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The Conservation of Agricultural Biodiversity in Uzbekistan: The Impacts of the Land Reform Process

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The Conservation of Agricultural Biodiversity in Uzbekistan: The Impacts of the Land Reform Process.

Introduction:

Central Asia is one of the most important centers of biological diversity for crop plants in the world, especially for tree crops of fruits and nuts. This paper reports on an ongoing research effort between an international conservation network and Uzbek scientists to study the socio-economic processes impacting local farmer conservation. A specific focus is the economic transition process, especially the evolution of the collective farm sector and changes in land tenure. The project seeks to understand how the economic transition process can affect the conservation, access and utilization of crop genetic resources. The paper focuses on the cultivation of fruit trees, nut trees, and grape vines in home gardens and the importance to rural households. The linkages between land tenure, economic transition, and agricultural biodiversity have not been examined thoroughly, and this paper aims to contribute to both methodological and empirical understanding of the processes at work.

The process of economic transformation has been gradual and incomplete in the agricultural sector of the Uzbekistan economy. Changes in land tenure regimes are recent and ongoing, providing a starting point to explore the links between household agricultural behavior and local agro-biodiversity management. Furthermore, due to the crisis in rural incomes, it is useful to study the contribution of crop diversity assets to livelihoods. The paper will present secondary data to describe the general process of

transition facing rural households, followed by preliminary analysis of primary data on home gardens.

Policy Issues

A nascent body of literature examines the motivation of households to conserve crop genetic resources on farm and *in situ*. A variety of social and economic forces have been explored as explanatory factors for household decisions to plant a variety or a portfolio of varieties. Agro-ecological conditions, consumption preferences, market integration, risk aversion, economies of scope, have been found to influence the conservation decisions. Institutional aspects, such as property rights and collective action, of local plant genetic conservation have not been studied as thoroughly.

In the formal sector there are a series of government and commercial institutions such as crop breeding centers and seed companies that directly supply crop genetic resources at a regional and national level. However at the village and household level the linkage between informal institutional forces and conservation appear to be principally indirect. There are few examples of explicit collective action for CGR conservation or distribution, but households participate in the social network of a seed system, an institution composed of actions surrounding exchange and management of genetic materials. Households do not articulate property rights over crop genetic resources, but property rights to land – through land tenure and other institutions impact the types of genetic resources that households manage.

The farmer seed system is not an explicit form of collective action, but is implicitly constructed from sources of seed, exchanges, behavior on selection and propagation, and other elements of the human behavior, both economic and cultural. The

farmer seed system approach to conservation is to document the flows and sources of genetic material in addition to information on what is grown. (It is important to clarify – although in English the general term is “seed system”, in this case it includes sapling and grafts and rootstock etc to include any form of CGR that households are accessing.) One key component will be to look at sources, whether households source from relatives, from neighbors, how often they go outside their village or local social network, and how often they go to the market for genetic material. Another component of seed systems relevant to this study is the rate of access and exchange, how much new material is being accessed, and how often are new trees or vines planted.

In looking at how property rights institutions impact crop genetic resource management, it may not be property rights over genetics that are interesting, but property rights to land and other inputs, and freedoms to make independent decisions that drive diversity outcomes. Land tenure itself is a bundle of different rights, and can depend on the degree to which households can perceive and carry out those rights. In the course of economic transition there are contemporaneous changes to a range of different property rights, each may have a different weight in impacts on crop genetic resources. In comparing the transition path in Uzbekistan to that in China, Pomfret notes that the productivity in Uzbekistan lags behind because the reforms in China (beyond land reform) included reforming the banking sector, the input supply sector, and labor markets. Lerman and Brooks study of Turkmenistan asserted that the effective level of transferability is more important than actual title to land. In a comprehensive review of agriculture in transition, Rozelle and Swinnan compose a scale of transition that includes a range of agricultural market liberalization measures. Macours and Swinnan focus on

the creation of markets in a range of key inputs, and show relationships to the degree of productivity growth during the early period of transition.

Background on Uzbekistan

Uzbekistan is a hotspot of both agro-biological and cultural diversity. Over sixty distinct cultural and linguistic groups exist in Uzbekistan alone, and it is a center of origin for over 40 crops including apple, peach, plum, almond, walnut, pistachio, grapes, and such horticultural crops as garlic, melon, spinach, etc. Vavilov described the area in his early collecting missions, and described the combinations of wild forests of fruit and nut trees next to ancient oasis cities inhabited for millennia. Up to the current day, the US Department of Agriculture has been involved in collecting expeditions, throughout Central Asia and specifically in Uzbekistan for fruit and nut varieties. Although the Soviet modernization of agriculture led to centralized planning of widespread monocultures on vast irrigated acreages, significant diversity was maintained in household garden plots where traditional agricultural practices and inherited varieties were maintained free from state planning. The warm, irrigated climate of Uzbekistan led it to be used by the Soviets to supply fruits and vegetables to the northern cities, and there was a small but significant infrastructure and trade in these crops.

The Soviet agricultural research system was well developed, and Soviet botanists actually pioneered the study of wild and farmer varieties of crop plants. The network of VIR experiment stations in each republic, and Shreder field stations in each province have a long history of collection and conservation of agricultural biodiversity. However, as in most areas, the state sector contracted in the 1990s. The Uzbekistan VIR station was transformed into a national research institute for plant industry. The regional

research stations are faced by limited funding for activities necessary to keep their collections alive, and have largely limited other activities, despite the huge benefits to local farmers. These experiment stations actually play a dual role, collecting and conserving traditional varieties, but also making selections and providing both improved and local genetic materials for planting. In a field visit in October 2002, the team talked with directors of the Shreder centers in Fergana, Namangan, and Samarquand provinces, who all mentioned difficulties keeping field collections alive, in one case the trees in the field collection were leased to local families for maintenance.

The issue of agricultural biodiversity is also related to other important environmental issues in Uzbekistan. One pressing issue is the diversification of the overall economic system away from the cotton monoculture. The cotton production system is notoriously reliant on intensive chemical inputs, and inefficient irrigation infrastructure. The diversification into different fruit, nut, and vegetable crops, especially ones that draw on local genetic resources, has the potential to reduce polluting inputs, and provide more economic options than the single dominant cash crop. Due to the government's heavy reliance on cotton exports as the principal source of revenue and foreign exchange, the government may seek to steer the path of economic diversification to assure some level of export earnings. From the point of view of the individual farmer, given that cotton is subject to production orders, and most of fruit and vegetable production is not, when given the option farmers seek to move out of cotton into these other activities. Furthermore, the principal environmental-resource issue in Uzbekistan is water resources management; while fruit and nut crops are slightly less thirsty than

cotton, they are more adaptable to advanced irrigation techniques, and can reduce the rates of salinization and provide shade for soils.

Home Gardens and Rural Poverty in Uzbekistan

Home gardens are a focus of this study because of their importance in the conservation of crop genetic resources, but at an aggregate level they are an important sector in the agricultural economy of Uzbekistan, and at the household level are important components of livelihood strategies. Data that will be shown below in the tenure section will show that gardens are the principal producers of fruit and horticultural crops in Uzbekistan, and this general tendency holds for Central Asia, and in Russia and the Commonwealth of Independent States. In Uzbekistan home gardens are not just oriented toward home production, but satisfy more than half of national demand in fruits and nuts, and provide significant share of export market in those commodities. Despite the collectivization of the vast majority of land in the Soviet period, household gardens remained a fundamental cultural unit, and individual initiative was always permitted on these micro plots. Growing fruits and tending vegetables remains a strong component of the culture in Uzbekistan.

Furthermore recent studies have shown that gardens are central to household strategies to survive the poverty and economic collapse in the post-Soviet era. Kandiyoti, in preparatory studies for the World Bank living standards assessment, raises several issues of how garden production was a strategy for the rural poor. In an assessment of Rural Poverty carried out by the Expert Center, access to garden lands provided a significant buffer to the income shocks of the early nineties. In data on rural Russia, Wengen found that gardens composed around 30% of the incomes of rural poor, and

Seeth, et al. found gardens to be the second most important source of income in rural households, ranging from 10-50% of income. In Uzbekistan this is exaggerated by the fact that many parts of the rural economy remain without cash; households may work for the shirkat for access to benefits or payment of gas and electric utilities, but sales of horticultural goods are a rare source of actual cash income.

Land Reform in Uzbekistan

The process of land reform in Uzbekistan is complicated by the divergence between legal frameworks and actual implementation, by regional differences, and even by the different names used. For this paper a series of reducing simplifications will be used that may not apply in every case, but can describe the general situation. First of all, following independence the state farms, *Kholkoz*, were transformed into independent entities, *Shirkats*. In most cases the *Shirkat* is basically a continuation of the *kholkoz*, including the same leadership. However there are some cases with newer forms of production, including short term and medium term leasing of land, and renting and leasing of tractors and other services. There is a range of how independent and entrepreneurial the new *Shirkat* leaders are: some following the latest production methods, and acquiring new American tractors and making independent production decisions. In many other cases the *Shirkats* are basically indistinguishable from the Soviet era counterparts. One important aspect for this case study is the expansion of garden plots, where all families living on a *Shirkat* were eligible to receive an additional plot of land for own production (around 0.15 ha). Again, these household plots are free from the planning of their production, and they rely on market and informal sources for inputs. The households working on collective farms were organized into work brigades,

usually an extended family or a group of families. Currently these work units, or *Pudrats*, compose an intermediate form of tenure arrangement, with households either leasing land, or contracting to work a part of the shirkat under various forms of sharecropping or profit sharing arrangements.

Households with a small amount of land (less than 1 ha) who seek to be recognized as independent entities can be recognized as *Dehkan hojalik* farmers.¹ The *Dehkan hojalik* can operate independently from the Shirkat, and can bring their produce to market. While not every household plot is automatically a *Dehkan hojalik*, the procedure is more simple and less subject to corruption than larger land reforms, and it is easier for an average family to become independent. The *Dehkan hojalik* are the sector of farmers most likely to utilize agricultural biodiversity, and due to the linkages to the historical conservation of diversity in household plots, more likely to be able to access traditional varieties through informal networks.

The larger scale of land reform is the creation of private farmers, called *Firmer hojalik*, who apply for land from the local Shirkat and hokimiyat and are leased between 5-15 hectares of land on a long-term lease. In the cases that we interviewed, the successful private farmers, *Firmer hojalik*, had usually been involved in the previous state farm leadership and were able to utilize wealth and political connections to get their land holdings. This can be intentional, as wealthier farmers and brigade leaders and agronomists are more likely to be successful when their land is decoupled from the collective farm. On the other hand this bias in the land reform process is typical of the

¹ The term Dehkan can also be used to refer to a peasant or small farmer in general. Furthermore the term Firmer is confusingly similar (if not adapted from) the English word “farmer”. In the presentation here *Dehkan hojalik* and *Firmer hojalik* are used in the new legal sense of independent legal entities representing new tenure classes as recognized by Uzbek law.

corruption throughout post-Soviet Uzbekistan and in many ways inherited from the bureaucratization of state-led farming. Even after these private farmers are given land titles, there is a range of the degree with which they are independent of production orders, or the type of treatment they receive from the hokimiyat or farmers association. One interesting case for agricultural biodiversity is private farmers who receive as a parcel the orchards from a Shirkat, and if dedicated to fruit and vegetable production how will they make planting decisions in the future. As the private farmers are more entrepreneurial and dealing with larger harvest, the ability to market export crops, or to contract to processing firms will have a significant effect on what varieties are planted.

The influence of these different land reform sectors varies between the different crops, due to the history of how they were grown in the past, and the degree of independence from centralized planning. In Figure 1, official data from the government economics ministry shows how for several crop groups, the majority of production comes from household production. In this figure the household plots includes the independent Dehkan farmers.

[Figure - Percentage of Production by Farm Type]

One can see that for vegetables and potatoes, over 80% are grown in the household plots. In the case of fruits and melons, still over 60% are grown in households, and in the case of melons a larger share is produced by the private farmers. In the case of grains (and even more so for the case of cotton) the majority is produced on Shirkats, and this encompasses a much larger total land area, and a greater share of subsidized inputs, and production credits. Households remain the largest producers of meat and milk, and this can be important when looking at the allocation of expanded household plots. In many

cases maize and other forage crops are grown as inputs into household livestock activities – and this will be a competitor for fruits and vegetables in looking at planting decisions on additional household plots.

In looking at different crop choices, important differences derive from the relative factor endowments in the different sectors, especially the amount of labor available for production. Data from a World Bank household survey in 2000 are presented in Table 1 that document the availability of labor under the different tenure categories. This data is not national data, but is compiled from a stratified sample of representative communities, and a sample of each type of households within each community.

[Table - Workers per Ha]

From this table it is obvious that the labor available for the Dehkan farmers is far higher than that of either Shirkats or Private Farmers. In most cases this is mainly a function of the fact that the Dehkans have very small land plots, less than 1 ha by law and often 0.25 to 0.5 ha. The labor pool usually consists of the entire family or an extended family. This can have an important effect on horticultural crops – where they may be more labor intensive and less mechanized than row crops like wheat and cotton. Finally this is an important area to investigate where the productivity potential of Dehkan farms can be much higher than others because of the amount of labor available, especially when other key constraints are eased.

However it is important to notice that many Dehkan farmers are involved in multiple economic activities, as described in Table 2.

[Table - Off-Farm Labor]

A majority of Private farmers are dedicated entirely to agriculture, and as their landholdings are around 10 ha, this amount of land could take more than all of the labor

of a single family. Dehkan farmers on the other hand are more likely to be involved either in other farm work on a Shirkat, and almost a third is involved in some form of off-farm work. This can also have an impact on the agricultural biodiversity in several ways, possibly when off farm work can provide income to invest in crop activities to households not eligible for agricultural credit.

As a basic approximation, the 2000 World Bank survey has data on the average number of crops grown by each tenure type. While this does not provide a true scientific measure of the level of agricultural biodiversity, it is useful to look at how tenure types increase the number of crops grown.

[Table - Average Number of Crops]

First of all, within the Shirkat and the Private farm, the plots have a greater number of crops grown than on the larger extension of fields. This illustrates the general pattern that the fields are planted to row crops, especially cotton and wheat, while plots are planted to a large number of different horticultural crops. In the case of the Dehkan farms, where the highest average number of crops is found, this maybe a combination of crops grown for household consumption and others for marketing. The shirkat household plot, the focus of empirical analysis later in the paper has a much higher level of crop diversification than the shirkat overall.

Finally, of interest to the case of agricultural biodiversity, is the seed system, or how farmers access genetic material. In this case the World Bank RESP survey asked where farmers acquired key inputs and from what kind of institution, and the results for seeds are presented in Table 4. Again while this may not directly be the result needed for

the diversity of tree crops, it is a useful start and corresponds to the trend of differentiation between larger private farmers and the smaller Dehkan farmers.

[Table - : Sources of Seed]

The most important trend in this data is that the Dehkan farmers are able to get the majority of their seeds saved from own production or through informal exchanges. This may be due to economic reasons, creating limited ability to buy seeds, or other agronomic reasons. The Private farmers are more likely to get seeds from the government – either through the Shirkat or directly from government agencies. However, even the private farms rely to a significant extent on own saved seed and informal exchanges.

In Uzbekistan the actual status of land tenure is actually a compound relationship of different property rights and degrees of autonomy from the shirkat. In land tenure specifically, the property right is a bundle of the security of that right, the perceptions of the durations of the rights, and the transferability of those rights. At this time many land holders in Uzbekistan have little knowledge of whether they can sell or rent lands, legally or even informally. In the RESP study a range of answers were provided as to how long households and farmer expected the length of their tenure to last.

The degree of actual economic independence must also be measured in other ways beyond tenure regime. Much of the inputs for Uzbekistan agriculture are controlled with a checkbook system, where farmers are allocated credit to purchase inputs, but have a range of restrictions on what inputs they can buy and when. The cash economy is limited and operates in parallel to the state economy which operates on a system of accounting inherited from the planned economy. A farmer might have to decide between paying a privatized tractor to plow field paying cash at the time of plowing from own

savings, or can deduct the cost of the tractor from a state tractor pool from a checkbook account to be paid at the time of harvest.

The control of planting decisions is a fundamental aspect of economic independence that can have significant impacts for crop genetic resources. In the household plots, households have complete independence, but in the firmer and pudrat arrangements, the shirkat often decides what crop and which varieties are planted. Or a firmer may be able to get an orchard parcel, but the fixed costs of orchard establishment prevent that household making variety specific decisions, at least in the short term. In a pudrat share cropping arrangement, there can be different degrees of autonomy on what input decisions the household can make, from inputs to sources of inputs, to timing of labor activities and harvest.

Finally, independence in the marketing of agricultural production is fundamental to the tenure arrangement. In most fruit and nut crops there is basically a free market and a variety of buyers, which makes these sectors attractive to individual households. In contrast cotton marketing is controlled by the state, and the cotton price is manipulated because its export earnings provide a large share of the national budget. Recently there are international joint ventures in the fruit and grape industries, and these large industrial buyers may have lasting influence on which fruit and grape varieties are planted. Interviews with dried fruit and nut traders revealed a range of different output market arrangements, from traders going door to door in specific villages where they have social networks, to households coming to the bazaar to sell in bulk, to relatively sophisticated contracts for apricot trees purchased at fruit maturity, and processed by traders. The processing can be an important part of the sales of the crops studied, and the expenses

(and corresponding value added) of processing may be born by either producers or traders.

Primary Data from Samarqand Household Survey

The first set of information analyzed from the household survey is the level of diversity of fruit crops held by households. A subset of fruit species are selected, in order lead a more detailed analysis, these are apricot, apple, grape and walnuts. The first set of information presented is the number of varieties of each species grown by a given household, these are presented in Figure [-].

[Figure - Histograms of Numbers of Varieties]

These histograms are presented for all of the households in the sample, so the first column of each histogram represents households not growing any of that species. There are many households with none of each of the focus crops, especially in Grapes and Nuts. The second thing to notice in all crops is that there are a low number of total varieties for each crop, with the mean at one. This is actually typical of many in situ conservation studies, similar results have been found for grain crops around the world. However the large number of zeros and the low number of varieties causes statistical problems for the modeling of diversity and the construction of diversity indices, which may require some methodological innovation tailored to this sparse data. Looking at individual crops, in apricot there are low number of varieties, hypothetically lower than the Fergana valley where apricots have a longer history. By comparison apple seems to be more popular, less zeros and slightly higher numbers of varieties. Nuts are the least diverse, with over a third of the sample not growing and only a few with multiple varieties. This makes nuts

hard to model individually, but is included as a representative of other minor species such as peach, mulberry, fig, cherry, etc that are also included in overall garden diversity but not consistently in all gardens. Finally, Grape is the species with a higher number of varieties, and this may be related to the commercial production, ease of propagation, or greater choice of varieties, all of which will be discussed later.

An easy check on the hypothesis that some households favor diversity more than others is to see whether a household with a high number of varieties in one species is likely to grow a high number of varieties in another species. These correlations are presented in Table [-]

[Table - Correlations between numbers of tree varieties grown]

The largest correlation is between apples and apricots, a higher number of apple varieties planted is highly and significantly correlated with a higher number of apricots. To a lesser degree apples and grapes and apricots are significantly correlated. It is interesting to note that apricots are correlated with diversity in all other fruits. However two caveats need be issued here, that the size of the garden, which will drive the number of trees planted, is not held constant, and that these numbers include both the 0-1 decision of whether to plant and the 1-1+ decision of whether to plant a diverse set of varieties. However these correlations are an interesting target for further exploration.

Maintaining the subset of possible species, we turn to the sources of genetic material that farmers report for these crops. Results for the classification of source of material is presented in Table [-] and the location of the source of material in Tables [-].

[Table - : Source of Genetic Material – Social Relation]

[Table - : Source of Genetic Material – Location]

To begin by looking at the categories across crops, the own source of genetic material is very important, and households are able to graft and propagate their own starts of all of these crops. In the family, parents are the most important source, and in all cases family sources are more important than friends or neighbors. The bazaar is the most important source for all crops except grapes, where it is still the most important external source.

The Shirkat is a relatively small source of material, reflecting the independence of households in planting their own gardens. Finally the Shreder Institute is a relatively rare source, but this may be because much Shreder material comes through middlemen at the bazaar. On a crop by crop comparison, grapes are the easiest to propagate, and this may be reflected by the fact that more HH rely on own and family sources than external sources. Apples and Apricots are relatively difficult to propagate, especially when grafting is involved, and this is why more material comes from specialized traders at the bazaar, and probably indirectly from Shreder.

The table on the location of seed sources presents data that both in agreement and contradictory to the previous table. The large number of no answer is probably due to the fact that households may not know where market traders come from, and so this data could possibly be attributed to the outside/other category. On the one hand the data show that the majority of materials are from within the same village , and a smaller amount from the close region. For grapes about 10% come from outside the immediate region, 16% for walnuts, but a higher 20% and for apricots and 25% for apples. This agrees with the above data that more grape material is sourced locally and apricots and apples are principally sourced in the market. On the other hand a majority is sourced

from within the local region, while above a majority is sourced from the bazaar. The overlap may be due to some households sourcing from bazaars held in the local area, or may show an inconsistency in the response.

Turning to focus on just grape varieties alone, we can begin to separate households into subgroups based on the total number of grape vines that they have. These groups correspond to size class: not growing, garden only, small commercial, and large commercial. In Table [-] data are presented for the number of varieties grown, the total number of vines grown by a household, and the percent of new vines of this total

[Table - Grape Growers Sorted by Size Class]

The small commercial and large commercial producers have more varieties than the smallest producers. This corresponds to findings in other studies that middle and larger farmers may be able to grow more varieties on more land, be matching varieties to more conditions, or other possible economic reasons. The number of vines is of course a function of the construction of size classes, but is a useful illustration of the size and scale of operations. Finally the planting of new vines can illustrate the issues of demand and access to genetic resources. In the case of grapes it appears that the smaller households have been planting and replacing vines more recently. This may also reflect that the larger producers are actually using parcels of the shirkat, where the vines are planted by the shirkat and just managed by the households.

Within our study site the survey sample was structured to cover two administrative regions within Samarquand oblast, Urgut and Bulungur. These two are compared to test whether one district has more diversity than the other. The results for the number of varieties and the percentage of new plantings are presented in Table [-]

[Table - Tests for Differences between Regions]

The districts do not show a significant difference in numbers of varieties planted, except in apricots. Urgut appears to have more new plantings of apple, perhaps because a new interest in commercial growing of apple in gardens, and perhaps because the colder climate makes replacement of saplings more frequent. Apricots have more varieties grown in Bulungur and less new trees, again a climatic explanation of warmer more favorable weather is possible. In Grapes it is interesting that there is no difference because Bulungur has a greater number of Shirkat hectares oriented towards wine and raisin production. However small artisanal grape production remains equally important in both areas and this probably drives the overall result.

Finally this comparison is interesting in light of the fact that the historical and contemporary diversity analysis carried out by the Shreder center expert consulting for the CAPRI project identified Urgut as the region with significantly higher levels of diversity. At this point our analysis suggests that although the region may be higher in diversity overall, the number of varieties held per household is not significantly higher.

Conclusions

This preliminary analysis offers a few findings that can help to steer future research questions in this area. First of all the land reform process is moving slowly, involving both households and larger producers, and encompasses a variety of property rights beside land. Due to historical and current conditions, small household production has been very important for fruit and nut production, both in terms of quantities produced and PGR conserved. The key questions that we have tried to motivate in this paper are, How will land tenure changes affect diversity? How will land tenure change affect

household livelihoods? And how does collective action for access to PGR interact with both land reform and household livelihoods.

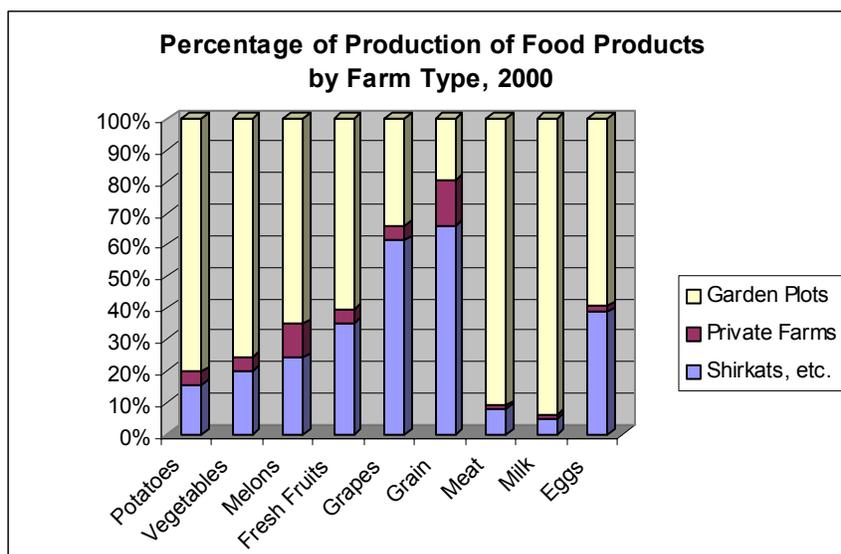
From the early analysis of the household data a few trends are apparent. Household gardens hold a relatively diverse number of species, while larger plots appear to grow larger numbers of varieties than smaller plots. Diversity in terms of varieties planted is correlated across fruits species – households with more varieties in one species are more likely to plant more of another species. Access to PGR seems to have three main channels, informal collective action between relatives and neighbors within communities, formal channels through the government and sourcing at the local bazaar. There appears to be some contradiction between households reporting a large amount of material sourced within the community, but on a different question material sourced largely from the bazaar, which is not within the village. The case of fruit and nut trees is difficult because access to PGR is not on an annual basis, and the survey must rely on recall data. In many cases of leased plots, the households get plots that are previously planted with perennial crops, and thus they may not decide on which materials are planted, nor necessarily know the source and history of the PGR. However increased planting in household plots, and increased planting of small independent plots, will rely increasingly on informal seed source and local traders than government sources. Therefore there is an indication that strengthening collective action to facilitate access to PGR will serve to improve economic opportunities for households.

Direction of Future Research

At this point this paper is intended to guide the path for future analysis. The first step is to look at the interactions of the tenure system with diversity. Within the sample

there are 296 household plots, 114 pudrat contracts, 9 firmers, plus a variety of other rental and lease arrangements. The framework for analysis will start from looking at the diversity of household and commercial plantings, from numbers of species and varieties, to targeting specific rare or landrace varieties. Furthermore the question of access to PGR will be addressed through looking at who is planting new material, and what share of gardens or larger plantations are recently sourced. The analysis of diversity will extend through the analysis of the seed system, where PGR is sourced and from whom. These seed system variables will be interacted with the land tenure variables to explore for differences in forms of access. A combination of trader interviews and the seed system data will be used to address the evolving importance of the market as a source of PGR. The transformation of agriculture in Uzbekistan is going on at many different levels simultaneously and the implementation of reforms varies widely with local conditions. While this project will not be able to generalize for all of rural Uzbekistan, the goal is to document current trends for future policy options that integrate economic reforms with access to PGR and livelihoods.

Figure 1



Source: Ministry of Macroeconomy and Statistics c.f. WB RESP survey

Table 1

	Workers per ha
Private Farms	
Total	0.35
Irrigated	0.43
Dekhan Farms	
Irrigated	10.34
Shirkats	
Total	0.59
Irrigated	0.67

Source: World Bank RESP survey

Table 2

	Private Farmers	Dekhan Farmers
Not Employed Outside Of Farm	83%	56%
Dually Employed On A Shirkat	10%	14%
Involved In Other Off-Farm Work	7%	30%

Source: World Bank RESP survey

Table 3

	Average number of crops
Shirkat	1.24
Shirkat household plot	3.28
Private farm field	2.28
Private farm plot	2.85
Dekhan farm	3.62

Source: World Bank RESP survey

Table 4 : Sources of Seed

	Private Farmer	Dekhan
Shirkat	16.7%	5.7%
State Organization	27.9%	1.0%
Private Firm	1.4%	2.6%
Other <i>Firmer</i> or <i>Dekhan</i>	4.1%	2.1%
Other Private Individual	32.4%	50.5%
Own production	29.3%	49.5%

Source: World Bank RESP survey

Figure 2: Histograms of Numbers of Varieties

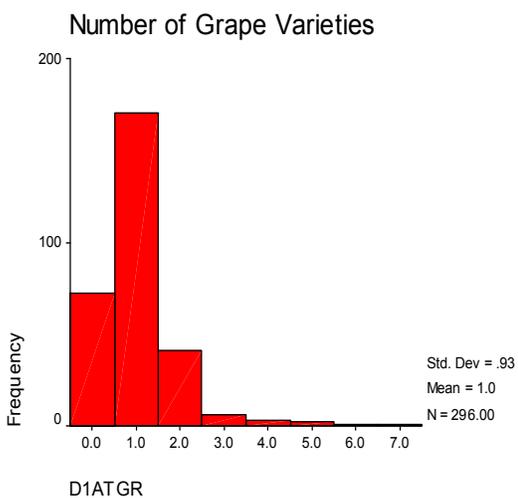
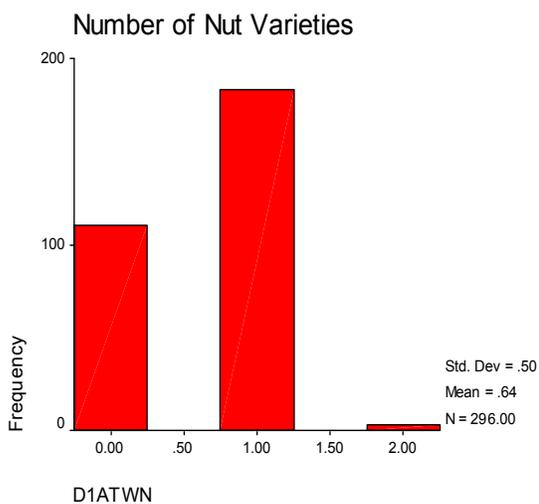
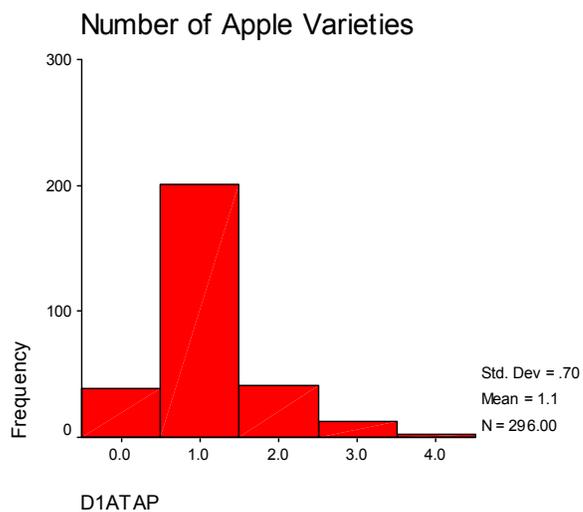
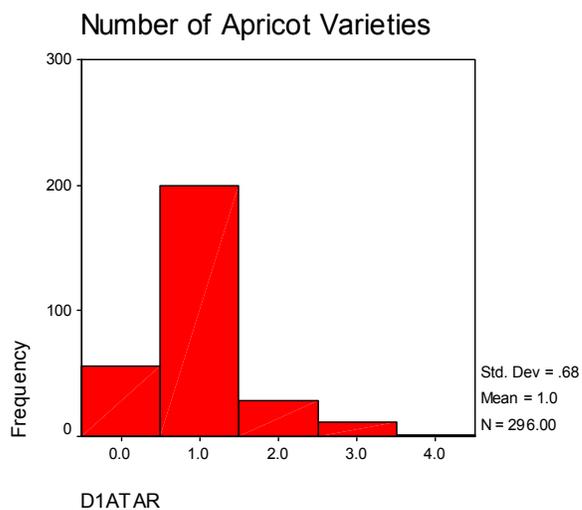


Table 5: Correlations between number of tree varieties grown

Pearson Correlation and 2-Tailed Significance

		Grapes	Walnuts	Apricots
Apples	Correlation	.310**	.089	.723**
	Sig.	.000	.126	.000
Grapes	Correlation		.060	.134*
	Sig.		.306	.021
Walnuts	Correlation			.306**
	Sig.			.000

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 6: Source of Genetic Material – Social Relation

	Grapes	Apricots	Apples	Walnuts
No Answer	6	10	9	8
Parents	28	15	19	14
Sibling	7	3	1	5
Children			1	
Neighbor	14	6	5	6
Friend	4	2	3	2
Relative	10	4	9	5
Own Source	64	36	26	36
Bazaar	61	142	158	97
Shirkat	22	6	7	2
Shreder	8	16	19	11
Total HH	224	240	257	186

Table 7: Source of Genetic Material – Location

	Grapes	Apricots	Apples	Walnuts
No Answer	27	28	27	21
Next Door	8	4	5	4
Same Village	138	107	109	95
Same Shirkat	23	32	36	22
Same Sel Soviel	6	17	18	16
Other	22	52	62	28
Total HH	224	240	257	186

Table 8: Grape Growers Sorted by Size Class

	0	1 to 50	50 to 500	500 +
Number of HH	82	150	43	21
Average Number of Varieties	0	1.21	1.84	1.67
Average Number of Vines	0	11	132	1003
Average Percent new Vines	0	22	16	10

**Table 9: Tests for Differences Between Regions
Number of Varieties and Percentage of New Trees**

		Urgut	Bulungur	T-Test Means	Mann- Whitney
Apples	N	105	152		
	Number of Varieties	1.21	1.34		
	Percent New Trees	0.3	0.18	*	*
Grapes	N	105	119		
	Number of Varieties	1.46	1.28		
	Percent New Vines	0.18	0.20		
Apricots	N	88	152		
	Number of Varieties	1.02	1.34	**	**
	Percent New Trees	0.34	0.18	**	**
Nuts	N	88	98		
	Number of Varieties	1.02	1.01		
	Percent New Trees	0.34	0.24		

** significant at the 0.01 level (2-tailed).

* significant at the 0.05 level (2-tailed).

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