	49.0	0.77
	H2	228.0	228.2	0.10
	H3	101.8	102.7	0.81
Non agricultural output	H1	41.5	41.9	1.02
	H2	94.5	94.6	0.17
	H3	30.4	30.7	1.05
Migration activity	H1	18.6	17.6	-5.35
	H2	79.1	74.6	-5.73
	H3	23.3	22.1	-5.08

Predictably the reduction in marketing cost, via increase in export prices led to increase in agricultural production activities of village households, the exception is large household in cash crop production. The most responsive sector proves to be a large livestock sector. Although the non agricultural sector also increased the output, migration activities declined as a result of exogenous change.

Across households, the large and small households were the ones who were able to increase their outputs most, although differently in different sectors, perhaps reflecting different advantages. The medium holders stayed in the middle case/ground.

How this translated into export is reported in table below.

Table 19: Changes in export quantities, experiment 1

Export sectors	Base (000 soms)	Exp (000 soms)	% change
Food crop	249.0	256.1	2.83
Cash crop	391.2	389.7	-0.37
Large livestock	484.1	491.5	1.53
Small livestock	205.4	206.2	0.38
Migration labor	121.1	114.4	-5.55

By all means the increase in (some) export is modest, while food crops responding more compared to other sectors. Surprisingly despite the increase in production (and improvements in prices induced by reduction of transaction cost), the export of cash

crops has been reduced. While we can explain the decrease in migration labor, by higher demand for agricultural labor, the case with cash crop export is more complex. On the one hand the household own demand for cash crop may have increased.

Table 20: Changes in market versus for home production, experiment 1

Sectors			Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	Market	16.8	17.2	2.4
		Home	90.6	91.0	0.4
	H2	Market	141.1	145.4	3.1
		Home	408.4	410.2	0.4
	H3	Market	91.1	93.4	2.5
		Home	147.1	147.6	0.3
Cash crop	H1	Market	18.6	18.6	0.0
		Home	74.1	74.2	0.3
	H2	Market	250.4	249.3	-0.4
		Home	538.3	540.0	0.3
	H3	Market	122.1	121.8	-0.3
		Home	157.5	157.8	0.2
Large livestock	H1	Market	46.9	48.0	2.4
		Home	32.5	32.7	0.4
	H2	Market	309.9	314.0	1.3
		Home	214.7	215.6	0.4
	H3	Market	127.3	129.5	1.7
		Home	81.0	81.2	0.3
Small livestock	H1	Market	25.2	25.5	1.1
		Home	23.4	23.5	0.4
	H2	Market	115.9	115.7	-0.2
		Home	112.1	112.5	0.4
	H3	Market	64.3	65.0	1.1
		Home	37.6	37.7	0.4

Indeed, with increase in market demand Table 20 shows that sale for market has been increased, but the household own demand has also increased. The interesting result is that for cash crop and to a less extent in small livestock sectors the marketed output is either smaller than for home sale or negative. The reduced level of market sales might be due to income effects which increased for home production (for home consumption) to a greater extent than for market sale. In the textbook agricultural model, the agricultural agents unambiguously increase the output supply as a result of reduction in transaction cost. Here, in the village model, the rural households modeled as producers and consumers allowing for profit and consumption effects. In the village model higher demand put upward pressure on local labor and land demand. On farm production compete for resources for home versus market (export) production. Subsequently, the higher wages create a negative input price effect on production and village input demand. In addition to profit effect the negative village input cost effect may have contributed to the negative price elasticity of aggregated marketed supply.

Let us look at the changes in local demand and local prices of village inputs.

Table 21: Changes in demand and in prices in village markets, experiment 1

Village traded inputs	% change in	
	demand	prices
Village land	-0.18	2.2
Village labor	1.23	0.5
Village horse	1.62	0.7
Village tractor	0.63	1.3

While there is increase in prices the demand for majority of village inputs also increased. The only dampening effect on production was exerted by decrease in demand (as well as supply) of village land. Thus, where village land is the important input into the production, the output level of that sector would tend to decline. This underlines the importance of the village markets.

In addition to village inputs, the increase in production activities entails the increased demand for factors across the sectors, as well as across the household groups.

Table 22: Changes in factor demand from sectors, experiment 1

Factors	Sectors	% change		
		H1	H2	H3
Labor	Food crop	1.43	2.26	1.68
	Cash crop	1.13	1.01	0.92
	Large livestock	2.24	1.68	1.82
	Small livestock	1.37	0.79	1.37
	Non agricultural	1.17	0.24	1.08
	Village	1.41	0.92	1.27
Land	Food crop	0.10	0.58	0.72
	Cash crop	-0.25	-0.36	-0.50
	Village renting	0.67	-0.66	
Capital	Food crop	0.54	0.69	1.75
	Cash crop	0.24	-0.04	-0.18
	Large livestock	1.36	0.63	0.91
	Small livestock	0.50	-0.25	0.46
	Non agricultural	0.30	-0.80	0.18
	Village renting			0.38

The increase in the value of labor factor increased its demand across all sectors except for in migration, and in fact the increase in labor use by households could be only achieved via reduction of the labor use in migration.
In cross sectoral terms, land saw a better return in food crop sector and as a result land has been directed to that sector reducing its use in cash crop sector and from renting activities. Similar picture emerges with use of capital, better sectoral opportunities in some sectors attracted capital from other activities. This was possible as we allowed for capital flows in the model. The justification of this was that capital account in addition to including the capital, also served as a residual account, which embraced the values of land which did not fit into the land account. We believe that this is a correct reflection of the production practices of village households.
As the factor demand has changed so did the factor income of village households.

Table 23: Changes in income, experiment 1

Factor demand

Factors	% change		
	H1	H2	H3
Labor	0.51	0.74	0.62
Land	2.02	2.24	2.10
Capital	1.47	1.91	1.62

Income

	Base (000 soms)	Exp (000 soms)	% change
H1	566.5	572.3	1.02
H2	2848.6	2885.1	1.28
H3	1442.0	1456.3	0.99

Overall, it seems that reduction in transaction costs produced a positive impact on households' income (positive income elasticity). In terms of the factors, household land and capital impacted most the increase in income, as the agricultural activities which responded to induced changes are more intensive in these factor use rather than labor.
In terms of households, the medium group witnessed the most increase, although the between group difference is not that large.

With modest income gains the changes in consumption, including of leisure are also quite small. Although the differences are indiscernible, with rise in income the households tend to consume more of imported consumption goods like processed food and manufactured commodities. It could be attributed to changes in the price ratio between imported goods and home produced/consumed goods.

Table 24: Changes in consumption, experiment 1

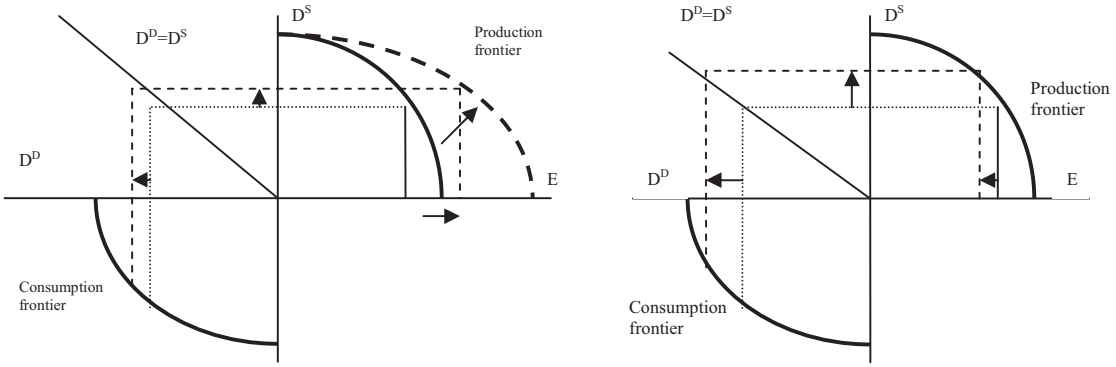
Commodities		Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	87.4	87.7	0.39
	H2	389.7	391.5	0.46
	H3	139.0	139.5	0.37
Cash crop	H1	67.9	68.1	0.28
	H2	492.4	494.0	0.33
	H3	142.7	142.9	0.19
Large livestock	H1	32.5	32.7	0.42
	H2	214.7	215.6	0.42
	H3	81.0	81.2	0.31
Small livestock	H1	23.4	23.5	0.39
	H2	112.1	112.5	0.36
	H3	37.6	37.7	0.36
Non agricultural	H1	26.3	26.4	0.51
	H2	51.7	52.1	0.67
	H3	88.3	88.8	0.48
Processed food	H1	81.4	82.1	0.83
	H2	276.5	279.4	1.03
	H3	184.3	185.8	0.83
Manufacturing	H1	99.5	100.3	0.82
	H2	414.7	418.9	1.02
	H3	300.5	302.9	0.82

In general, the policy of reducing transaction and marketing cost has complex effect in our simple village economy. First of all, the reduction in transaction cost of exporting (marketing) agricultural produce affected the relative prices which village household face, P_E/P_D. So, the households received more incentives to trade and they increased the output as well as export. As production for export became more profitable, the rational farmers employed more factors to produce agricultural export.
However, the village supply of factors due to its isolated location is limited. This dampens and for some sectors (cash crop) reverses the positive effect of reduction in cost. The internal village markets also exert some dampening effect via rise in prices of local village inputs. In addition, the village households are modeled as non separable decision making units (consistent with our findings and reflecting the village reality). As such

there is a strong profit effect, which reversed the positive effect on marketed supply for some commodities.
Income and consumption effect of reduction in transaction cost is quite moderate and unequal across different households groups, reflecting the importance of distributional impact of policies.

In conclusion the policy has effects which differ from one sector to another and which could be conveniently summarized using the Figure 26 below.

Figure 26: Sectoral effect of reducing the transaction cost on domestic and for export production



In the first (left) figure the policy effect is depicted with respect to majority of commodities. A rise in P_E/P_D ratio amounting to transaction cost means more export is produced. At the same time more of domestic household production also occurs with increase in household consumption due to income effect. On the other hand, limited supply of factors and the same income effect shift the production in some other sectors, reducing the export supply, but still allowing for more of domestic/for own household supply and consumption. This is depicted in the second (right) figure.

5.2 Policies that entail the productivity enhancing technological change

Another aspect of remote village is that farmers in that village are not able to benefit from technological and other advances. In the aftermath of the reform era, agricultural productivity and incomes of the farmers have stagnated or even decreased. This is mostly due to the lack of investment in education, research or extension in general and in particular (especially) for distant rural areas.
Because agricultural research and technology development is characterized by economies of scale, externalities and long gestation period, the private sector will not invest in such activities (Ellis, 1992). The private business is interested in investing in technologies which ownership can be protected and use of *know-how* can be limited in order to earn on investment. Unlike the industrial sector, agricultural research and extension is highly location specific, due to geographical and climatic conditions and thus relatively few technologies can be directly imported from abroad or even other parts of the country. Accordingly, there is a broad agreement in the literature that agricultural research and extension are public goods, and the state should play a dominant role in providing this

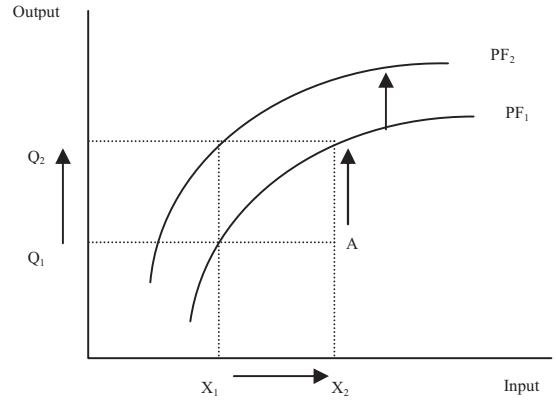
type of service. The role of the state is to induce new technologies, fund location specific research and extension services via state or private institutions, as well as provide the appropriate incentive structure for the private sector to invest in technological development. However, since reforms started Kyrgyzstan is seriously underinvesting in public agricultural research and extension. On the other hand, the limited technological progress is not solely due to underinvestment, but also related to institutional weakness that prevailed after the liberalization of agricultural sector. The mandate for agricultural research and extension is given to Ministry of Agriculture, but system collapsed with dissolution of collective farms. For example, in the former large agricultural farms, crop rotation was a common (and mandatory) practice, land distribution and shifts in the cropping pattern towards self-sufficiency caused the now private farmers to abandon crop rotation. As a result, yields had drastically declined due to reduced soil fertility, high infestation with plant diseases and weeds. So the contemporary problem is not much of introducing the new technology but simply advising farmers in everyday questions related to agricultural production, small-scale processing and marketing.

On a country level and more so on regional level, the higher rates of growth in agricultural productivity are necessary to promote broad-based economic growth, reduce rural poverty, and effectively manage natural resources. In turn, agricultural productivity growth is based largely on new technology, better extension services and information, which needs to be provided through national agricultural research and extension systems, which are especially targeted to disadvantaged rural areas. So the policy implication of the problems in this area is twofold. First, the public investment in agricultural research in the marginal regions should be increased by significant amount just to make up for the years of neglect since the reforms started. But the much needed increase in public expenditure for research and extension should be rationalized and optimized in respect to institutional structure. This involves decentralization of extension functions to the local levels with active participation from local farmers and stimulation of private- public cooperation.

Theoretically, three sources of agricultural output growth can be distinguished. First factors are attributed to increases in conventional inputs (which cause movements along the production function), second to increases in non-conventional inputs (which cause a shift in the frontier production function), which are the focus factors here like research, advisory and extension services, and last set of factors which change the output are due to changes in technical efficiency (the distance that individual farms are away from the frontier) (O'Neill, 1999).
To illustrate this, we resort to the following Figure 27. The increase in output from Q_1 to Q_2 is possible if farmer moves from point A to efficient production frontier (i.e. improving on technical efficiency), use more input from X_1 to X_2 and finally if there is technical progress depicted by shifting the production frontier from PF_1 to PF_2 (under assumption of constant return to scale):

$$\Delta Q = \Delta \text{in efficiency} + \Delta \text{ in input use} + \Delta \text{ technology}$$

Figure 27: Sources of agricultural output growth

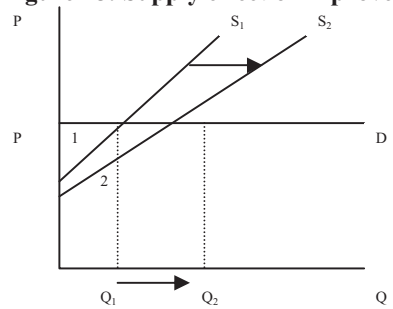


Source: adapted from O'Neill, 1999

Within this framework of agricultural growth, there are two channels of impact of research and extension in terms of agricultural production. The first channel is to transmit the dissemination of new technologies to farmers as a way of increasing agricultural productivity, thus speeding up the adoption or use of new and better technology and practices. The second channel is via role of extension in improving human capital and the management skills of farmers, thus assisting individual farmers to improve their level of technical efficiency. In a static context, both channels would have the effect of moving farmers closer to the frontier. In a dynamic framework, where the frontier is allowed to shift, the role of research and extension via diffusing innovation is not on changes in technical efficiency. Instead, the effect of new farm technologies is in shifting outwards the production frontier, i.e. farm supply curve shift to the right as farmers are able to supply more of agricultural output at every price.

In the present research, we are not interested in the technical efficiency issues of policy measures (and in fact we implicitly assume that our household groups are technically efficient), the focus is on dynamic implications of the better extension and research/advisory polices. So the main approach is to assume that increase in state investment in advisory and extension services cause an outward shift in the marketed supply curve (for agricultural output as a whole). In a way this is similar to the reduction in the marginal cost of producing greater quantities of output and for that reason village farmers are ready to supply more at each, given market price level. Applying the concept of producer surplus and assuming the perfectly elastic demand curve from the rest of the village we can depict this situation as follows.

Figure 28: Supply effect of improvement in productivity



Source: Ellis, 1992

From this figure, it could be seen that with perfectly elastic demand curve the village farmers are likely to capture a large producer surplus (in addition to triangle 1 the area 2 gained) following the policy induced technological change (shift in supply), accompanied by proportional increase in output. This time the policy is not indirectly affecting prices like with transaction/marketing cost policy measures. So the technological improvement experiment could be thus implemented by increasing the technological shift parameter in the CES production function of agricultural crops.

Theoretically, the technological progress would increase the marginal productivity of household owned resources employed in agricultural crop production. The profit maximizing farmers would likely increase the allocation of resources to crop production. Since the village factors are scarce and limited, the prices of these factors also increase. In addition, the outward move in demand for factor used in crop production drive also prices for village traded inputs (village non tradables). With no other possibilities to substitute for scarce factors the rural households would withdraw the factors (assuming factor mobility) from other household non crop activities in order to meet higher demand for factors and inputs in crop production. In the end the higher factor prices for household factors and village inputs might dampen the positive impact of technological improvements of crop production. Again signing the outcome is theoretically difficult, to see the impact, empirical simulation needs to be conducted.

The village model presented earlier is very much suited to derive impact effects of alternative policy measures that are outlined above.
Both within household and village effects are modeled in village general equilibrium model. In addition, the village model captures the general income effects. The overall impact of exogenous changes incorporates all these effects in direct and indirect ways. So in order to see how these different effects intervene and produce the net village effect we actually run the village model imposing the shocks to the base situation.

Experiment 2: 10 % technological improvement in crop production

In terms of the model this experiment translates into 10 % shift in the efficiency parameter of CES production function of crop sectors. The increase in the agricultural crop production that result from technological change are relatively large compared with transaction reduction experiment considered earlier. Across the sectors, apart from crop sectors which benefited directly the non agricultural sector also showed the increase in production level. However as resources has been directed to crop sector the livestock sector and migration activities has been reduced. The latter fell in considerable amount, whereas the smaller reduction in livestock sector was due to the fact that more crop production meant that more of crop residues are available as inputs into livestock. In interpreting the results one has to be cautious: such a large increase in production as well as decrease in migration was possible due to labor mobility between sectors. In case the migration labor is of different quality and skills (which we did not assume and found in our village) the labor imperfect mobility would dampen the increase and soften the decrease in migration.

Table 25: Changes in the production activity, experiment 2

Sectors		Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	108.8	122.0	12.12
	H2	583.9	667.0	14.25
	H3	249.9	288.2	15.33
Cash crop	H1	95.1	107.0	12.53
	H2	806.2	936.4	16.15
	H3	298.5	343.1	14.94
Large livestock	H1	82.7	80.8	-2.37
	H2	554.4	548.4	-1.09
	H3	240.0	240.6	0.25
Small livestock	H1	48.6	45.0	-7.51
	H2	228.0	212.0	-7.00
	H3	101.8	91.6	-10.02
Non agricultural	H1	41.5	43.6	5.22
	H2	94.5	99.7	5.52
	H3	30.4	31.4	3.27
Migration activity	H1	18.6	11.7	-37.31
	H2	79.1	50.7	-36.00
	H3	23.3	14.8	-36.59

The policy makers are interested in not just improving the productivity per se, but for the sake of increasing the export from village. The outcome on export is reported in the table below.

Table 26: Changes in export quantities, experiment 2

Export sectors	Base (000 soms)	Exp (000 soms)	% change
Food crop	249.0	333.0	33.71
Cash crop	391.2	515.9	31.89
Large livestock	484.1	460.6	-4.85
Small livestock	205.4	168.7	-17.86
Migration labor	121.1	77.1	-36.32

While the sale of crop commodities has increased and in considerable amount the livestock and migration sectors declined in large amounts as well. Again the fixed factor supply produces such a sectoral trade off and the policy makers should take into account this fact.

With such a large crop increase, we would be interested to see how the home production changed versus for market sale.

Table 27: Changes in market and for home production, experiment 2

Sectors			Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	Market	16.8	23.8	41.6
		Home	90.6	96.6	6.6
	H2	Market	141.1	190.3	34.9
		Home	408.4	439.8	7.7
	H3	Market	91.1	118.8	30.4
		Home	147.1	156.9	6.7
Cash crop	H1	Market	18.6	25.5	37.2
		Home	74.1	78.7	6.2
	H2	Market	250.4	336.1	34.2
		Home	538.3	579.4	7.6
	H3	Market	122.1	154.4	26.4
		Home	157.5	167.3	6.2
Large livestock	H1	Market	46.9	43.9	-6.4
		Home	32.5	33.6	3.3
	H2	Market	309.9	293.0	-5.5
		Home	214.7	225.7	5.2
	H3	Market	127.3	123.7	-2.8
		Home	81.0	85.0	5.0
Small livestock	H1	Market	25.2	20.9	-17.1
		Home	23.4	24.0	2.6
	H2	Market	115.9	95.1	-17.9
		Home	112.1	116.7	4.1
	H3	Market	64.3	52.7	-18.1
		Home	37.6	38.9	3.5

For crop and non agricultural sectors, both home (domestic) and markets (export) sales increased. However, for livestock sector the market sales decline while for home production increased. Thus the need for more home production emanated from higher domestic demand dampened the negative effect of factor outflow from the livestock sector. The higher domestic demand also prevented the reduction in non agricultural sector of the village economy. But due to small share of the domestic non agricultural sector in village the impact was small.

Within the village, the demand for village inputs increased, especially since these are more intensely used in crop production.

Table 28: Changes in demand and prices in village markets, experiment 2

Village traded inputs	% change in	
	demand	prices
Village land	0.89	12.4
Village labor	15.49	0.0
Village horse	2.98	12.0
Village tractor	7.67	4.0

Demand for village labor witnessed the largest increase, while the price of village labor actually did not rise, as more of migration labor was available. Since land and other village inputs do not have such substitute the demand was constrained by rise in their prices.

As village inputs are not only factors of production it makes sense looking at how the demand for other factors changed.

Table 29: Changes in factor demand, experiment 2

Factors	Sectors	% change		
		H1	H2	H3
Labor	Food crop	6.11	11.36	10.97
	Cash crop	7.42	12.69	11.91
	Large livestock	-1.70	-0.49	0.69
	Small livestock	-6.61	-5.99	-10.27
	Non agricultural	5.32	5.28	2.45
	Village renting	13.07	15.13	9.63
Land	Food crop	-1.53	-1.05	-0.16
	Cash crop	-1.14	0.98	0.11
	Village	13.51	-6.24	-
Capital	Food crop	6.15	7.00	4.47
	Cash crop	5.50	10.11	7.88
	Large livestock	-3.40	-2.75	-1.80
	Small livestock	-8.23	-8.13	-12.49
	Non agricultural	3.50	2.89	-0.08
	Village renting	-	-	6.91

As expected, the increase in crop production was achieved by using more of labor and village labor, especially from migration activities, which experienced almost 40 % reduction in labor use. The limited land supply and higher land rents induced the substitution of capital for land, which is possible in our model given the definition of capital. In essence, land and capital were redirected from other sectors to the crop sector where these factors received the higher return. This factor remuneration eventually affected the income levels.

Table 30: Changes in income, experiment 2

Factor Income	% change		
	H1	H2	H3
Labor	0.62	0.95	1.98
Land	10.24	13.78	14.68
Capital	2.61	3.56	4.87

Total income

	Base (000 soms)	Exp (000 soms)	% change
H1	566.5	581.0	2.55
H2	2848.6	2961.6	3.97
H3	1442.0	1501.7	4.14

Despite the reduction in migration and livestock, all three groups of households were able to benefit from the technological improvements in crop sector, as the income levels for all groups increased. The rise in income level is on the larger side, especially compared to the previous experiment. The large land holders seem to benefit most. In terms of factor return land contributed most to income increase, which could be explained by rise in

prices of land. So in terms of income impact, technological change policy dominates the transaction/marketing policy.

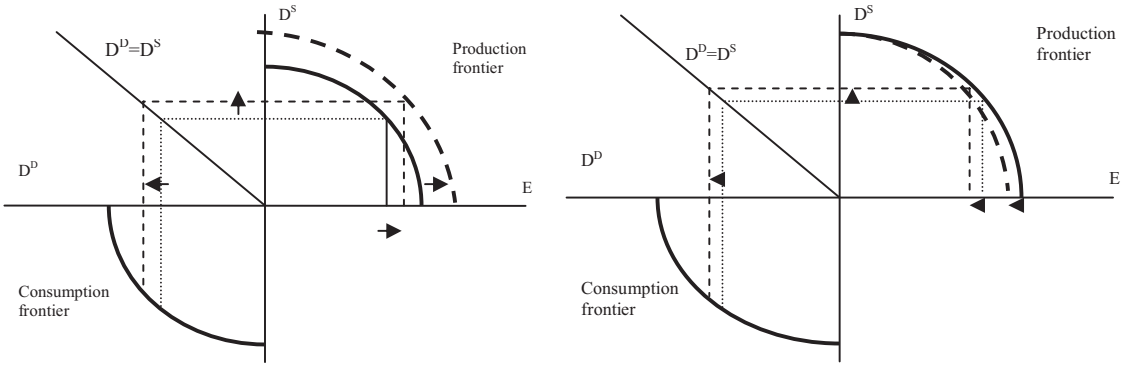
Naturally changes in household income and in sectoral production result in changes in demand for consumption commodities from own production and from abroad, as well as leisure demand.

Table 31: Changes in the consumption demand, experiment 2

Commodities		Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	87.4	93.3	6.83
	H2	389.7	421.1	8.06
	H3	139.0	148.8	7.08
Cash crop	H1	67.9	72.5	6.79
	H2	492.4	533.5	8.34
	H3	142.7	152.4	6.81
Large livestock	H1	32.5	33.6	3.34
	H2	214.7	225.7	5.15
	H3	81.0	85.0	5.03
Small livestock	H1	23.4	24.0	2.62
	H2	112.1	116.7	4.05
	H3	37.6	38.9	3.48
Non agricultural	H1	26.3	27.3	3.82
	H2	51.7	54.6	5.66
	H3	88.3	92.8	5.03
Processed food	H1	81.4	84.8	4.15
	H2	276.5	293.2	6.03
	H3	184.3	194.2	5.41
Manufactured	H1	99.5	103.6	4.13
	H2	414.7	439.6	6.02
	H3	300.5	316.6	5.39

The consumption of all commodities that constitute the household basket has been increased. The most increase was on crop commodities that are produced domestically, but still the demand for imported food also increased (which in our model do not have substitute). Interestingly, despite the reduction of livestock production, the households managed to increase the home consumption of livestock, mainly because they reduced for market sale production. Finally, better income also resulted in increase in leisure demand, which signifies the importance of trade off between leisure and migration, on the one hand, and leisure and agricultural production on the other hand.
Overall, the policy induced shift in supply of agricultural crop, resulted mainly in sectoral changes.

Figure 29: Sectoral effect of improvements in productivity on domestic and for export production



In Figure 29, the outward shift in production frontier for crop production resulted in increase for household consumption as well as for market sale. Thus the household increased village export and were able to benefit in terms of higher domestic consumption. However, as village model shows, there is sectoral trade offs. The factor constrains and non separable nature of village households render that for sectors which are not directly influenced by changes the output might decrease. The livestock and migration activities experienced factor outflow and reduction in for market production. Thus the export of those commodities declined whereas home consumption slightly increased.

Compared to transaction cost experiment, technological progress produced large and positive income effect. So overall, this experiment illustrates that potential of technological improvements for income generation is quite large, but the sectoral trade offs also quite substantial.

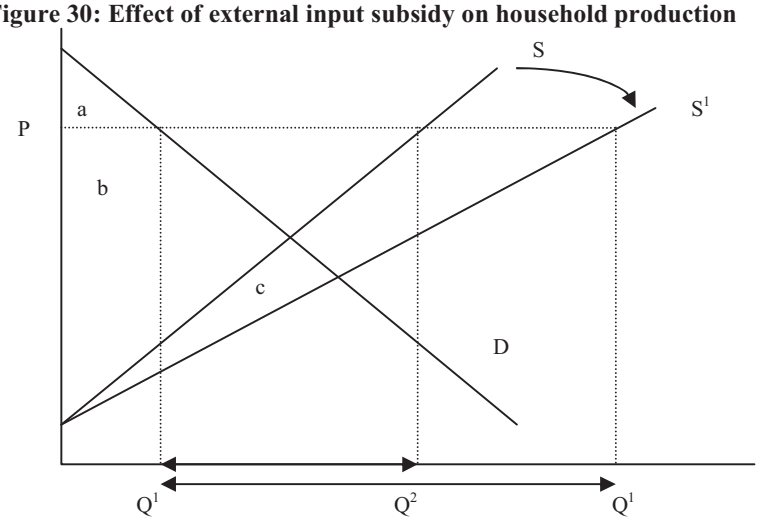
5.3 Policies that reduce the price of external inputs (e.g. input subsidies)

This section will turn to the case of the prices of variable inputs employed by our rural farmers. The focus is on the variable external inputs that are used by the village farmers and reflected as inputs in the village SAM, such as fertilizers, related chemicals, purchased seeds, fuel and to a lesser extent irrigation water. On a broader context, the input policies are concerned directly with prices of inputs and indirectly on access to inputs, i.e. ensuring provision and information about inputs use. During the survey of the households', most frequent concern expressed by villagers were the ever raising input costs given the distance from the large input markets. One could argue that when it comes to inputs the policies that affect the delivery of inputs eventually impact through the prices of inputs. So, the analysis here integrates both price and delivery dimensions of input policies into the one i.e. cost reduction of inputs, focusing on the external/imported inputs as the ones which difficult to obtain by villagers.
The nature of the external input use is such that inputs used in complementary way. For example, the more fertilizer use makes sense with more of water or more seeds application (Ellis, 1992). Hence, the input price policies should be implemented

simultaneously for several external inputs. This approach when all external inputs are affected at the same time is followed in our simulations.
The main argument for implementing input price subsidies, as part of the policies aiming to support agricultural development in more remote areas, is that via reduction of the cost of production the farmers would receive support to increase their production. In many countries input subsidies have also served as a way of raising farm incomes, particularly where farmers were isolated and constrained in the use of external inputs. Similarly, the input subsidies, by encouraging the adoption of new and better technologies, allow for increase in agricultural productivities.
The lack of progress on rural development especially in Africa reversed the trend which did not favor state interventions in direct support of agriculture. There is an emerging new view that input subsidies will help with achieving food security, improving soil fertility, and even social protection of vulnerable groups (Dorward et al., 2004). This is true for Kyrgyzstan too. Agricultural stagnation and understanding that markets could fail prompted political pressure to implement some sort of national input subsidy program. Agricultural productivity improvements could be thought of as the foundation for agricultural economic growth and social development in rural areas. In recent years, production growth of the major agricultural crops in Kyrgyzstan was stagnant or was based on extending the cultivated area. Poor infrastructure, high transaction costs (for both inputs and surplus production), inadequate institutional support (credit and extension) contributed to low agricultural productivity in Kyrgyzstan's agricultural sector. So, the input subsidies allow for increase in the net income gain from input use and are designed to improve productivity and to ensure adequate level of return in agricultural production, which eventually benefit both rural farmers and urban consumers.

In order to see what effect the input subsidies might have on village farmer, we start with graphical presentation of the producer and consumer surplus which reflect the dual nature of rural farmer. The graphic is constructed such that to reflect the net selling nature of our households, i.e. the price of agricultural output is above the household shadow price, which explains production surplus going for market sale (export):

Figure 30: Effect of external input subsidy on household production



Source: Adapted from Ellis, 1992

So the policy of input subsidy aims at increasing in output via cost reduction and improving efficiency. As marginal cost decreases with each level of output, the farm supply curve pivots outward, from S to S^1. The farm household initially produces at point Q^2 and consumes at Q^1, the rest is marketed. The consumer's surplus is area a and producer's surplus is area b. With input subsidy, the quantities supplied increases to point Q^3 whereas the consumption remains the same. The Figure 30 then demonstrates the welfare effect of input subsidies. As consumer welfare is still a, the producers surplus gains the area c. Thus assuming that the input subsidies did not entail the decrease in output prices the policies would result in gains from a producer side and increase in output. However, with likely reduction in prices, the producer side of farm household might experience the net welfare loss. In terms of our graphic, the outcome is not completely clear. The impact and farmers response greatly depend on elasticities of demand and supply.

Employing the profit maximizing logic we can also try to predict the sectoral effect of agricultural input subsidies. Introduction of input subsidies for crop production (mainly fertilizers and seed) would have a positive effect on their production and more so the more the specific crop requires the external input (input intensity), i.e. cash crop. Thus it might also induce more market sale for export increasing the marketed production. The mirror effect is reduction in output in other sectors, as a result of factor flow. Since the households are differently represented in the production of crop and non agricultural goods the distributional effect is also differential.

Experiment 3: 10% cost reduction of the external inputs for crops

Table 32: Changes in the production level, experiment 3

Sectors		Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	108.8	111.33	2.29
	H2	583.9	598.25	2.46
	H3	249.9	257.29	2.97
Cash crop	H1	95.1	96.49	1.49
	H2	806.2	824.85	2.31
	H3	298.5	300.55	0.67
Large livestock	H1	82.7	82.35	-0.49
	H2	554.4	552.52	-0.35
	H3	240.0	240.22	0.09
Small livestock	H1	48.6	47.46	-2.40
	H2	228.0	222.65	-2.35
	H3	101.8	98.16	-3.61
Non agricultural	H1	41.5	41.93	1.14
	H2	94.5	95.69	1.29
	H3	30.4	30.68	1.03
Migration activity	H1	18.6	16.83	-9.63
	H2	79.1	72.03	-8.99
	H3	23.3	21.24	-8.94
Village Land	H1	8.6	8.70	1.06
	H2	15.0	14.63	-2.32
Village Horse	H3	9.0	9.13	1.83
Village Tractor	H3	85.4	87.91	2.98
Village Labor	H1	15.7	16.15	3.07
	H2	35.7	37.05	3.88

As a result of 10 % reduction in external input price simulation, all household groups were able to increase their crop production, but the large land holders have the lower elasticity. The food crop category saw a largest increase, reaching almost 3% rise in production. Cash crops' increase was moderate and livestock production witnessed a decrease due to shift of factors and increase in relative cost of inputs in livestock.
On village local markets, the labor renting households, small and medium holders, continued to increase their labor supply in response to increased demand. In the land market, the small holders increased their land supply but medium holders preferred to reduce the land renting out and instead to cultivate the land themselves. As expected, the higher labor demand in the village reduced the outside migration declined by 9-10 % as crop production became more profitable. The assumptions here is that labor is not sectorally differentiated and thus households can costlessly move labor from migration to agricultural production.

Table 33: Changes in market versus for home production, experiment 3

Sectors			Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	Market	16.8	18.0	7.2
		Home	90.6	91.9	1.4
	H2	Market	141.1	148.1	5.0
		Home	408.4	415.4	1.7
	H3	Market	91.1	96.5	5.9
		Home	147.1	149.0	1.3
Cash crop	H1	Market	18.6	19.1	2.8
		Home	74.1	74.9	1.2
	H2	Market	250.4	259.5	3.6
		Home	538.3	547.5	1.7
	H3	Market	122.1	122.6	0.4
		Home	157.5	159.0	0.9
Large livestock	H1	Market	46.9	46.2	-1.5
		Home	32.5	32.8	0.9
	H2	Market	309.9	305.1	-1.5
		Home	214.7	217.6	1.4
	H3	Market	127.3	126.6	-0.6
		Home	81.0	81.9	1.1
Small livestock	H1	Market	25.2	23.9	-5.3
		Home	23.4	23.6	0.7
	H2	Market	115.9	109.3	-5.7
		Home	112.1	113.3	1.1
	H3	Market	64.3	60.4	-6.1
		Home	37.6	37.8	0.6

Together with output increase the households were able to increase their marketed surplus of food and cash crops. Home production of these crops also increased, but at lesser extent. The balancing factor was a decrease in the marketed surplus of livestock produce, although more crops were available for crop residues used as livestock feed.
In terms of household groups, it seems that the input subsidy affects all groups favorably. In the food crop sector, small households experienced the largest increase, whereas in cash crop sector the medium holders responded with the highest elasticity.

Table 34: Changes in factor demand, experiment 3

Factors	Sectors	% change		
		H1	H2	H3
Labor	Food crop	2.99	3.31	3.61
	Cash crop	2.54	3.53	1.90
	Large livestock	-0.33	-0.12	0.36
	Small livestock	-2.20	-2.04	-3.50
	Non agricultural	1.13	1.24	0.87
	Village renting	2.96	3.60	3.49
Land	Food crop	0.24	0.10	1.24
	Cash crop	-0.49	0.03	-0.85
	Village	1.06	-2.32	
Capital	Food crop	3.39	3.29	2.64
	Cash crop	2.20	2.92	1.10
	Large livestock	-0.69	-0.72	-0.33
	Small livestock	-2.55	-2.63	-4.16
	Non agricultural	0.78	0.64	0.18
	Village renting			2.78

Generally, the 10 % of input subsidy has a moderate effect on households' factor demand. The main increase impacted the family labor, the demand for family labor employed in agricultural production increased for all households, but not across all sectors, e.g. the out of village seasonal work and livestock reduced the payments to labor. Interestingly, the demand for land was stagnant or negative, which reflects the higher substitutability between land and on the other hand, labor and capital. Thus, the demand for labor and capital increased more than the land demand.

The demand dynamics eventually impact the income distribution among households as factors demand determines the structure and contribution to the income. The calculation shows that income increase was quite low, less than 1 percent for small and large holders and just 1.16 percent for medium holders.

Table 35: Changes in income, experiment 3

	Base (000 soms)	Exp (000 soms)	% change
H1	566.5	571.3	0.85
H2	2848.6	2881.6	1.16
H3	1442.0	1455.7	0.95

Overall, the external input price reduction of 10 % resulted in cash and food crop production and marketed sale increase for all households. In addition, the smallholders also benefited from labor and land renting. However, since the relative cost of livestock increased as well, the livestock sector experienced reduction. Migration work diminished as household directed its labor to agricultural crop production. The income effect however, was marginal. Results show that external input price reduction (input subsidies) might be geared more toward increasing the marketed crop sale rather than increase in income (i.e. poverty reduction).

5.4 Policies to make the credit funds and investment available to rural farmers

The financing of agriculture being the main activity in rural areas is adversely characterized by the high level of risk; both climatic and economic (price fluctuations, difficulty and seasonality of realizing the harvest). In addition to this, information about potential clients, especially in difficult to reach areas, is difficult to obtain for banks, making loan applications excessively costly to evaluate, especially when loans are small and regionally specific. The remote farmers are poor and also own few assets, making it infeasible for the financial institution to provide lending with collateral. Thus, the isolation and remoteness of the rural households worsen the conditions for farmers to be able to access the conventional credit resources. So, farmers in rural areas are severely constrained by the lack of financial resources needed to acquire the productivity enhancing working and fixed capital. This limited access to credit capital for farmers is said to result from market failures in the credit and other rural markets.

The lack of collateral, non existent institutions and high risk might be part of the problem. Arguably, the more important problem in rural credit is the issue of enforceability and imperfect information. Owing to the same characteristics of the rural sector that make it unattractive destination for investment, the enforceability of contract is aggravated by the poor developments of the property rights and appropriate institutions. This feature is very evident in a transition country, like Kyrgyzstan. Land rights are not clearly identified and codified. Reclaiming assets including land using the court system is problematic as these procedures are not established in the legislature. The enforcement problems might explain in part why the credit system in transition countries is dual, where along side with formal banks and parastatals a significant fraction of credit transactions takes place in the informal sector. The informal mechanisms replace the conventional methods with informal, social solutions, sanctions and ties.

In chapter one, we already mentioned that one of the reasons why market is imperfect is due to imperfect information. In the context of credit market, the problem of imperfect information has direct relevance, manifested in problems of moral hazard and adverse selection. Adverse selection occurs when lenders do not know the particular characteristics of the borrower and by charging higher interest rate accounting for risk premium the lenders end up with high risk borrowers. The way to reduce this risk is to require collateral, but as we said, collateral is a problem for rural households. The extension of the adverse selection problem is the moral hazard problem. The moral hazard is situation when lenders can not know the borrower's action. The borrower with high debt (i.e. who borrows more) is more inclined to take more risky decisions. On the other hand, the risky decision making reduces the probability of paying off the debt.

The remote rural areas face the "periphery bias" that is the government and private sector policies, including related to credit provision, favor the economic agents in centers over the peripheries. Credit is an essential input in the agricultural production. If there is limited availability of credit, it becomes an effective constraint meaning that the capital use in agricultural production is limited to the available capital rather than to the productive potential of capital and other inputs on farm production. This eventually

translates to that prices in the input and output markets that farmers face are increased by the value of the credit constraint. This value is equal to the unit of credit in terms of lost/forgone income of the household. Thus the value of earned income is reduced and price of inputs is increased by restricted availability of credit, respectively. As a result credit restriction reduces the ability of household to make better possible use of the available resources. There is a lot of literature that links the availability of credit with higher capital/mechanization use, adoption of new technologies and better inputs that eventually raises incomes and reduces the riskiness of the agricultural production.

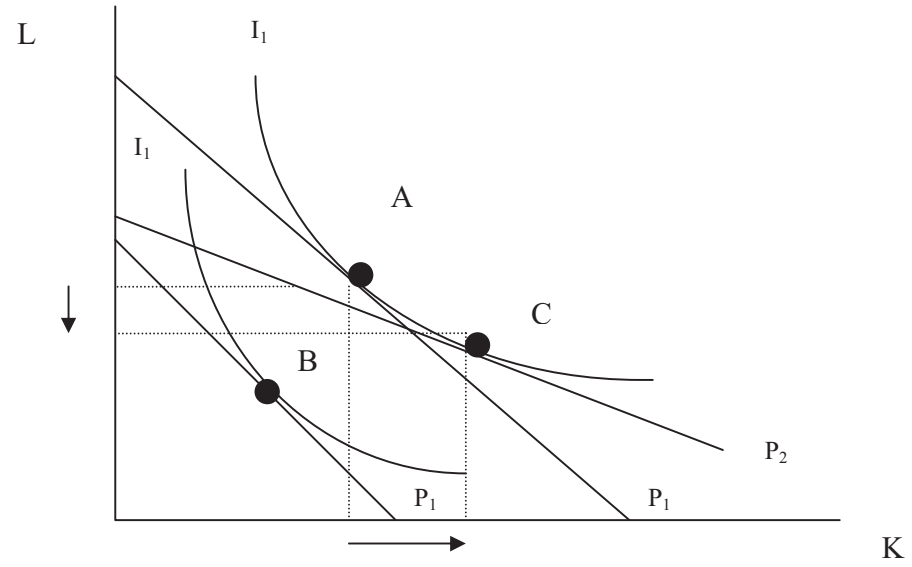
Due to the fact that traditional commercial banks typically have no interest and means in lending to rural households as the latter lack viable collateral and the high transaction costs involved, some developing countries have set up special credit programs aimed at improving rural household access to credit. In fact, the credit market failures establish legitimacy for more and direct government interventions. The discussion of the rural credit market features yielded the conclusion that lending in the rural sector is too low from a social optimal point of view. So the government efforts to expand the lending in the marginalized areas would raise the welfare by counteracting the externalities arising from imperfect information. Without intervention, the rural areas will continue experience a rural/periphery lag, not only in the delivery of credit , but also in the diffusion of new ideas/technologies and in the implementation of actions conducive to more efficient, sustainable and broadly-based rural markets.

Against this background, historically in developing countries, subsidized formal credit has been advocated on efficiency and equity grounds. However, the performance of these policies is regarded as quite unfavorable. Many formal, parastatal institutions, that controlled interest rate below the market rate, have been designed to channel credit from official banks to rural sector (farmers) and to address the perceived deficit of credit funds. Given that it is recognized, that the general failure of the old credit policies in the past, that relied on old institutions and delivery forms, there is a growing literature that seeks alternative forms in managing and channeling credit to rural markets. The problems of the old credit delivery system were related to that low interest rate and high transaction costs kept the savings and viability of the old delivery institutions at very low, unsustainable level. As a result, new paradigm is arising that tries to account for the problems of tradition credit policies. The reorientation of financial policies in the rural sector needs more attention regarding institutional design. Rural credit system should not be a monopolistic system, but rely on local institutions and specifities, that ensure the viability of credit providers. The promising methods of credit delivery are group lending and community responsibility, improvements in the incentives structure and direct assistance with marketing of the harvest (Besley, 1994).

Thus, recognizing that government should always play a major role in provision of credit, but assuming that appropriate institutional and delivery systems are in place, we posit that one of the important ways to stimulate growth in the local economy is to improve access to credit by village farmers. Generally, we assume that better and equal access to credit results in increasing (fixed) capital endowments by each household group in the village model. In other words, we hypothesize that more credit is used to expand productive capital in the medium run and not necessarily to smooth out consumption risks of

farmers. In this context, the effect of more capital could be viewed in the framework of technical change and factor substitution dynamics.

Figure 31: On substitution possibility with more available capital



Source: Adapted from Ellis, 1992

The iso-product curve is depicted by curves I_1, which represent the fixed level of output and relative prices between labor and capital, is shown by P_1 iso-cost lines. So, technical change could be depicted as movement from point *A* to *B* with minimizing the use of both capital and labor, but the same output level as before. Within the same framework it could be shown that when the prices or the supply of the factors change, the same level of output could be produced with different combination of factors: labor and capital. For example, shift from point *A* to point *C* indicates that less labor and more capital is used. This shift characterizes factor substitution in our village model and is viewed by curvature of the curve.

An increase in capital as a result of increase in directed credit program of the government for the village brings about increase in the production capacity, supply, income and demand, but differently for different households and sectors. Depending on the capital use intensity by sectors and households, the increase in capacity should relax some of the constraints of households in terms of labor and land endowments, thus paving the way for higher income and growth. But this can occur only to a limited extent depending on the substitutability of the primary factors in the model.

Experiment 4: 10% increase in capital stock that result from credit reforms

The results of the investment experiment appear in the tables below.

Table 36: Changes in the production level, experiment 4

Sectors		Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	108.8	111.32	2.28
	H2	583.9	599.26	2.64
	H3	249.9	257.52	3.06
Cash crop	H1	95.1	96.91	1.93
	H2	806.2	817.33	1.38
	H3	298.5	300.29	0.59
Large livestock	H1	82.7	91.61	10.71
	H2	554.4	609.88	10.00
	H3	240.0	261.96	9.15
Small livestock	H1	48.6	55.04	13.18
	H2	228.0	257.18	12.79
	H3	101.8	115.29	13.21
Non agricultural	H1	41.5	42.84	3.34
	H2	94.5	98.25	3.99
	H3	30.4	31.08	2.35
Migration activity	H1	18.6	13.47	-27.67
	H2	79.1	57.80	-26.97
	H3	23.3	16.38	-29.79
Village Land	H1	8.6	8.49	-1.35
	H2	15.0	14.99	0.05
Village Horse	H3	9.0	9.42	5.03
Village Tractor	H3	85.4	89.59	4.95
Village Labor	H1	15.7	15.85	1.17
	H2	35.7	36.55	2.47

Conventionally, asset accumulation positively affected the level of production across the sectors and households. Non crop production saw the largest increase concentrating in livestock production. The rise in capital stock by raising the marginal productivities of complementary factors (land and labor) induced the households to direct the resources to capital using sectors. This simultaneously resulted in flow of factors out of some sectors which in our village model is the seasonal migration activities. In the village market, capital accumulation also contributed to more demand and supply of the village inputs, except for land renting by small households.

Table 37: Changes in market versus for home production, experiment 4

Sectors			Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	Market	16.8	16.7	-0.7
		Home	90.6	93.2	2.8
	H2	Market	141.1	141.7	0.4
		Home	408.4	421.4	3.2
	H3	Market	91.1	93.8	2.9
		Home	147.1	151.4	2.9
Cash crop	H1	Market	18.6	18.3	-1.3
		Home	74.1	76.1	2.7
	H2	Market	250.4	245.7	-1.9
		Home	538.3	553.8	2.9
	H3	Market	122.1	119.7	-2.0
		Home	157.5	161.3	2.4
Large livestock	H1	Market	46.9	54.0	15.2
		Home	32.5	33.9	4.2
	H2	Market	309.9	353.0	13.9
		Home	214.7	224.0	4.3
	H3	Market	127.3	143.3	12.6
		Home	81.0	84.0	3.7
Small livestock	H1	Market	25.2	30.5	21.1
		Home	23.4	24.5	4.6
	H2	Market	115.9	139.5	20.4
		Home	112.1	117.5	4.8
	H3	Market	64.3	76.2	18.5
		Home	37.6	39.1	4.1

As livestock sector is capital intensive, marketed production also increased in this sector. In contrast, the marketed production of the crop activities stayed the same or even decreased (for crash crop). This effect is reminiscent of the Dutch disease syndrome, when better terms in one sector draws resources into that sector increasing the prices of the factors, which leads to reduction in other sectors.

The different dynamics in different sectors and household groups eventually lead to different factor demand and thus to factor income. In terms of factor income, we see that small holders were the ones who gained most from investment into the capital, whereas the larger households gained in terms of labor factor income. This illustrates how the linkages in the village model differently impact the households. Overall, compensating factor income changes resulted in almost equal increase in income for all household groups.

Table 38: Changes in income, experiment 4

Factor income

Factors	% change		
	H1	H2	H3
Labor	0.60	0.96	2.22
Land	3.30	3.05	2.71
Capital	7.38	7.19	6.05

Total income

	% change
H1	2.68
H2	2.81
H3	2.85

Generally, this experiment shows the merits of the credit/investment led growth, but with some qualifications. The impact of policies is uneven between the village activities, while all sectors increase production; the marketed supply might not increase. The village general equilibrium effect and constraints diminish the positive effects of investment on production and income.

5.5 Policies/ outcomes that affect the village labor market

The main motivation of this study is to examine the growth options and the effects of policy reforms through counterfactual simulation experiments in the village economy/model. So far we contemplated the experiments that directly related to the policy instruments. In this final section, we evaluate the impacts of changes in the institutional settings for the village labor market. These changes are not necessarily associated with specific policies, but may be the result of the current trend. The changes are concerned with exogenous increases in the demand and share for village market of hired labor and for seasonal labor (migration labor) in external/outside of the village markets.

Most village households have diverse sources of livelihood including off own farm income and significant income from migration work. As we postulated, it is equally important to view the rural households in the context of both the local economy and larger regional or even international economy. The extent of integration of different types of farmers with outside markets, whether national or international, also affects the ways the households chose the livelihood strategy. The degree to which the alternative strategy potential is realized depends on the institutional environment which is determined by national economic development and increasingly by globalization trends.

In the village one could observe two main tendencies that result from the process of slow integration of the village with the larger economy. The first is that larger (elite) households, with established connection outside the village, with potential to market agricultural produce try to consolidate more land and hire more labor for commercial agricultural production. The local experts argue that the current fragmentisation of farmers is a temporary phenomenon, that single farms are not capable of large scale trade and marketing. The process is under way, which sorts out the entrepreneurs who will eventually consolidate the farms into some sort of cooperatives and ones who will work for cooperatives. It is assumed that this tendency could translate to expanding the share of the local labor market for village hired labor. The production structure in the village might point that comparative advantage of the village economy is in labor intensive agricultural activities. So, improved market access by most commercialized group of households (large households) or cooperatives should benefit the labor abundant group of village households (small and medium land holders), who will be village laborers.

The second tendency is that in the absence of better market access for village produce and thus for internal work opportunities, the villagers increasingly seek ways for seasonal and migration work outside of the village. The migration work in the context of our village includes agricultural work in the other rural areas with better access to markets, non agricultural work in the more urban areas and sometimes works outside of the

country. In the case of the failures in the scale of the village to integrate with the national economy leaves not so many options for village households. The diversification out of the village activities to more off village activities then would present the way for village development. Thus, expanding the off-village income-earning opportunities and seeking to enhance access for the rural poor to these sources of income is thus a particularly important aspect of the modern approach to rural development.
So under this simulation scenario, we posit the increased share of local hired labor market and migration off village labor market, holding wages fixed. In both of these experiments, the on farm labor use would be reduced, entailing the reduction in the on farm production, but differently in magnitude and incidence for various groups of households. At the same time, the reduction in use of family labor would raise the shadow price of the on farm labor. These dynamics would induce the reallocation of labor and other inputs to activities which intensively use the labor or inputs whose price increased. Also, the substitution possibilities between the factors would impact the final outcome, which in the context of the non separability of households would be difficult to predict in advance.

Experiment 5: Expanding the share of the in village labor market

The specificity of this simulation is that results are not much sector but household specific. Since in the village the large holders are the ones who rent in village labor and small, medium holders are the ones who rent out the labor.

Table 39: Changes in production level, experiment 5

Sectors		Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	108.8	111.30	2.26
	H2	583.9	597.61	2.35
	H3	249.9	350.91	40.44
Cash crop	H1	95.1	94.08	-1.04
	H2	806.2	801.69	-0.56
	H3	298.5	360.46	20.74
Large livestock	H1	82.7	81.68	-1.30
	H2	554.4	552.69	-0.31
	H3	240.0	252.69	5.29
Small livestock	H1	48.6	45.31	-6.82
	H2	228.0	214.51	-5.92
	H3	101.8	90.52	-11.12
Non agricultural	H1	41.5	43.15	4.06
	H2	94.5	101.87	7.83
	H3	30.4	28.58	-5.91
Migration activity	H1	18.6	14.61	-21.51
	H2	79.1	64.51	-18.50
	H3	23.3	16.88	-27.65
Village Land	H1	8.6	9.10	5.72
	H2	15.0	16.96	13.23
Village Horse	H3	9.0	8.02	-10.64
Village Tractor	H3	85.4	83.22	-2.52
Village Labor	H1	15.7	16.55	5.64
	H2	35.7	39.15	9.76

The experiment was devised such that the share of the village labor for smallholders increased by 5 % and share of medium holders increased by 10 %, i.e. proportional to the base share. In some sense the results of this experiment is similar to the one where the capital stock was increased. The production effect is higher for hired labor intensive sectors/households. The large households experienced multifold increase in their crop production, with not only the higher hired labor input, but also as marginal productivity of inputs in that sector increased, attracting more resources from other sectors.
Since the hired labor comes from family labor endowments, less family labor for small and medium holders decreased the production in cash crops and livestock sector. Accordingly, it became more profitable to rent out land and reduce migration work; the latter witnessed largest reduction.

Table 40: Changes in market versus for home production, experiment 5

Sectors			Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	Market	16.8	19.3	14.8
		Home	90.6	90.6	0.1
	H2	Market	141.1	155.8	10.5
		Home	408.4	408.4	0.1
	H3	Market	91.1	174.3	91.2
		Home	147.1	163.8	11.3
Cash crop	H1	Market	18.6	17.8	-4.3
		Home	74.1	73.9	-0.2
	H2	Market	250.4	247.3	-1.3
		Home	538.3	537.3	-0.2
	H3	Market	122.1	163.8	34.1
		Home	157.5	174.5	10.8
Large livestock	H1	Market	46.9	45.7	-2.6
		Home	32.5	32.7	0.5
	H2	Market	309.9	307.2	-0.9
		Home	214.7	215.8	0.5
	H3	Market	127.3	131.9	3.6
		Home	81.0	87.3	7.9
Small livestock	H1	Market	25.2	21.9	-13.3
		Home	23.4	23.4	0.0
	H2	Market	115.9	102.3	-11.7
		Home	112.1	112.1	0.0
	H3	Market	64.3	51.0	-20.6
		Home	37.6	39.4	4.8

The situation with marketing of agricultural produce is similar to the situation with production. The larger households, who hire in labor benefited and sell more for markets comparing to home consumption. The scarcity of family labor induced that family labor intensive production increased contributing to the increase in the sale for market of the food crops for all household types. In other sectors (livestock and cash crops) as a result of non separability and reduction of production marketed surplus was reduced.

The factor use/demand also reflect the factor flows between sectors and households.

Table 41: Changes in factor demand, experiment 5

Factors	Sectors	% change		
		H1	H2	H3
Labor	Food crop	3.91	3.04	25.51
	Cash crop	1.39	1.80	11.93
	Large livestock	-0.79	0.35	5.58
	Small livestock	-6.37	-5.42	-11.15
	Non agricultural	4.05	7.74	-6.93
	Village renting	5.39	9.42	-1.68
Land	Food crop	0.99	1.19	7.09
	Cash crop	-2.28	-1.38	-4.86
	Village	5.71	13.23	
Capital	Food crop	5.06	4.12	8.72
	Cash crop	0.54	1.17	8.65
	Large livestock	-1.47	-0.25	4.33
	Small livestock	-7.01	-5.99	-12.21
	Non agricultural	3.33	7.10	-8.03
	Village renting			-2.85

Labor had out flown from migration and livestock activities and was used by large holders and in crop production. To match the higher hired labor, the large holders demanded more of village rent in land, which resulted to the differential income distribution among households.

Table 42: Changes in income, experiment 5

	Base (000 soms)	Exp (000 soms)	% change
H1	566.5	573.3	1.20
H2	2848.6	2866.7	0.63
H3	1442.0	1528.7	6.01

As internal village market for hired labor expands the primary beneficiaries are large land holders as they are able to increase the use of hired labor input and increase production. This also entails the increase in the share of village land use. Increase in the production and marketing by large holders support the importance of the village linkages. These links ensured that production effect in one group translated into higher income in other household groups as a result of higher returns for household owned factors.
Overall, the findings of this experiment reveal the dependence of the households within the village and the potential of the village markets translating the exogenous changes across the different households.

Experiment 6: Expanding the share of the off village labor market

In this experiment the demand and share of seasonal/migration work outside the village was increased by around 50% for all household groups. The effect of the simulation on the village economy is experienced in two ways. First the labor for in-village production

becomes scares and thus more valued and second, the changes in the labor use also change the use of the other factors.

Table 43: Changes in production level, experiment 6

Sectors		Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	108.8	108.0	-0.81
	H2	583.9	569.7	-2.42
	H3	249.9	241.4	-3.39
Cash crop	H1	95.1	95.4	0.31
	H2	806.2	805.7	-0.07
	H3	298.5	293.3	-1.75
Large livestock	H1	82.7	81.0	-2.15
	H2	554.4	542.3	-2.19
	H3	240.0	234.7	-2.20
Small livestock	H1	48.6	46.5	-4.41
	H2	228.0	218.5	-4.18
	H3	101.8	95.9	-5.79
Non agricultural	H1	41.5	40.1	-3.26
	H2	94.5	91.5	-3.16
	H3	30.4	30.7	0.98
Migration activity	H1	18.6	27.6	48.21
	H2	79.1	116.4	47.05
	H3	23.3	36.3	55.49
Village Land	H1	8.6	8.0	-6.93
	H2	15.0	15.2	1.21
Village Horse	H3	9.0	8.8	-2.39
Village Tractor	H3	85.4	85.0	-0.38
Village Labor	H1	15.7	14.1	-9.86
	H2	35.7	31.7	-11.01

As labor was reoriented to migration work, agricultural production has experienced reduction. Sector wise, livestock activities witnessed the largest decrease, household group wise, the large land holders reduced the production most. As village labor is used by large holders and as the labor renting out households reduced the supply of village labor in favor for own production the large holders saw the largest reduction. So the increase in migration work outside village is possible at the expense of the in village agricultural production.

At the same time, the decrease in agricultural production is mitigated by the need to sustain the home, household own consumption.

Table 44: Changes in market versus for home production, experiment 6

Sectors			Base (000 soms)	Exp (000 soms)	% change
Food crop	H1	Market	16.8	14.9	-11.8
		Home	90.6	91.7	1.2
	H2	Market	141.1	125.1	-11.3
		Home	408.4	410.2	0.4
	H3	Market	91.1	83.5	-8.4
		Home	147.1	146.3	-0.5
Cash crop	H1	Market	18.6	17.6	-5.2
		Home	74.1	75.3	1.7
	H2	Market	250.4	244.0	-2.6
		Home	538.3	544.3	1.1
	H3	Market	122.1	117.6	-3.7
		Home	157.5	157.2	-0.2
Large livestock	H1	Market	46.9	44.5	-5.0
		Home	32.5	33.2	2.0
	H2	Market	309.9	296.2	-4.4
		Home	214.7	216.8	1.0
	H3	Market	127.3	122.8	-3.5
		Home	81.0	80.9	-0.1
Small livestock	H1	Market	25.2	22.7	-10.0
		Home	23.4	23.8	1.6
	H2	Market	115.9	105.6	-8.9
		Home	112.1	112.9	0.7
	H3	Market	64.3	58.6	-8.9
		Home	37.6	37.3	-0.6

Indeed, agricultural reduction affected the quantities of for market production. All household groups maintained the production for own consumption and even slightly increased the production for home as a result of income effect.

So the redirection of labor to migration activities increases the shadow price of the family labor in village economy. This incentive further ensures that family labor is supplied to the most profitable, from households' point of view, activities. Thus, the increase in demand for family labor is satisfied by shift from family labor intensive activities (livestock etc) and partially from leisure.

Table 45: Changes in income, experiment 6

Factor income

Factors	% change		
	H1	H2	H3
Labor	9.23	8.49	6.35
Land	0.98	-0.41	-2.28
Capital	-1.37	-1.82	-1.90

Total income

	% change
H1	4.70
H2	3.73
H3	2.16

The income of villagers increases as a result of expanding migration/off village work opportunities. As we can see, the increase is not even across households and factor

sources. The laborers, small and medium households experienced income rise as the return to labor has been increased. The more asset rich and dependent on in-village production large land holders gained the least due to reduction in factor remuneration for land and capital. Although marketed surplus decreased, the structure of the village import changes, shifting from importing production inputs to more of consumption import as income has changed. The negative production effect seemed to be smaller than positive effect of higher family wages on income.

Concluding on this experiment, we can say that migration off village labor markets demonstrate the complexities of the village wide responses to exogenous changes. The outflow of labor reduces the availability of labor and increases the shadow price of family labor. This leads to contraction of production, but more so for households who hire labor. On the other hand, the consumption needs preclude the drastic reduction in the agricultural production and better terms for labor abundant households, which might support the migration led development hypothesis for the village.

6 The study: summary, conclusions, limitations and future directions

The agricultural reforms in Kyrgyzstan that took place and were induced by collapse of the Soviet Union did not create an efficient agricultural sector capable of drastically reducing rural poverty and providing the basis for agricultural led growth.

The agricultural sector of Kyrgyzstan represents the backbone of the rural economy, accounts for 40 % of the country's GDP and is a sector where more than 50 % of the country's labor force is employed. Thus the sector and the rural area in large is the most important sector for the country, with great poverty reducing potential.

However, the numerous constraints and environment in which the new class of agricultural producers-rural farm households ended up in the post reform era pose a great difficulty for implementing and achieving agricultural based strategies of rural development.

The retrieval of the state from the rural sector, which was motivated by shock style reforms, had led to array of problems, related to missing markets. In contrast to collective and centralized farms, private farmers faced difficulties in accessing markets (for input and outputs), availability of credit, research, capital (including human), dismal infrastructure and other public goods. The problems get worse the more remote is the location of the rural farm-households. So, it would not come as a surprise that chronic poverty in Kyrgyzstan is concentrated in rural areas.

The observation of the rural sector in the post reform period confirms that reforms and retrieval of the state from the sector was not followed by market formation, as it was believed to occur with liberalization. In this context, rural poverty in some of the transition countries could be in large extent related to market and coordination failures. The assumption that private farmers in Kyrgyzstan operate under perfect market conditions in a post reform period is not supported by our study.

Another aspect that may contribute to the fact that rural poverty in Kyrgyzstan is persistent phenomena is related to spatial dimension of the rural sector. The remoteness, low endowment of public capital and infrastructure, low private assets (including human capital) create spatial externalities which especially manifested after the reforms and state withdrawal.

There is considerable theoretical work that relates the coordination and market failures prevalent in the post reform agricultural sector of Kyrgyzstan to the poverty traps. In other words, the current situation in the rural areas may imply that the rural poor may remain poor without having chances to grow out of poverty, even if growth is experienced in the economy, potentially leading to poverty traps. Rural development policies that specifically and spatially target the poor rural farmers, and stimulate agricultural production, which is dominant occupation of the farmers, may then be needed in order to address the rural poverty and growth.

The notion of market failures is closely related to high transaction cost and institutional underdevelopment of rural sector in post reform period in Kyrgyzstan. Arguably not the small part of the problem is attributed to spatial remoteness of the rural sector. However the geographical location which often is associated with both high transaction cost and limited access to the markets tend to be overlooked in the analysis of the rural development.

In this context the role of the state, which under liberalization paradigm used to be given a secondary importance yielding the main coordination role to the market, is revised and underlined. It is argued that under transition the role of the markets is overrated, more proactive public policies are needed to guide and improve situation in the rural sector of the Kyrgyzstan.

The poorest regions in Kyrgyzstan are the ones which are geographically distant from centers/markets and disadvantaged in terms of access to roads, infrastructure. In addition the rural economies especially, the remote ones, have distinct boundaries embraced by village (or group of neighboring villages) and characterized by the heterogeneity of farm households who interact between each other within the village economy reflecting the internal differentiation between households and various degree of integration with outside world.

It is argued that to improve the situation in poor rural sector, the policies should seek the appropriate measures accounting for spatial aspect and interaction component of the local economies. Since the agricultural sector is the backbone of the rural economy, agricultural focused policies that address the constraints of the rural farmers and take into account the idiosyncrasies of the local rural economy is viewed as most relevant.

Despite the importance of the rural sector for development in Kyrgyzstan, there are few country specific and systematic studies, which comprehensively examined the issues related to policy impact on the rural farm household behavior and income at micro level and taking into account the specifities of the local rural economy. Part of the reason has to do with lack of data and capacities of the local authorities in Kyrgyzstan.

The present study fills this gap and sets as its objective the development and application of a regionally specific and village focused general equilibrium model and examining the relevant for distant rural economy development policy options in terms of their impact on production, marketed sale and household income. To optimize the selection of most relevant policy instruments the policy makers need to understand the local economy linkages, the magnitude of the linkages, structure and diversity of actors and sectors. The research aims at providing quantitative analysis of the village in a transition country setting, incorporating the richness of the local economy, heterogeneity of village households and diversity of the rural economic activities.

Extending the current literature the study employs the most modern approach to achieve its objectives. Special attention has to be given to the inside village and outside village linkages, income effects of changes and remoteness of the local rural economy so to

accommodate these features the village CGE modeling approach is argued to be the most appropriate methodological framework.

Commonly the behavior of rural households is studied and modeled using large country CGE and microeconomic farm household models. However, what both approaches miss is the interaction component between rural households. The between household linkages are of high importance in determining the outcome of the changes on household behavior, production, incomes. In Kyrgyzstan, spatially the rural area is organized in villages, which differ in remoteness and degree of integration with external markets (market centers). The remoteness in turn is often the reason for emergence of the village specific markets, which is also related to local household heterogeneity. So, in reality the rural economy could be viewed as a set of local smaller economies, with own idiosyncrasies i.e. local interactions, between groups of households, who differ in asset holding, participation in markets and degree of engagement in various sectors of the local rural economy. Based on this argument the appropriate framework for studying household behavior as well as policy analysis is the village modeling approach. The village model is viewed as middle ground between country CGE and smaller AHM models, the important feature of the village model is that it allows and illustrates the importance of village markets and household interactions.

The big advantage of the village model is that it is based on the agricultural household model, representing the core behavior of the model, and the additional layer representing the inside village markets/interaction is added. To account for village-economy wide impacts of the changes and income equilibrium effects, the village model is constructed as a computable general equilibrium model, embracing the local-village economy.

The motivation to use the village model comes from the features of the local economies in the rural areas. First of all, the rural areas are not homogenous; most obvious distinctions are climatic and geographical conditions. Perhaps the most important is that location of the rural farmers within the country differs in access to roads and markets. In contrast to other studies, the present research attempts to bring to forefront the issues related to spatial aspect of the local economy.

The point here is that institutional underdevelopment, remoteness and high transaction cost create conditions when local (village) only markets emerge. These markets typically are very location /village specific, i.e. operating only in particular village and/or for specific factor/commodity. The geographical constraints limit the spatial equalization and flow of factors between the specific village and external markets. So, it makes perfect economic sense for the farm-household to trade and interact among each other in the village context, which involves less transaction cost and is more informational efficient.

Another aspect for the village market existence is the household heterogeneity. The privatization of the assets which used to belong to collective farms did not produce egalitarian distribution. The elite of the former collective farms managed to privatize the best land and assets (tractors, agricultural tools, buildings), creating the separate class of large scale, commercial farmers. There is also, division of labor in the local village economy. The livelihood strategies include the different degree of involvement in farm-off farm activities. As a result the opportunities to trade the factors/commodities arise

between different households, similar to trade potential between countries with different comparative advantages, confound by the village boundaries.

The behavior of the village model is entirely determined by the households' behavior which is a core of the village model. The microeconomic agricultural models represent the work horse of the policy studies of farmers' behavior in the developing countries. However, the assumption of perfect markets is not supported by our study. As the current literature on rural household behavior in developing countries indicates in the presence of market imperfections and failures the decision making of the rural farmer is non separable. Employing the notion of high transaction cost it could be shown that even with price increase the farmers tend to stay subsistence oriented and unresponsive to market signals. The non separability of rural households assumes that production and consumption decision making of farmers is interdependent or simultaneous. The typical reason for non separability of decision making in rural areas would be the imperfect labor markets.

The challenge for the village analysis is then to incorporate the non separability aspect into the village model. One way to account for non separability is to make each village activity explicitly household specific, i.e. the given sector represented not as general sector for the village economy, but as particular sector relevant only for the particular household. This should be complemented by valuing the commodities and factors at the household specific (shadow) prices. This way the household (group of households), who is engaged in household specific production and household specific consumption activities is assured to take the decision (on both production and consumption) simultaneously. In other words, both production and consumption decisions are specifically related to particular household and not general across the sectors and households like is done in conventional CGE models.

The possibility to include into the village model the farm household in a non separable way is another important feature of the model used in this study. The introduction of non separability allows capturing more realistic production response of the farm households to policy changes. Thus, these two features: introducing internal village specific markets and allowing for non separability in household decision taking makes the village model stand out from other methodological approaches studying the household behavior in the rural setting.

Another advantage of the village model is that it is structured as computable general equilibrium model. This allows for flexibility in imposing the functional forms of production and consumption functions.

After careful study of the input structure of the household production activities the research concluded that in contrast to conventional approach of separately nesting the factors and intermediate inputs, in the village the households explicitly delineate the external and domestic inputs with different substitution possibilities within each pair of inputs. This is explained by geographical location of the village and access to inputs. Transaction cost plays an important role in degree of substitution between local and external inputs. Thus the inputs are classified as imported and domestic.

The study favors the use of nesting CES production function rather than restrictive Cobb Douglas specification. Such nesting with CES production function reflects the different technical requirements in each activity and differential access to the different inputs by different household groups, which improves the realism of the model (Kuiper, 2005).

In the village model, as households take decisions on production (production is household specific) they at the same time take decision on consumption (consumption is also household specific), which means that households produce for markets and for own consumption. The demand system of household is represented by LES and modeled using the Stone Geary utility function, which allows for including the minimum subsistence consumption levels, a very important feature of rural households in developing country.

The subject village on which the present study focuses is a typical village of rural South in Kyrgyzstan. The study village is remote and located on the hills, surrounded by mountains on the one side and by state border on the other side. The village, in Soviet times, used to grow tobacco and fodder for small ruminants. Now the rural farmers grow maize, wheat, potato, sunflower, i.e. complete reorientation from industrial to food crop production had occurred. Off farm work opportunities in the village are limited and seasonal migration work is important livelihood strategy.

The village represents the common village which is underdeveloped, far from markets and located in marginalized area, with own linkages in the local economy. The current state of the village economy could be in large part explained by its history and geography. Under planned economy the village carried out the specific functions of agricultural production of limited number of agricultural commodities for industrial use and supply and in turn was supplied with all inputs from the center/central markets. The structural reforms and collapse of the planned system entailed the destruction of the input -output linkages. So the geographical remoteness, which is associated with economic marginalization, is the main problem of the village.

However, no *a priori* assumptions can be made on whether the village households make their decision in separable or non separable way, i.e. whether they face imperfect markets. The observed limited involvement in off farm labor and land market by villagers could as well be just the equilibrium outcome or preference of the rural farmers. Thus the test of non separabality was in order to determine the mechanism of the household decision making. Particularly, the test of non separability is important for two reasons. First is to understand and evaluate the market environment in which the rural households operate, as there are no direct indications of missing markets. Second the knowledge of the non separability is needed to model the household behavior. As it was mentioned above, the sectors in the village CGE model are not related to any particular household when the households are separable; otherwise the production/sectors should be household specific and estimated with household specific prices of household non tradables.

The test of non separability assumes that by definition in separable farm households there is no connection between production and consumption side characteristics. The empirical evaluation of non separability relies on interrelation between households' demographic variables which related to consumption side and labor demand which is related to production decision making. In separable household this relation is absent implying the

independence of consumption decision from production decision. Otherwise, the presence of relation point to imperfect markets and non separability of decision making.

Equipped with that knowledge the empirical test of the subject village households was carried out and revealed that hypothesis of separability, i.e. perfect markets supporting the recursiveness between production and consumption is rejected. So, the result of the non separability test needs to be incorporated in the village SAM. In addition the investigation of the households' production data revealed that there are no markets and thus no prices for family labor, and some not that obvious household non tradables, but nonetheless important agricultural inputs like household land, manure and crop residues.

To properly account for the presence of household non tradables, we needed to estimate the household specific prices in order to impute the values of these production inputs and enter them into the village SAM. These prices are not observable, by definition and could be either assumed hypothetically or estimated using the production /profit function approach. Since the latter is economically consistent, the profit production function is estimated to derive the shadow/household specific prices using Translog and Cobb Douglas specifications.

The underlying assumption is that no matter how imperfect the labor or other input markets are the shadow wage or the shadow price of input is identical to the marginal value product of labor or input on the farm. Thus the procedure involves first estimation of the production function on the farm and then calculation of the corresponding marginal value products. Using this marginal value product as the shadow wage/prices, as well as quantities derived from the survey, the values for the production accounts in the village SAM obtained.

In addition, the estimation yielded micro economically sound results of prices, which could be compared with observed prices of some close substitutes of household non tradables. Comparing the off farm wages and household labor wages revealed that the former is higher, which indicate the constrained off farm labor market in the village. The price of land for large land holders match the observable price for village rented land, which is consistent with the fact that only large land holders rent in land. The deviation of the observable and shadow wages is additional evidence that village farm households are functioning in far from perfect market environment.

Since there is limit on number of households to be included in the village computable general equilibrium model, the surveyed farm households are clustered into three main household groups. The observation confirms that this grouping into three households captures the underlying heterogeneity of village households. The main criteria for differentiating into small, medium and large land holding households were: size of the land owned; degree of market orientation (commercial production); difference in input type and use intensities (of hired labor, land, mechanization tools, imported inputs); difference in involvement in off village migration. These are main factors for clustering the households into different groups, which reflect the spectrum of potential and livelihood strategies of diverse types of village households.

The unique village SAM is then constructed using the results of the household survey in a single village which reveals in a quantitative and empirical ways the differences between households and highlights the importance of the village markets. The village SAM is a database for village CGE and at the same time a tool providing snapshot of the local economy, market and income linkages between household groups within the village as well as interactions with the markets outside of the village.

The village SAM construction revealed that the village is not very well integrated in external markets, which makes it ideal candidate for empirical investigation of the village markets of village non tradables. Hired labor, rented land, village work horse and tractor are among the commodities which are traded only in the village. The large land holders tend to be more commercially oriented, and well endowed with capital assets. This alongside with good connection they have outside of the village allows the large land holders to produce more for the market. Thus they also tend to have more livestock and produce more of cash crops. Being large producers, the large land holders stimulate the local labor and land markets, in which the small and medium holders participate. The small land holders are more substance oriented. The large transaction cost precludes them to market much of the agricultural output as such they tend to provide labor services to the large land holders. The medium holders take the middle ground between the small and large land holders. The medium holders provide both land and labor in local markets, but also participate in the off-farm off the village seasonal labor markets. In terms of production, the small holders use the traditional technologies, whereas the large landholders tend to be more capital and external input use intensive.

The whole point of constructing the village SAM and village model was to understand the market environment, the diversity and linkages in order to assist in designing and optimizing the rural development strategies. The exposition of the village economy with its boundaries and interdependencies helps to provide an appropriate framework for right rural policies. It is argued that the case of the village can be presented as show case of majority villages in the rural area of Kyrgyzstan. The most important common feature that villages in rural areas share is their remoteness and difficulty in assessing the markets. The locational disadvantages make the majority of rural villages marginalized and peripheral regions, which demand special approach.

The explicit consideration of the main features of the peripheral regions, namely: agricultural focus, existence of local markets and spatial remoteness causing high transaction cost, lead to the limited options of rural policies that are appropriate and most relevant in the spatial context of the underdeveloped rural economy. The main component of the policies is to allow more access to markets: input and outputs for the main sector of village economy – agriculture.

Apart from welfare implications of the policies, the policy makers are motivated by aversion of the growing food dependence of the country from imported sources and unstable agricultural supply of food and industrial crop from domestic sources.

Thus it is argued that in the context of the remote rural region, the most relevant policies are the ones which affect the production environment and linkages within the local economy and with external markets.

Transaction cost, taken here as the cost of marketing agricultural produce to outside (village export) markets reach as much as 10-15 % of the export value. Thus the reduction of the cost to access the external markets is one of the top priorities to stimulate the development and village production.

Remoteness and large distance often preclude the villages to access new technologies and new research. For the subject village, the question is not as much of the lack of new technologies but simple access to better infrastructure: consultancies, conventional technologies and support from trained agronomists. Thus better access to more efficient research and consultancies along side with better technologies can make a big difference for the villagers and therefore would constitute the second set of development option.

The often cited problem that villagers voiced during the survey was the high cost of external inputs. This is partially related to the large distances from the input markets and associated transaction costs, but is also due to limited supply of the imported industrial inputs. The cost of fuel, better seeds, fertilizers and agricultural tools are reported to be very high for villagers to afford. Under such circumstances, the regional authorities in order to stimulate agricultural production of local farmers considering the policy option of reducing the price of the external (imported) agricultural inputs. The price support comes in form of preferential access to those inputs and sharing the cost of importation of the inputs (since many of the external inputs are not produced domestically).

It became a mainstream recommendation for rural strategies and poor regions to broadly implement the policies making credit available to poor farmers. The development literature points that one of the main imperfection that rural areas face is credit market failures. The typical problems of imperfect information and moral hazard are coupled with isolation of the rural areas that further complicates the flow of credit into the villages. An important aspect of the credit policy as a development strategy for the village is that it has to be converted into the larger capital stock in order to have an effect on production and income. Since the village model is not of dynamic type, better credit access by village farmers means the more capital endowments by all farmers, i.e. the analysis assumes the effect of a medium to long run term.

The last economic growth inducing option in the village context is argued to be the expansion of the inside village and outside village labor markets. The evidence of labor surplus was found for the village, thus broadening the inside village agricultural labor markets or the more off farm off village work opportunities may benefit the laborer households who are the poor ones. The expanded off village work opportunities correspond to growth in off farm job sector in neighboring towns or regional center. Evidence of successful rural development experience, say in China, suggest that decline in rural poverty comes in hand with rise in off farm jobs. There are signs suggesting that, increasingly more off farm labor opportunities might be available for the village farmers, especially for the poor ones. So, looking at the impact of the labor flows between different activities, presents the interesting case for policy makers.

The results of the policy experiments demonstrate that it is very important to approach rural development from the village perspective. It is confirmed that spillovers within the

local economy occur and thus partial equilibrium analysis is inferior, especially when the changes affect the household income distribution. This study documented the existence of local markets and showed that the effects of the local village factors should not be ignored. The research tries to illustrate that rural area is a diverse phenomenon. The differential level of integration and isolation make the village an important unit of analysis as much as rural farm household. Although the villages are not completely isolated from the external markets, the remoteness from infrastructure and centers constitute the common feature of the poor rural economies. In that context, the exogenous changes launch the set of linkage triggers within the village economy spilling over via village markets.

The study revealed that market environment in distant rural regions is far from perfect. It is confirmed that rural households behave in non separable way and this has a great impact on how the rural farmers respond to the changes in the production environment. In fact, the low marketed sale elasticity of village farmers is in large part attributed to the non separability in farm decision making, the profit effect dominated more than other effects (e.g. price effect). This was especially evident from the experiment on reduction of the transaction cost, when export and incomes increased only moderately. The marketed sale considerably increased with productivity improvements and external input subsidies, but with unequal distribution of income benefiting mostly the large land and medium land holders. More capital contributed to the growth of the capital intensive activities-livestock sector and via bidding up the price of the factors and due to income effect suppressed the crop export. The labor market expansion effect was different in different cases: when the expansion affected in-village market then both small-medium and large land holders benefited, whereas with off village labor expansion the large land holders had to decrease the production due to labor outflow.

Overall, any policy option involves tradeoff, mainly sectoral and distributional. Judging from production and income responses of the households, it seems that access to credit/capital as well as access to productivity improving research, consultancies and human capital produce better outcome, benefiting all households and export markets. Reduction of transaction cost, subsidies on external inputs and in village labor market growth lead to larger sectoral trade off and unequal income distribution benefiting only large land holders.

In summary, the results derived from the study show that better credit/capital and productivity improving policies have a greater potential to benefit the rural household in the remote regions that have remain untouched by state rural polices, after the reform experiences. Naturally , the conclusions of this study is based on the analysis of the single village and thus should be generalized with caution, although the subject village is argued to be the broad representative of the larger South rural area of the post reform Kyrgyzstan. Another qualification is that credit access and technology improvement should not be viewed as only solution to the problems of poverty and development, but should be considered on the broader context as a very important and critical element of the comprehensive rural development strategies for remote areas. The present study is evidence (although confined to the investigation in the one village) that credit policy and technological advances can contribute to agricultural production and income growth of the farm households in remote village. However, these polices would be more effective if

complemented by improvement in rural infrastructure, development of efficient markets for input and outputs.

The present research examined the market environment, the decision making, the linkages within the village economy and the development strategies relevant for a remote rural area by studying in detail the economy and important features of the village and main household groups of the village. A unique database was developed and static CGE type modeling approach was used. At the same time the research can be viewed as a foundation for a more extensive study, i.e. the study has considerable potential for extension.

One way of extending the study would be incorporating many household groups or even all individual households into the model. It is believed that estimating algorithms and methodological requirements of embedding more households is becoming more possible. Having the full spectrum of rural households would provide a complete picture on effects of changes on income and production.

Another potential avenue for extension is making the model dynamic instead of static. Then investment decision making should be specified and incorporated in the model. Technological change and market emergence take time and thus the analysis that spotlight these issues needs to track the dynamics of the changes. The model which was plied in the study is of static nature, which was motivated by data availability and objectives, but the conclusion we derived is applied to the medium to long term perspective, as a comparative static between two periods/states of economy when all the economic forces worked out themselves.

It is also straightforward to extend the number of local markets in the village model. To conduct similar study for the other regions, but with different local markets one would need data and information on how the local markets function. The markets could be perfect or imperfect with the special rule of how prices and quantities clear. Related to this the different functional forms (especially improving the demand system) and various institutions could be embedded in the model to capture the specific optimization behavior of the farm households.

The final note is that, we would like to carefully propose to view the village economy and its characteristics as a symbol of the country's economy. In no way we suggest blowing up the policy conclusions based on the village analysis on the country scope. Nevertheless, certain characteristics are relevant both on village and country scale: landlocked, remoteness from the main trade routs, infrastructural backwardness and large share of agricultural sector. These features could be distinguished on micro and macro levels and thus some of the findings of the micro study could be carefully extended to the macro analysis.

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APPENDIX

The village CGE model explains and follows the flows of the village SAM. The CGE model represents the set of simultaneous equations, solved with the use of optimization software such as General Algebraic Modeling System (GAMS). The following table presents the main equations of the model, which heavily draws upon the work of Holden and Löfgren (2005) and Löfgren, Harris and Robinson (2002).

Equation	*Description*
$PE_c = pwe_c - ice_c$	*The domestic price of export is the world price of export (pwe), minus the trade input of c per unit of commodity c exported (export transaction cost)*
$PM_c = pwm_c + icm_c$	*The domestic price of import is the world price of imports (pwm), plus the trade input of c per unit of commodity c imported (import transaction cost)*
$PDD_c = PDS_c$	*Demand price for c produced and sold domestically (to household itself) is defined as the supply prices of the composite commodity (no local transaction cost)*
$PQ_c * QQ_c = PDD_c * QD_c + PM_c * QM_c$	*The supply prices for commodity is defined as the volume share weighted sums of expenditure on domestically produced (QD) and imported (QM) commodities*
$PX_c * QX_c = PDS_c * QD_c + PE_c * QE_c$	*The supply prices of domestically produced commodity (PX) is defined as the volume share weighted sums of expenditure on domestically produced (QD) and exported (QE) commodities*
$PA_A * QA_A = \sum_c PXAC_{A,C} * QAXC_{A,C}$	*The sum of product of prices of activities output by the quantities commodities produced provides a mapping between the supply prices of commodities and the activity prices (PA).*
$Q_A = \alpha * \left(\sum \delta * Q_{INP,A}^{-\rho} \right)^{-\frac{1}{\rho}}$	*CES production function for generating activity output for top level, and aggregated input for lower level*
$PINP_A = PQ_A * Q_A * \left(\sum \delta * Q_{INP,A}^{\rho} \right)^{-1} * \delta * Q_{INP,A}^{(-\rho-1)}$	*The first order conditions for profit maximization determine the price of inputs (PINP), and is derived directly from the first order condition for profit maximization as equalities between the price for each input (and factor) in each activity and the values of the marginal value products of those inputs (factors) in each activity*
$PINP_{C,A} = PQ_C$ $PINP_{F,A} = WF_F * wfdist_{F,A}$	*Mapping the intermediate price as supply price or in case of factor as factor price*
$PA_A = PQ_{INP,A}$	*Mapping the activity price from CES production (price of activity output for top level, and aggregated input for lower level)*
$Q_{INP,A} = Q_{INP,A}$ $QF_{F,A} = Q_{INP,A}$	*Mapping the intermediate input quantities as supply quantity for inputs or in case of factor as factor quantities*
$\theta_{A,C} * QA_A = E = QXAC_{A,C}$	*The output to commodity supplies, where the weights (theta) identify the amount of each commodity produced per unit of output of each activity, referring only to fixed coefficient commodities*
$\sum \theta_{A,C} * QA_A = \alpha * \left(\delta * QXAC_{A,CMRK}^{\rho} + (1-\delta) * QXAC_{A,CHOM}^{\rho} \right)^{\frac{1}{\rho}}$	*The output transformation function , and the associated first-order conditions (below), establishes the optimum allocation of domestic commodity output between home demand (CHOM) and marketed demand (CMRK), by way of Constant Elasticity of Transformation (CET) functions, with commodity specific share parameters (delta), elasticity parameters (rho) and shift/efficiency parameters (alpha)*

$QXAC_{A,CMRK} = QXAC_{A,CHOM} * \left(\left(\frac{PXAC_{A,CMRK}}{PXAC_{A,CHOM}} \right) * \left(\frac{1-\delta}{\delta} \right) \right)^{\frac{1}{\rho-1}}$	*The first order conditions defining the optimum ratios of marketed to home production in relation to the relative prices of marketed (PXAC CMRK) and home supplied (PXAC CHOM) commodities*
$QX_C = \alpha * \left(\sum_A \delta * QXAC_{A,C}^{-\rho} \right)^{-\frac{1}{\rho}}$	*This equation aggregates the commodity outputs by each activity (QXAC) to form the composite supplies of each commodity (QX). The assumption is that when a commodity is produced by multiple activities it is differentiated by reference to the activity that produces the commodity; this is achieved by defining total production of a commodity as a CES aggregate of the quantities produced by each activity*
$PXAC_{A,C} = PX_C * QX_C * \left(\sum_A \delta * QXAC_{A,C}^{-\rho} \right)^{-1} * \delta * QXAC_{A,C}^{-\rho-1}$	*The first order condition for the optimal combination of commodity outputs*
$QX_C = \alpha * \left(\delta * QE_C^{\rho} + (1-\delta) * QD_C^{\rho} \right)^{\frac{1}{\rho}}$	*The output transformation functions, (and the associated first-order conditions below), establish the optimum allocation of domestic commodity output (QX) between domestic demand (QD) and exports (QE), by way of Constant Elasticity of Transformation (CET) functions, with commodity specific share parameters (delta), elasticity parameters (rho) and shift/efficiency parameters (alpha)*
$QE_C = QD_C * \left(\frac{PE_C}{PDS_C} * \frac{1-\delta}{\delta} \right)^{\frac{1}{\rho-1}}$	*The first order conditions defining the optimum ratios of exports to domestic demand in relation to the relative prices of exported (PE) and domestically supplied (PD) commodities*
$QX_C = QD_C + QE_C$	*Output transformation, in cases where commodities are produced and demanded domestically but not exported, and those cases where commodities are produced domestically and exported but not demanded domestically*
$QQ_C = \alpha * \left(\delta * QM_C^{-\rho} + (1-\delta) * QD_C^{-\rho} \right)^{-\frac{1}{\rho}}$	*The domestic supply equations are modeled using Constant Elasticity of Substitution (CES) functions (and associated first order conditions below) to determine the optimum combination of supplies from domestic and foreign (import) producers. The domestic supplies of the composite commodities (QQ) are defined as CES aggregates of domestic production supplied to the domestic market (QD) and imports (QM), where aggregation is controlled by the share parameters (δ), the elasticity of substitution parameters (rhoc) and the shift/efficiency parameters (alpha)*
$QM_C = QD_C * \left(\frac{PDD_C}{PM_C} * \frac{1-\delta}{\delta} \right)^{\frac{1}{1+\rho}}$	*The first order conditions defines the optimum ratios of imports to domestic demand in relation to the relative prices of imported (PM) and domestically supplied (PDD) commodities*
$QQ_C = QD_C + QM_C$	*Domestic supply in cases where commodities are produced but not imported, and those cases where commodities are not produced domestically and are imported*
$YF_F = \sum_A WF_F * wfdist_{F,A} * QF_{F,A}$	*The payment to factor accounts for services supplied to activities, i.e., domestic value added. Factor incomes (YF) are therefore defined as the sum of all income to the factors across all activities*
$YIF = shif\left((1-tf_f) * YF_F - trnsfr_{ROW,F} \right)$	*The factor income is spent on factor taxes, transfers to the rest of the village and is divided among domestic institutions by fixed coefficient*
$YI = \sum_F YIF + \sum_{INS} trnsfr$	*The households receive total income which consist of factor income and transfers from: from government and rest of the village*
$EH_H = (1 - \sum_{INS} shii) * (1 - MPS_H) * (1 - trnsfr_H) * YI_H$	*Household consumption expenditure (EH) is defined as household after tax income less savings and transfers to other institutions*

$PQ_C * QH_{C,H} = PQ_C * \gamma^m + \beta^m * \left(EH_H - \sum_C PQ_C * \gamma^m - \sum_{A,C} PXAC_{A,C} * \gamma^h \right)$	*Households are then assumed to maximize utility subject to a Stone-Geary utility function. Household consumption demand consists of two components, 'subsistence' demand and 'discretionary' demand. Discretionary demand is defined as the marginal budget shares (beta) spent on each commodity out of 'uncommitted' income, i.e., household consumption expenditure less total expenditure on 'subsistence' demand.*
$QINV_C = IADJ * qbarinv_C$	*Investment demand is exogenously determined*
$YG = trnsfr(Gov, RoV)$	*Government income is fixed transfers from the rest of the village*
$EG = \sum trsnfr(H, Gov)$	*Government expenditure is fixed transfers to households*
$\sum_A QF_{F,A} = QFS_F$	*The factor market is cleared by equating factor demands and factor supplies for all factors. WF is equilibrating variable*
$QQ_C = \sum_A Q_{INP,A} + \sum_H QH_{C,H} + QINV_C + QT_C$	*Market clearing for the composite commodity markets requires that the supplies of the composite commodity (QQ) are equal to total of domestic demands for composite commodities, which consists of intermediate demand (Q_{INP}), household (QH), investment (QINV) and transaction demand (QT)*
$\sum_C pwm_C * QM_C = \sum_C pwe_C * QE_C + \sum_{INS} trnsfr_{INS,ROW}$	*The rest of world account clears by balancing the capital account, consisting expenditure on imports and total income from the rest of the world, which includes export revenues and transfers from the rest of the world to the household*
$YG = EG$	*Government expenditure is equal to government income*
$MPS = mpsbar$	*Marginal propensity to save is exogenously given (fixed)*
$\sum MPS * YI = \sum_C PQ_C * QINV_C$	*Total savings is defined within the model and hence there has been an implicit presumption that the total value of investment is driven by the volume of savings.*