

**Asset-pooling and labor specialization in uncertain times:
Implications of small-group farming in the Kyrgyz Republic for agricultural
restructuring**

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*Institutional Complexity and Resource Access after Land Reform: The Challenges of Co-operation
for Rural Livelihood Improvement in Transition Economies.***

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1. Introduction.

During the last decade, as the former system of socialist collectivized agriculture has been broken up, private farms and household plots have become the dominant form of agricultural production unit in the Central Asia and the Caucasus, with the exception of Uzbekistan. This trend has major importance for efforts to alleviate poverty in the region, as well as implications for the development of governance and civil society. Rural poverty is acute in the region and has shown little change during recent years, even as countries have experienced relatively high overall growth.

The gross trend obscures a great deal of differentiation in both sectoral and farm performance throughout the region. Understanding this differentiation may be important for helping the region's rural areas become more dynamic and grow faster, and for helping farmers with fewer endowments to become competitive. Some observers and policy makers believe that individualization of production aligns incentives correctly and, when coupled with provision of inputs through competitive markets, offers the best pathway for improving productivity, incomes and living standards (reference). Others see the atomization of small producers as an inefficient development, resulting in operations which cannot achieve cost-savings in input supply or scale efficiencies in production. The government of Kyrgyzstan, for example, is now heavily promoting "small-scale cooperatives" to overcome some of the perceived limitations of atomization, although it has yet to amend the Law on Cooperatives or the tax code in this direction.

Private farms have been formed under many different organizational arrangements and with many different sizes. A working hypothesis suggests that a plethora of 'middle-ground' institutional arrangements have emerged to help poor rural households overcome farming constraints. These new arrangements have been largely overlooked in mainstream literature. This paper explains the emergence of these new types of small, multi-family enterprises in Kyrgyzstan, and provides evidence from a recent farm survey that the formation of groups at the local level reflect a response to uncertainty and asset portfolios. The general hypothesis builds on work done analysing agriculture in a variety of transition countries (Lerman, Sabates-Wheeler, Meurs, Mathijs) that highlights the advantages to cooperation in farming in an environment of multiple market failure and uncertainty.

The data used for the analysis were collected during a farm survey performed in 2001-2002 jointly by the University of Wisconsin-Madison, Center for Social and Economic Research CASE-Kyrgyzstan and Ministry of Agriculture and Water Resources of the KR under the umbrella of USAID-funded BASIS collaborative research project. The full sample consisted of 463 farms and is representative in terms of geography and different farm types. Descriptive statistics and econometric analysis illustrate how individual farms, familial-groups and multi-family farms ranging from 6-45 families emerge in response to asset constraints and operate according to different production relations (that is, not all forms are able to optimise returns). One underlying motivation for cooperation appears to hinge on asset-pooling and this is confirmed by the analysis here. These results can contribute to formulating policies and support strategies for enhancing the performance of new farming institutions or groups, through analysing what processes work best to provide the most effective access to resources and livelihoods for the rural poor.

The aim of the paper is to provide background for a closer analysis of these new types of farming units. Overall we find that the total factor productivity of small groups formed on

familial ties is higher than that of other individual farms and larger groups. While this suggests that familial groups are more efficient at utilising their factors of production, perspective plots of production land and labour suggest that these groups are not optimising production as they appear to be operating on increasing returns to scale. Some discussion is provided at the end to explain why the different groups may be operating under different returns to scale technology, chiefly based on labor specialisation, asset pooling and risk sharing.

2. History of land reform in Kyrgyzstan

Since 1991, the government of the Kyrgyz Republic has carried out a series of measures aimed at transforming its farm sector from a state-managed to a private, market-oriented one. Resource-poor Kyrgyzstan did not have the luxury of continuing to operate a large state agricultural sector based on state support after independence (although a variety of state supports did continue to some enterprises and in some sub-sectors for several years). Consequently, its agricultural restructuring moved relatively quickly, especially in the southern oblasts. Ninety percent of Kyrgyzstan is high mountains, suitable only for grazing. The ten percent of the country which is suitable for agriculture is chiefly found in the northern Chui Valley, the Talas Valley, and around Lake Issyk-Kul. In the south, the Ferghana Valley is the main area suitable for crops. Soviet-era irrigation works utilizing snow-melt are critical for the country's crop agriculture. Due to the limited cultivable area, the amount of arable land available per worker is low (averaging 1.1 ha), and irrigated land is even more limited.

Land reforms began in 1991, with the issuance of the Law on Peasant Farms. This Law permitted individuals and groups to request land and other assets from the parent state or collective farm to establish peasant farms. Typically making land available to trained technical personnel like agronomists and zootechnicians, this initial phase created a relatively well-endowed initial group of about 10,000 so-called peasant farms covering 3.3 million hectares of total land, by 1994. This first generation of peasant farm enterprises were given a number of privileges such as access to farm inputs from state sources, subsidized loans and tax exemptions.

In 1992 government renewed its efforts to privatize and reorganize the unprofitable state and collective farm sector (except in Chui oblast). The State Property Committee (GosKomImushestvo or GKI) was mandated to reorganize these farms into joint-stock companies, agricultural cooperatives, and associations of peasant farms. A presidential decree issued in 1992 established local commissions to undertake the evaluation of land shares and other assets and to reorganize the farms along new corporate lines and created another body, the Republican Center for Land and Agrarian Reform, to oversee the process. Like most of the former Soviet republic, land shares and other assets were distributed on paper to farm members and others working in the rural area. The Kyrgyz Republic was more proactive than other countries, however, in permitting workers to claim the land share in a specific location and establish individual or peasant farm.

In early 1994 a new presidential decree established the procedures and approach for the final stage of the land reform and farm restructuring program, which was nominally completed in 2001. Under these provisions, all collective and state farms, and ultimately even experimental

and breeding farms, distributed shares of their arable land to all farm residents and shares of non-land assets to farm employees based on the number of family members and years of service of the individual worker. Land shares could be physically withdrawn (theoretically at any time although this was resisted by some managers). Pasture land is not included for distribution in the reforms.

Shareholders, under the supervision of the local commission and the Centers for Land and Agrarian Reform, either put their shares into a restructured version of the parent farm as a joint-stock company or cooperative, so-called association of peasant farms, or separated from the parent enterprises pool their shares to establish group farming enterprises (usually referred to as peasant farms) or individual family farms. Both land shares and asset shares could be withdrawn to establish these new farms, but indivisible assets were primarily kept intact on the parent farms. After the passage of the Land Code in 2000 these land shares were converted into private ownership, but per the Agricultural Land Law of 2001 they can only be transacted with another certificate holder.

3. Agrarian Structure and Performance Today

The main trend in farm restructuring since 1994 has been the rapid growth of individual and peasant farms, which are now all legally grouped into the category of “peasant farms” (*krestianshyie khozyaistva*). The numbers continue to grow each year. These kinds of farms are clearly the predominant farming enterprises type in the southern oblasts, where they control over 75 percent of arable land. In Chui oblast in the north, larger farm enterprises remain, often containing higher proportions of ethnic Russians and retirees.

Table 1: Number of Agricultural Enterprises, 1991-2000

Year (end)	Farm enterprises created by the restructuring of SCFs						
	Total Private enterprises	of which:		Total Collective Peasant Enterprises	of which:		
		Individual farms	Group farms		Agricultural Cooperatives	Joint Stock Companies	Other collective peasant enterprises
1991	4,567	--*	--	--	--	--	--
1992	8,695	--	--	170	125	--	45
1993	18,269	--	--	239	160	--	79
1994	21,264	--	--	340	152	72	116
1995	23,180	--	--	909	608	74	227
1996	31,078	9,576	21,502	995	639	61	295
1997+	38,218	13,505	24,713	672	327	45	300
2000	66,555	--	--	661	281	46	314

* not available ** planned by end 2000 + July 1 @ June 1

Source: RCLAR

The range of farm sizes is enormous, and essentially bi-modal (see paper by Childress 2003).

Table 2: Distribution of Land Resources by Size, 1999

Land Area, ha.	All farms	Individual	Multi-Family	Collective	State
<1	11	8	3	0	0
1-3	52	36	16	0	0
3-5	46	32	14	0	0
5-10	80	34	46	0	0
10-20	84	27	57	0	0
20-50	85	10	73	1	1
50-100	31	1	18	11	2
100-500	39	1	10	22	6
500-1000	13	0	0	12	1
1000-5000	20	0	0	12	8
>5000	6	0	0	2	4
TOTAL	468	149	237	60	22

Source: Mogilevsky and Childress, Table 3

3. Distribution of Physical Resources.

The most important physical factors which determine the production capacities of the farm is the availability of productive resources, namely: 1) labor; 2) land; 3) animals; 4) machinery and equipment. As we will argue later, these assets were distributed relatively equally within the two main regions of Kyrgyzstan (North and South), based on the existing population of the state and collective farms at the time of privatization. Non-physical assets, of course, such as farming skill and connections with elites and political structures, are much more heterogeneously and idiosyncratically distributed.

Labor

The four types farms in the survey differ significantly in the amount of labor they utilize (see Table 3).

Table 3. Labor endowments of different types of farm enterprise.

	Republic	North large	North small and medium	South large	South Small and medium
Number of families, average per one farm	30	146	3	240	12
Number of workers, per one farm	40	136	6	296	25

Clearly, the number of employees in the large farms is bigger rather than in the small and medium farms, moreover, there are more employees in the South compared with the North in both large and small/medium farms. It is apparent that on average there are two employees per family in the small and medium farms but that this ratio is noticeably less in the large farms. In the North it is less than one, meaning that not all adult members of the farms work in the farm. Many of them may play their part in the farm by contributing land or non-land assets but are employed somewhere else.

Land

The differences in the the four broad classes of surveyed farms become particularly obvious when analyzing their agricultural land endowment (see Table 4). Precisely speaking, there are almost no farms which fit the national average. The agrarian structure is highly bifurcated. The difference in farm size is enormous. The average area of agricultural land in the large farms in the North exceeds by 100 times that of the neighboring small and medium farms; this difference is not so big in the South, but still significant. The average size in the small and medium category is between 15 and 20 ha.

Table 4. Agricultural land availability

	North large	North small and medium	South large	South small and medium
Total	1399.2	15.3	373.7	20.1
Own land	1115.0	10.2	271.9	15.9
Rented land	284.2	5.1	101.8	4.2

The large farms are successors of the former kolkhozes and sovkhozes, from which they inherited machinery, which is now heavily depreciated. The small and medium farms, were also assigned non-land assets but in general received much less machinery. The key question is now whether the distribution of is constraining productivity in the small-medium farm sector, or if markets for machinery hire are functioning efficiently.

Profitability of enterprises.

The farm budget comparison presented in Table 5 provides a summary description of the surveyed farms' performance. It takes account of incomes from crop production, livestock production and additional sources, and also direct and indirect¹ production costs. Net margin generated by the farm is calculated as the difference between gross income and direct and indirect costs. It should be noted that the way net margin calculation is not a complete economic description of the farm's marginal efficiency of resource use, because this would need to include the value of the farm owners' labor as well as fixed assets depreciation². This calculation provides a summary indicator of current-period profitability to compare operating margins across different farms.

To make possible the comparison between different types' farms in profitability, the return is calculated per one ha of farm land, per one worker and per one thousand Som of fixed assets value.

Table 5. Farm budget comparison

	Republic	North large	North small and medium	South large	South small and medium
Number of workers, person./farm	40	136	6	296	25
Area of land, ha/farm	163.4	1399.2	15.3	373.7	20.1
Total	1319.6	9166.0	212.5	4662.7	360.9
Profit, , thousand Som					
Per one ha	4.5	3.6	9.1	7.4	9.2

3. Descriptive Statistics: Characteristics of small scale farming in the Krygyz Republic³

There are several ways of classifying farms by size, such as by area cultivated, size of operation. Here we use the number of members as an indication of farm size. In Kyrgyzstan typically a member represents an entire family so counting members approximates with the number of families participating in a given farm. Our primary interest is to contrast individual farming with small-scale cooperation in agriculture, therefore we have classified the farms into two categories. First, individual, or one member farms; second, small groupings of families, comprising between 2 and 48 families. The frequency by which these farms occur in our sub-sample is shown in Table 6 below. The sub-sample chosen for this paper is restricted to individual and multi-family farms that are less than or equal to 100 hectares, which represents approximately 98 percent of individual and multi-family farms in the total sample. We have chosen the 100 hectare cut off as this is a standard procedure for

¹ Indirect costs include expenses related to the operation of the farm as a whole and can't be attributed to a certain type of activity. They include land tax and Social Fund payments, interest on credit, payments for electricity, pastures etc.

² Due to lack of stable prices for labor and production assets, it is not possible to assess correctly these values.

³ Area drop if >100; Drop if area ==90 and s==1 (outlier); Drop if LABOUR1>15 and m==1

differentiating between small and large farms in terms of area and it allows comparison with earlier work by Childress (2003) on large farms (greater than 100 hectares) from the same sample.

Table 6: Farm classification

Farm Type	Households	Percent
Individual (1 household)	126	34.24
Groups (2-48 households)	242	65.58
Total	368	100

Table 7 presents a comparison of the land areas and land/member ratios at the sample mean of each of these three categories.

Table 7: Farm Characteristics: land and labour per farm and per member

Group Type	Individual	Group	Total
Mean Area Cultivated	9.06	16.19	13.75
Mean number of workers	3.51	12.74	9.58
Land cultivated per member	9.06	3.74	5.56
Arable area owned/member	4.27 (3-median)	2.52 (1.8 median)	3.12
Available family labor per member	1054.7	666.47	
Family labor/hectare	344.6	458.5	
Hired labor per member	20.29	12.75	
Own equip/ member	99.45 (72) 57%	34.09 (180) 74%	
Tractors/member	1.11 (35) 28%	0.30 (93) 38%	
Plough/ member	1.04 (24) 19%	0.29 (80) 33%	
Truck/ member	1 (16) 13%	0.29 (67) 27%	

Table 7 shows that on average medium group members own, cultivate and rent less land than familial groups and individual farmers. The pattern of asset ownership and access is strikingly consistent across all asset types, with individual farmers owning and accessing more than familial groups and familial groups more than medium groups. For instance, on average the individual farmer cultivates nine hectares of arable land; the familial member, 4.4 hectares and the medium member, 2.07 hectares. Similarly, from Table 8 we see that the

pattern is repeated for labour use, equipment ownership and financial assets⁴. This finding is suggestive of an asset pooling incentive for group formation. Individuals households with small asset endowments or opportunities for expansion may seek to pool to reduce transaction costs, risk or access complementary assets.

The results presented above are highly suggestive of an asset constraint story motivating group formation around agriculture. Farmers are likely to secure access to further assets by pooling their resources with similarly placed individuals.

5. Production characteristics of small scale farming

While asset pooling appears to provide a strong explanation for cooperation in agriculture can we say anything about the production techniques and relative advantages of one type of farm over another? Table 9 below presents some information on use of various factors of production per hectare. Little can be said about relative efficiency of production across farm types using this information

Table 9: The use of different production factors per hectare, median by farm type

Variable/hectare	Individual	Familial
Workers	0.6538	0.869
Days of family and hired labour	196.7	266.62
Machinery	2390.8	2162.1
Total variable costs		
Hired labour (days)	0.168	0.281
Income	13.02	12.53

Using non-parametric methods we can obtain more useful insights into the relationships between different factors of production and output.

Figure 1 below shows the relationship of the predicted values of output for different combinations of land and labour in the Kyrgyz Republic for individual farmers. To generate this plot we estimate a nonparametric local polynomial regression (loess) for total income utilising only individual farmers. Figure 1 reports on the x-axis total AREA measured in hectares and on the z-axis labour, measured as number of farming days. The minimum number of reported full-time working days in farming activities for individual farmers is (?days) and the maximum (days). Hence as we moved along the z-axis individual farmers labour increases. We can see that increasing farmed area for given level of labour reaches a maximum level of production and then decreases. Similarly, for given area increasing labour shows a diminishing marginal productivity of labour. It is interesting to note that for high holding of land under individual farming there is not enough labour available to enter into the increasing marginal returns to labour for individual farmers. This points to an inefficiency in the market.

⁴ The pattern across farm types was consistent across a wide range of asset indicators, such as amount of arable land owned, amount of rented land,

FIGURE 1 Perspective plot for the local linear regression of production on the total farming area and total labour for individual farmers

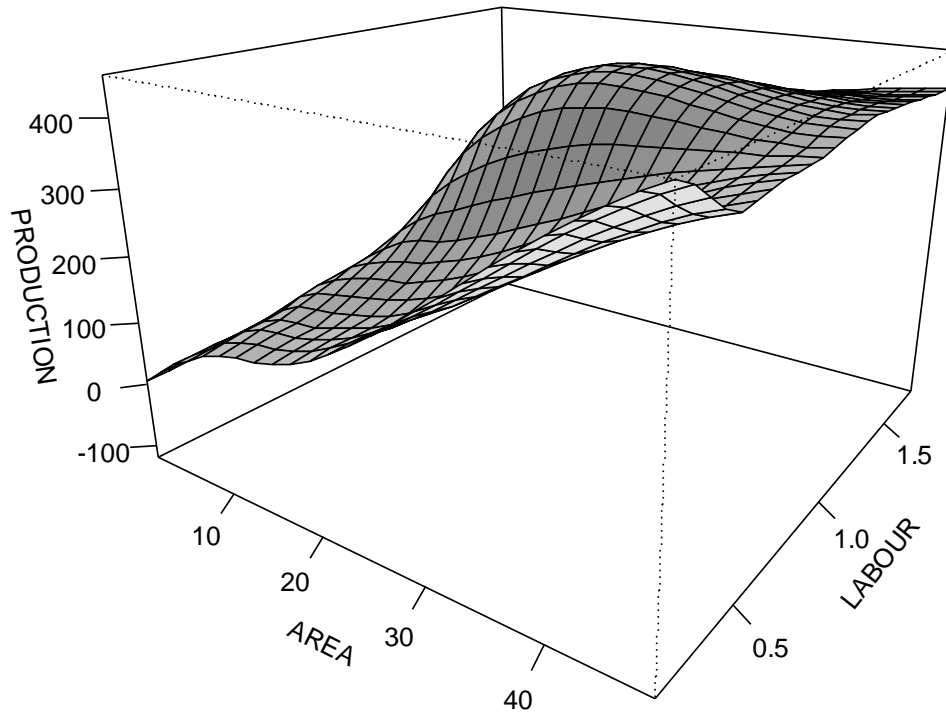


Figure 2. Perspective plot for the local linear regression of production on the total farming area and total labour for familial and medium-sized group farms.

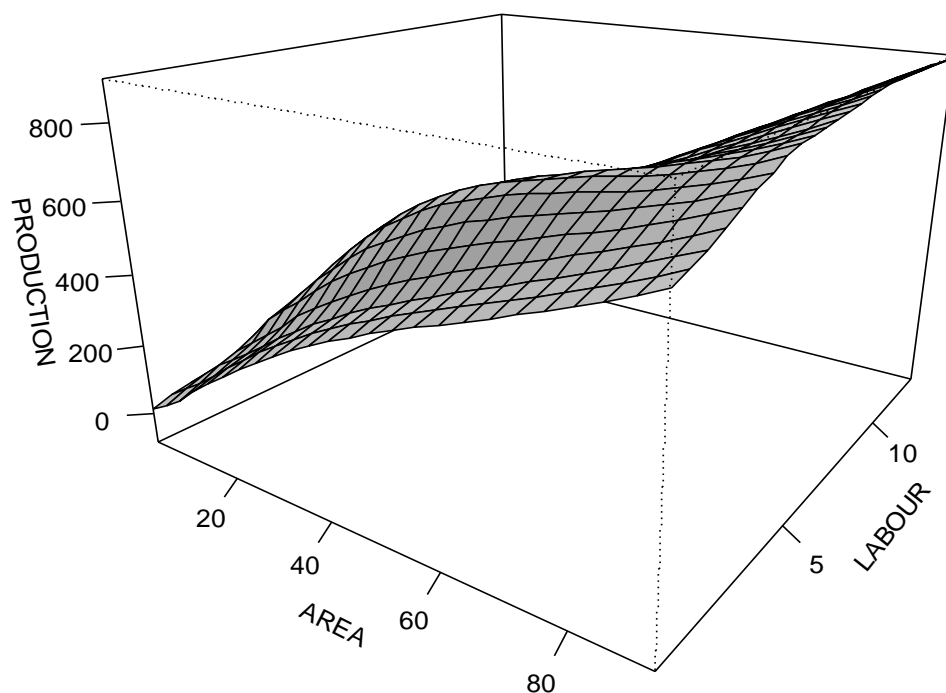


Figure 2 presents the same non-parametric regression for familial groups. These are again very interesting results. First, it seems that these farmers are producing in the region where the combination of land and labour increases production. It does not seem that production values have reached a maximum level (possibly due to inefficiencies or inexistence of markets), although the rate of increase for additional labor appears to markedly slow above the 5 member level. The rate of increase to additional land likewise appears to slow above approximately 40 ha. In this graph we can also see why the quadratic term of land is not significant in the quadratic production function parametric model (see below)

Having seen these effect represented graphically in the non-parametric estimation, it is logical to ask how they are expressed in a parametric production function. In this case we specify a standard quadratic model. The variables in the equation are listed in Table 10.

Table 10: Production Function variable names and definitions

Variable Name	Definition	Individual (means)	Familial (means)	Medium (means)
Crop_value	Total annual income from crop production ('000s soms)			
FERT	1 if fertiliser is used, 0 otherwise			
MACHINE	User cost of capital (10,000 soms)			
MACHINE_SQ	Squared value of machinery			

MA	Machinery* area
ML1	Machinery* labour
LABOUR1	Total labour-days (hired and family)/1000
LABOUR ²	Squared value of labour
LA	Labour*area
AREA	Area in hectares of cultivated arable land
AREA ²	Squared value of area

HERE I WILL INCLUDE A DESCRIPTION OF ALL THE VARIABLES AND A DISCUSSION OF THE QUADRATIC PRODUCTION FUNCTION. I DECIDED TO INCLUDE A DUMMY FOR FERTILISER SIMPLY BECAUSE THERE WERE SO MANY PEOPLE WHO DID NOT USE ANY FERTILISER.

Table 11. Quadratic production function coefficient values and summary statistics.

tot_income	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
	TOT		INDIVIDUAL		GROUP	
f	44.75341	15.06091**	16.84391	22.2751	60.13137	20.13367**
MACHINE	40.634	6.643638**	27.46172	14.7219*	38.95826	8.242922**
MACHINE_SQ	-1.648204	.4191166**	-3.797153	1.081491**	-1.191722	.7228412
MA	.6403274	.2346223**	1.688266	.5159165**	.4017623	.3723204
ML1	-.5985531	1.210069	34.59289	16.67373**	-.219812	1.419389
LABOUR1	32.69953	11.89298**	551.1998	154.4704**	33.88549	14.29353**
LABOUR1_SQ	-3.939456	1.434071**	-379.9328	103.0482**	-4.150796	1.654893**
LA1	.6677699	.2974569**	-3.040307	6.219811	.6184084	.3244981*
AREA	4.390268	1.710503**	-.4984474	4.954054 - 0.10	5.07072	2.120494**
AREA_SQ	-.1078918	.0369785**	-.0317567	.1204316	-.0876204	.0508915
_cons	-49.8622	16.50096**	-156.8816	51.1264**	-68.01728	24.79528**
R-Sq	0.6362		0.5811		0.6422	

Post-estimation

Total factor productivity (TFP) is one of the most common measurements of technical efficiency (Sadoulet and De Janvry, 1995). TFP is defined as the ratio of output to an index of all inputs. Below, the estimated parameters for land, labour, capital and chemical inputs are used as a measurement of aggregate input use in order to estimate the TFP and compare the different farming regimes (the parameters for the constant, organizational terms and lambda are not included).

Table 12 below shows the numerator and denominator values used to calculate the TFP. In this case the TFP measures the average product of aggregate inputs. The TFP is 0.43, 0.720 for individual and group farms, respectively. The results from this analysis indicate that smalllll-group farms utilize their factors of production more efficiently than individual farming.

Table 12: Total Factor Productivity for Individual and Family Society Farming

	Individual	Group
Total Average Output	277.151	280.17
Aggregate Input	120.269	201.782
Total Factor Productivity	0.433	0.720

6. Interpreting Results: Relevance for Policy and Need for Qualitative Understanding

The non-parametric estimation of the different shape of returns to land and labor, the quadratic production function estimation and the TFP calculations all suggest that the small and medium-sized group farming formations in Kyrgyzstan do provide some type of efficiency advantage versus fully individualized farming. This paper does not attempt to model the causality of these differences. Indeed, the thrust of the overall research project is to interrogate this issue qualitatively. But the results presented here merit discussion and clearly have some relevance for the set of policies regulating agricultural restructuring and the broader development and poverty reduction framework of the country.

The estimations from these data appear to confirm the hypothesis that there are some production efficiency advantages occurring in the familial and small cooperative groups. What might be explaining these differences, especially given that the descriptive statistics portray relatively similar levels of input use (except for labor) and output per hectare? We think that three processes are likely at work. The familial and medium group farms are likely able to a) specialize their labor effort better, both by dividing tasks within the work force and by uniting groups of workers around the relatively highly capable or skilled farmers (which could also be viewed as a self-selection effect); b) they are likely able to pool assets such as labor and machinery; and c) they are able to mitigate production risks better.

As the production function graphs reveal, the individual farmers appear to reach maxima for both land and labor endowments within the band of land sizes distributed during privatization. For these farms, expansion of land and labor is not expected to increase production efficiency (although it could increase total agricultural income and create some employment). For this group, only a shift in underlying technology or farming skill (technical efficiency) would be likely to improve agricultural productivity. In contrast the production functions predict that the familial and group farms would likely be able to profitably expand both the operational size of their landholdings and their labor force, although the production functions indicate that the rate of this increase would be predicted to slow as either land or labor increases.

These conjectures are consistent with the history of agricultural restructuring. The incentives for small and medium-size grouping reflect the unique distributional characteristics of the mass privatization and farm restructuring processes and the parallel underdevelopment of factor markets in Kyrgyzstan. While land assets were distributed in a highly equitable fashion in each region, non-divisible physical assets like machinery and buildings were distributed to groups of shareholders. Furthermore, non-physical, but equally crucial assets—technical and entrepreneurial skills, physical ability, networks of trust, contacts and influence, proximity to markets, agroclimatological attributes—were *a priori* distributed in a much more heterogeneous and idiosyncratic manner which, for any specific individual or household give significantly different value and functionality to the land and physical assets received in privatization and restructuring. Endowments of non-physical resources can be expected to vary significantly within families and within outwardly homogeneous communities.

In a theoretical world of perfect factor markets (especially for labor) the varying quantities and qualities of non-physical assets would be priced and allocated on the basis of a large number of transactions and allocated the full spectrum of productive sectors. But such a market solution is thus far impossible in Kyrgyzstan. When the seasonal, episodic, and specialized labor demands of agricultural production are taken into account, grouping may provide a way to ensure efficient use of land, equipment and non-physical assets while maximizing the non-farm opportunity set for the groups' members. The biggest constraint to full-time exit of workers out of agriculture, is the non-farm labor market, which thus far in the post-independence period has been sluggish and generated many more informal and part-time opportunities than stable jobs, limiting out-migration from

agriculture on a full-time basis, especially for women. Out-migration of young men is more common, particularly to Russia and other overseas labour markets, and creates an additional incentive for women-headed households to work with groups.

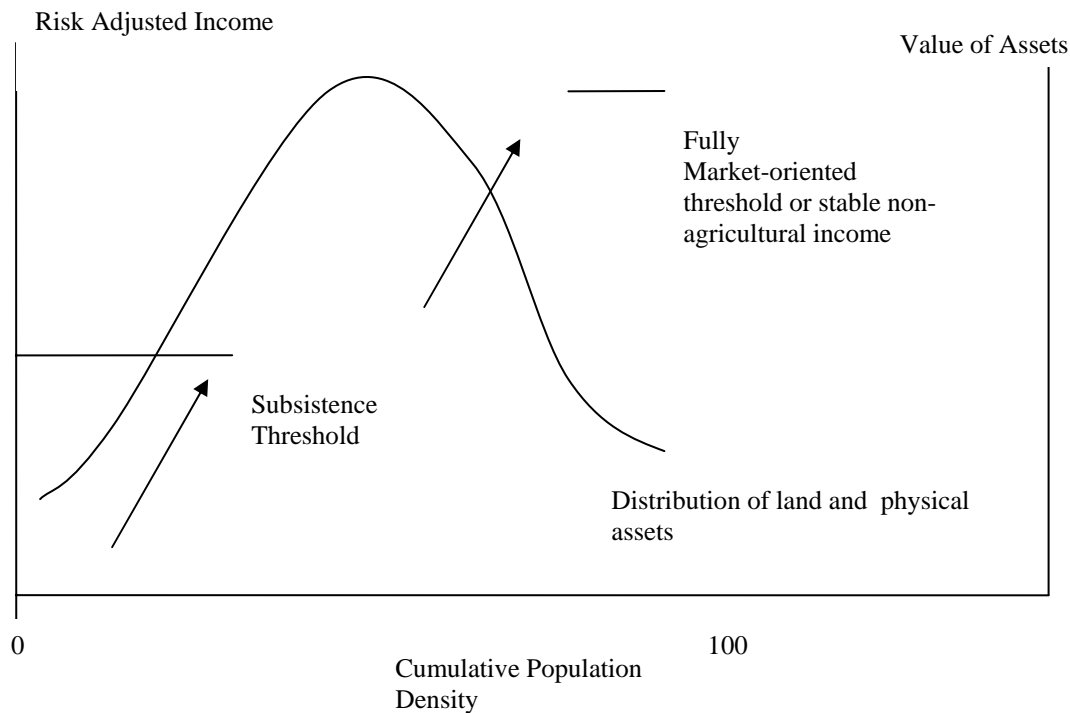
The second factor creating an incentive to work in family and medium-sized groups is risk. There is no agricultural insurance market in Kyrgyzstan and thin state-sponsored social protection, so individuals in agriculture face the full risk and uncertainty of climactic events, market fluctuations and institutional/legal changes. Land markets are only beginning to operate, although most of the activity is restricted to the Land Redistribution Fund (Childress and Giovarelli, 2003). Pooling of resources and mutual assistance can lower the risk for a particular or household from certain conditions, although it may create others.

The “lumpy” distribution of equipment and non-physical assets in a context of limited markets is a third factor. Most of the former state and collective farms were reluctant to physically part with commonly owned machinery, and only a few scarce, and often deteriorated pieces were made available to farms splitting off from the former large farms. Many small and medium farms have no machinery at all and must purchase machinery services on the spot during the season. Accessing this spot market for machinery hire in a timely manner is another incentive to work together, because more land can be prepared, tilled or harvested at one time, and the transaction cost of contracting the machinery is spread over multiple individuals or households. Machinery’s scarcity thus creates a situation in which there are obvious incentives to internalize the allocation of these assets within the productive unit (rather than fully marketize them through leasing arrangements), especially for expanding market-oriented production.

Re-organizing agricultural production in Kyrgyzstan during a period in which these three factors are present create incentives for grouping in agricultural production, but it is unlikely to be a very stable structural arrangement, because it is apparently based on medium-term deficiencies in other markets which are expected to change. Figure 4 depicts a heuristic diagram of this situation. While land and physical assets are relatively equitably, although lumpily, distributed within each region, the distribution of non-physical assets is unobservable but heterogeneous. Individuals whose physical and non-physical endowments are insufficient to ensure a subsistence threshold of risk-adjusted agricultural income have incentives to group with others in the context of constrained labor markets if successful grouping can really raise income or lower risk. The transaction costs of grouping with family and neighbours can be hypothesized to be the lowest available because of interlocking self-interest, fuller information and physical proximity.

Likewise for individuals above the threshold of subsistence whose endowments of physical and non-physical endowments are insufficient to move them toward a higher threshold agricultural income or asset accumulation, generally with a more market-oriented production regime will be likely to seek group membership. On the other hand of course, individuals whose own endowments are sufficient to overcome these thresholds by themselves, will have no incentive for grouping. Grouping does have costs and risks of its own—essentially risks of non-cooperation--not found in fully individualized production.

FIGURE 4. Heuristic Depiction of Physical Asset Distribution and Risk-Adjusted Agricultural Income. Non-physical assets are distributed idiosyncratically throughout a heterogeneous population, but land and physical assets are distributed with relative equality. Arrows represent direction of incentives to grouping or exit from agriculture for individuals with sub-threshold endowments.



The farm structure observed in Kyrgyzstan confirms this heterogeneity and it is intuitively easy to see that in such a situation, a fully individualized structure of production is unlikely. Individuals with partial shares in physical assets like farm equipment, and individuals with low or heterogeneous endowments of non-physical assets will have incentives to work together (to group). Likewise individuals with complementary endowments have incentives to share them (e.g. through asset pooling or labor specialization), up to the point at which the internal management costs of sharing them overcome the efficiency gains. These group formations may also be more or less stable of course, first because information about different individuals and preferences for specific activities requires time and experience to be revealed, and secondly because market and institutional conditions (including non-farm labor opportunities) change from season to season. In fact a lot of yearly change in farm structure has been observed in Kyrgyz agriculture (Childress 1999), and the larger process of disintegration of the old collectives and formation of individualized and small-group production units is the biggest single trend in the country's agriculture.

Intuitively, it would be predicted that there are diminishing returns to this type of group formation as the group size increases, because of labor supervision, free-riding and trust issues as the number of members increases. This intuition corresponds with the results depicted in the group-farming production function graph. The graph suggests a rapid increase in production income up to a the range of land size and labor of what is considered a mid-size farm operation in Kyrgyzstan (40 ha and 5 members), and a slowing of production incomes after those sizes. These results therefore depict a completely different production regime than that of large collective farms, and indeed appear to represent that small groups are closer to an extension of individual production logic which takes advantage of labor specialization and asset pooling, than to a corporate or collective production model.

What does this transitional agricultural structure mean for policies? First, the results point to the weakness of the Kyrgyz non-farm labor market and the need to focus public and private investments in non-farm employment generating activities. Grouping for agricultural production indirectly suggests that individuals with fewer non-physical assets are staying in agriculture, linking themselves with relatives and neighbors to assure their subsistence, or to reach higher levels of agricultural income, rather than seeking off-farm labor opportunities. Throughout the post-independence period Kyrgyzstan has struggled to find non-agricultural employment. Greater articulation of downstream processing and marketing activities to raw material production appears to point the way forward, and Kyrgyzstan now has a number of promising examples of how to do this.

Second, the results suggest that factor markets for land, equipment and technical agricultural advice remain underdeveloped. Making more machinery available through longer-term loan schemes, public-private partnerships with local government and integration with foreign suppliers of parts and equipment would take pressure off the machinery scarcity and promote a growing private sector involvement in supply chains for parts and maintenance.

Third, and more positively, the results argue for a mild encouragement of grouping as a transitional form of agricultural organization. Flexible mechanisms for farm structures, joint credits, and tax incentives could all be positive measures in this context which would be beneficial to agricultural efficiency and the non-farm labor market.

The evidence presented in this paper, based on a few strong, but not unambiguous quantitative indicators is largely suggestive. While the efficiency in production is a strong result from the estimations, the causal factors underlying group formation and description of benefits and costs of grouping are inferred more on the basis of economic theory and intuition than from primary data. For this reason the research project has focused new primary data collection on qualitative indicators presented in the words of the agricultural communities and households involved in operating small and medium-sized groups for agricultural production. Results from the qualitative survey are presented in the following sections.