Journal of Agricultural Economics, Extension and Rural Development: ISSN-2360-798X, Vol. 4(7): pp 520-531, October, 2016.

Full Length Research Paper

Capturing livelihood systems for tailor-made support in rural areas of Karakalpakstan, Aral Sea Basin

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Accepted 10th October, 2016

Rural households in the Aral Sea Basin are characterized by their heterogeneity giving the diversity of farms' livelihood settings in the post-independence area. The main objective of the present study was to formulate empirical agricultural livelihood typology in selected villages of Karauzyak district of Karakalpakstan, Northwestern Uzbekistan. A multivariate analysis combining PCA to K-CA, and expert knowledge were used in the present study to identify agricultural livelihood types. Based on the Sustainable Livelihood Framework, a multidimensional dataset of 100 households was collected through interviews. The results showed that the main variables affecting and shaping agricultural livelihoods in Northwestern Uzbekistan were human (labor, labor age, education and dependency), natural (land holdings and livestock), financial (annual gross income, and non-farm income) assets. Three agricultural livelihood types were identified: *(1) Educated, land-poor, livestock- and poultry-rich, off-farm-income-oriented household farms; (2) Farm-income-dependent, less educated, land-poor, poultry-turned farms;* and *(3) Land-rich, poultry-turned, off-farm-income-dependent farms.* The study recommends the use of this typology for further systems analysis, subsequent formulation of specific and targeted rural livelihood strategies and policy intervention.

Keywords: Agricultural livelihood typology, Smallholder farms, Sustainable livelihoods, semi-arid areas, Uzbekistan.

INTRODUCTION

Republic of Karakalpakstan is located in the Northwest of Uzbekistan, and embraces the vast dry lands in the low reaches of the Amudarya River Basin and the Aral Sea. Harsh environmental conditions, with cold winters and hot summers, largely affect the productivity of crop and livestock in the study area, which are characterised as generally low. Reflecting external conditions, the vulnerability of the livelihood system in Karakalpakstan, Aral Sea Basin is very high and the area is considered one of the regions with low income and highest vulnerability due to climate change in Uzbekistan. Hence, crop and livestock production under ongoing land degradation, scarce irrigated water resources and continuing climate change impact is a huge challenge for rural households in the Aral Sea Region. To mitigate negative impacts of the Aral Sea disaster, to help local households to get adapted to changing environments through better adoption of innovative, resource saving, and sustainable practices/technologies it is necessary in the first place to clarify existing household/livelihood typology for subsequent formulation of specific and targeted rural livelihood strategies.

Qualitative and empirical research conducted in Karauzyak district of Karakalpakstan, Northwestern Uzbekistan and Aral Sea Basin led to establishment of agricultural livelihood typology, based on the resources and strategies of rural households, showing the agro-economic logic in the increasing socioeconomic inequalities in rural areas. They exhibit different

biophysical and socio economic settings in relation to their livelihood endowment and orientation, which change over time.

Households-farms have different characteristics on biophysical resources (e.g. land, water and trees), economic resources (e.g. financial and infrastructures) and socio-demographic resources (e.g. labour, capabilities and networks). These features create heterogeneity since they are different for each household-farm in a given location. Identification of and accounting for this heterogeneity is important for a successful design of efficient and resilient systems, and proper policy interventions.

Policy change and technological innovations will affect each household type differently, depending on the relative importance of the different income sources and livelihood strategies

of the household. The specific objectives of the current study were to: (i) identify main factors shaping agricultural livelihoods at village level and (ii) identify and characterize agricultural livelihood types in Karakalpakstan, Aral Sea Basin.

Approach

The study builds on several research approaches, including farming or production system analysis, livelihood analysis and sustainable livelihood analysis.

The well-established farming systems research has been based on a clear understanding of the farming system in place so that interventions and recommendations could be tailored to unique circumstances. Farming system studies have a long tradition in agricultural research, but in the past have strongly focused on practical applications to raise production and to bring the efforts of agronomic research institutions closer to the multi-criteria decision making processes of farmers. These studies frequently focused on the variation of farming conditions in small areas or the influence of socio-economic characteristics of a small group of farmers on the adoption capabilities of research recommendations (Wattenbach, H. 2006).

The concept of a farming or production system considers that each farm (here household-based) mobilizes various resources such as land, labor, capital, equipment, and access to resourced for different income-generating activities. They all form a coherent set with complex interrelations (self-supply of inputs, investment, but also tensions in resource allocations). Within each farming system, typical households represent the socio-economic variation, which exists naturally in any rural society. These household types are developed in light of typical resource endowment, their mix of assets and changes in the last decade. The share of each household type in the farming system in combination with their production orientation allows analysing their ability to adjust to, opportunities deriving from, and vulnerabilities to changing production conditions.

For each household type, past developments in terms of resource endowment and composition of income sources shape the capacity to adjust to future challenges. Each agricultural household manages a farming system as part of his or her livelihood strategy. From a close perspective and considering all livelihood assets (social, physical, financial, natural and managerial) two households rarely operate the same system. Comprehension of both the internal functioning of each activity and its interrelations with the others helps to disentangle the farms' organization and logic of production. The overall outputs, consisting of self-consumed and marketed agricultural production and other revenues, underline the system's economic performance and risk exposure. This helps to characterize the households' potential livelihood trajectories (impoverishment, maintenance, or progress) in the medium term (Raphaële de la Martinière. 2012). Such degree of differentiation is, however, not suitable for policy support nor from a systems perspective. Instead of dealing with individual households, some grouping is necessarily required.

However, gaps were identified in the use of the farming systems approach, i.e. focusing of farming systems analysis on cropping activities and insufficient addressing of other contributing factors. Likewise, social scientists in many instances conclude that a lack of understanding of farmers' priorities and decision making criteria were the reasons behind slow adoption of new technologies. The "soft-science" notion in farming systems research was driven by failures to apply traditional farm management methods to individual, complex, smallholder farms and households. These are mostly characterized by mixed cropping practices, small production units, as well as decision making under the influence of multiple constraints on resource availability (absolute as well as seasonal fluctuations) and social obligations. Farming system studies, for over one decade, were mostly based mainly on PRA methods, and in the context of problem and identifying farmers' perspectives and constraints.

The shift was thus proposed from a farming systems approach to a livelihoods approach (Mukelabai Ndiyoi and Mwase Phiri, 2010). Research and actions for improving livelihoods is guided by the definition of livelihoods by Chambers and Conway (1992): A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living. It comprises the adequate stocks and flows of food and cash required to meet basic needs. It is made up of a range of farm and off-farm activities,

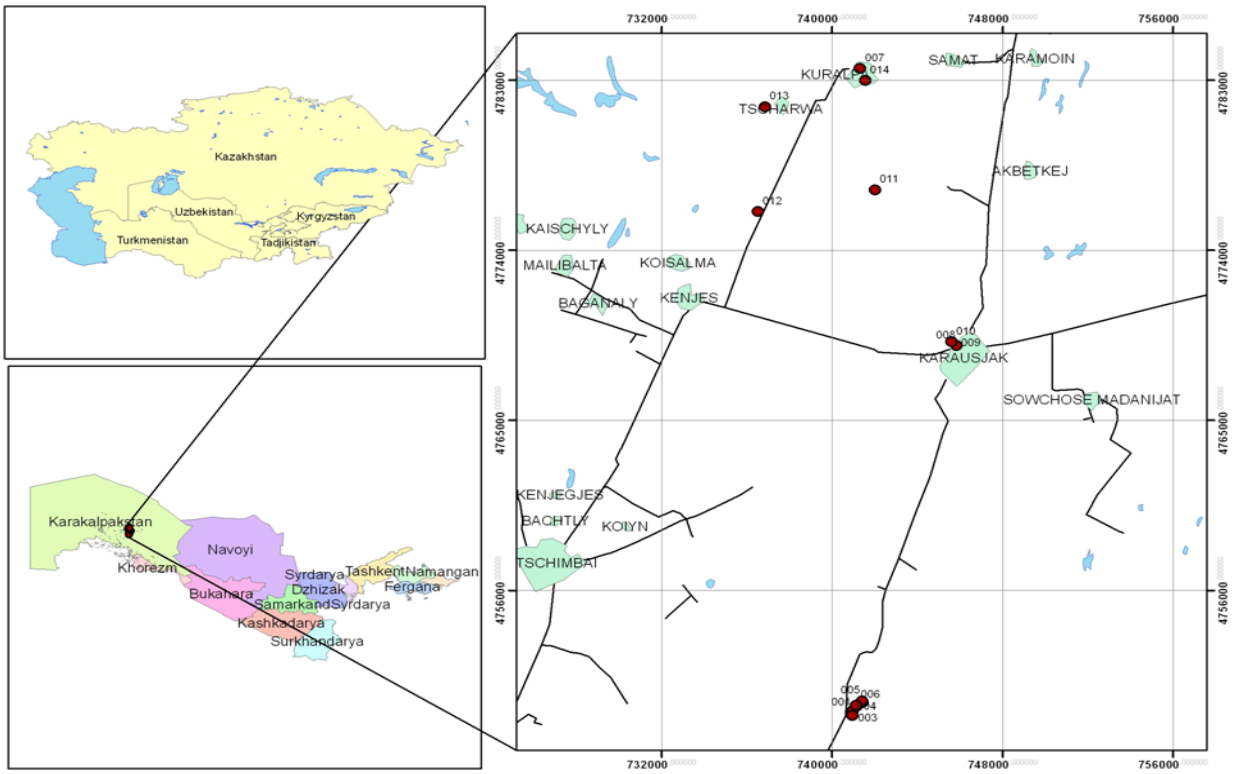

Figure 1: Locations of surveyed sites

which together provide a variety of procurement sources for food and cash.

Each household can have several possible sources of living, based on endowments of a household, and its position in the legal, political and social endeavours of the society. A livelihood is sustainable when it: (i) can cope with and recover from stress and shocks; (ii) maintain or enhance its capabilities and assets; and can (iii) provide sustainable livelihood opportunities for the next generation.

Livelihoods analysis is an approach that helps determine how people live or make a living. It incorporates an understanding of how household capabilities; assets and activities combine within a specified environment to achieve household well being in the short and long term. Livelihoods analysis assesses the resilience of household strategies in response to shocks and stresses; under conditions of available assets or endowments and capabilities (Mukelabai Ndiyoi and Mwase Phiri, 2010).

A livelihoods analysis aims to increase understanding about:

– The nature of livelihoods for various household types.

– The main issues concerning livelihoods, such as: major problems and constraints; shocks and stresses; coping and adaptive strategies; etc.

– The opportunities and potentials for addressing these issues.

– Potential strategies and priorities as well as actions to be taken.

Livelihood analytic approaches are applied worldwide to gain insight into the lives and livelihoods of for example communities at risk. This information is used for planning, monitoring or evaluation. Moreover, an understanding of changing household and community livelihood strategies is critical when designing sustainable development policies as well as programmes that reduce risk and build on local capacities (Mukelabai Ndiyoi and Mwase Phiri, 2010).

Finally, the concept of 'sustainable rural livelihoods' is increasingly central to the debate about rural development, poverty reduction and environmental management. The term 'sustainable livelihoods' relates to a wide set of issues which encompass much of the broader debate about the relationships between poverty and environment (Scoones I., 1997). The Sustainable Livelihood Framework serves to view a household-farm as a whole by taking into account all of its characteristics (features).

Study area

The study was conducted in Karauzyak district of Karakalpakstan, Uzbeksitan, Aral Sea Basin (Figure 1).

Total territory of Karauzyak district is 5.9 thousand km^2, of which agricultural arable land covers ca. 32.2

thousand ha, arable land – ca. 18 thousand ha, pastures – 380.1 thousand ha, and plots of local rural households cover 2.2 thousand ha. Climate is sharp continental with average air temperature in January of 6 ...8^0 C below zero, in June of 28 ...32^0 C above zero. In July-August the temperature can rise above 45^0 C.

The economy of Karauzyak district is based primarily on state controlled cotton and wheat cultivation by large farms. Some industrial branches and thus employment opportunities are developed. With regards to agricultural production, rural households in the study area possess livestock including cattle, cows, sheep, horses, poultry and goats and are engaged in production of wheat, potato, vegetables, melons and fruits.

Local people lead very simple lives, do not have ambitions to become rich or have better houses and cars.

METHODS

Data collection

The fieldwork included the household selection for individual interviews as well as group discussions focusing on the compilation of information for each of the three household types, which represent socio-economic groups and their corresponding livelihood systems. Available statistics provided descriptions on the importance of each system in the national context in terms of contribution to the production of key commodities as well as the determination of socio-economic characteristics of each system in terms of average holding sizes and cropping patterns.

In total 100 households living have been randomly selected and interviewed. Key informants were also interviewed such as members of local administration and Village Citizen Councils. Based on the advice of the Village Citizen Councils consultants, a mix of individual and group interviewing methodology was applied. Life stories were taken into particular consideration to understand socioeconomic trajectories since the Soviet era.

The questionnaires were guided by the Sustainable Livelihood Framework and dealt with farm assets (labor force, land, livestock, equipment, and cash flow), the functioning of cropping and livestock systems (including kitchen gardening, fodder, dairy, and poultry), marketing, and other income sources and activities. Special attention was given to the combination of these activities in terms of work time and cash-flow management throughout the year, to highlight unsuspected constraints and logics.covered mainly household characterization (e.g. demography, education and profession), farm lands inventory and land tenure, agricultural and farm tools inventory, crop and livestock production, off-farm income and remittance.

Data analysis

Data analysis led to the construction of a typology of family farming systems representing a specific combination of activities (Le, 2005; Le, Seidl and Scholz, 2012).

The identification of the agricultural livelihood types in study area combined multivariate analysis and expert knowledge. The multivariate analysis consisted of two steps. The first step used Principal Components Analysis (PCA) for identifying the main factors that discriminate household-farms. The collected multidimensional dataset was prepared by selecting main variables per capital with reference to the Sustainable Livelihood Framework (Table 1). The PCA was run with the varimax option and only Principal Components (PC) with Eigenvalues of at least 1 (>=1) were considered.

The second step consisted in K-mean cluster analysis (K-CA). The key variables, contributing most to the factors loadings (Loadings>=0.6) from the PCA results, were used. The knee method was employed to decide on the optimal number of clusters. ANOVA was used to characterize identified agricultural livelihood types and the results were confronted to expert knowledge.

RESULTS

Farming main settings in study area

In Karauzyak, households have an average size of nearly 6 members and are dominantly headed by males: only 13% of households' heads were female. Literacy rate in Uzbekistan and Karakalpakstan is reported to be 99%. Virtually all citizens throughout the country do have school education since primary and secondary education is mandatory and free of charge for everyone. In all surveyed households, eligible members (as per age) have at least a college degree (secondary education). Therefore, it is more appropriate to look at households where members have at least a bachelor's degree. Table 2 shows that in 32% of households there is at least one male with a bachelor's or higher degree and in 30% - a female with the same degree. So, in terms of access to higher education there is no gender issue. It is prestigious to have a university degree in rural areas, and therefore parents support their children, regardless of sex, in entering the university.

There is no independent public organization/public fund operating in Karauzyak. Except for those that are

Table 1: Household variables for Principal Component Analysis.

Livelihood asset	Variable	Variable definition	Source*
Human	$H_{HEADAGE}$	Household head age (year-old)	D
	$H_{HEADEXP}$	Experience of the HH head in Agriculture (years)	D
	H_{NBEDUC}	Number of members with bachelor or higher degree in the household	C
	H_{SIZE}	Household size (no. of people in the household)	D
	H_{LABOUR}	Number of workers of the household (labour)	C
	H_{DEPEND}	Dependency ratio of the household	C
	$H_{NONAGROINC}$	Number of household members with non-agriculture income	C
	$H_{EXTSERV}$	Households that have interest in Extension services (1=yes, 0=no)	C
Physical	$H_{DFMARKET}$	Distance to nearest food market from household house (km)	D
	$H_{DLMARKET}$	Distance to nearest livestock market from household house (km)	D
	H_{CAR}	Number of cars possessed by the household	D
	$H_{TRACTOR}$	Number of tractors possessed by the household	D
	$H_{TRACTANIM}$	Number of traction animals (horse and mule) possessed by the farm	D
	$H_{GSFACILITY}$	Number of grain storage facilities possessed by the household	D
Natural	$H_{HOLDINGS}$	Farm land holdings (ha)	D
	$H_{HOLDINGCP}$	Farm land holdings per capita (ha/person)	C
	$H_{FALLOWCP}$	Farm fallow land per capita (ha/person)	C
	$H_{CULTLANDCP}$	Farm cultivated land per capita (ha/person)	C
	$H_{SHFALLOW}$	Share of fallow area in land holdings (%)	C
	$H_{SHCOTTON}$	Share of cotton area in land holdings (%)	C
	$H_{SHCEREAL}$	Share of cereals area in land holdings (%)	C
	$H_{SHMFCRP}$	Share of marketable food crops area in land holdings (%)	C
	H_{LUCP}	Livestock unit per capita (LU/person)	C
	H_{LUHA}	Livestock unit per ha of cultivated land (LU/ha)	C
	H_{PUCP}	Poultry unit per capita (PU/person)	C
Financial	$H_{SHRFINC}$	Share of household farm income in household annual gross income (%)	C
	$H_{SHREMITINC}$	Share of remittance income in household annual gross income (%)	C
	$H_{SHNOFFINC}$	Share of Off-farm income in household annual gross income (%)	C
Social	$H_{LEADCOM}$	Household head leadership in the community (1=yes, 0=no)	D
	H_{PUBORG}	HH member participates in any public organization (1=yes; 0=no)	D
	$H_{SATCSDM}$	Level of satisfaction with HH member contribution to social decision-making (1=satisfied; 2=partly satisfied, 3=not satisfied)	D
	H_{ACSBRW}	Household access to reliable sources of borrowing (1=Yes; 0=No)	D

Note: [a] D = Direct extracted from the questionnaire; C = Compound information calculated based on information coded in the questionnaire.

Table 2: Main farming system characteristics in Karauzyak

H_Size	5.5
H_Female Head (%)	13
H_Illiteracy (%)	1
H_ Bachelor degree (%) : female	30
H_Bachelor degree (%) : male	32
H_Network membership (%)	10
H_Holdings (ha/person)	0.07
H_Livestock (unit per person)	0.64
H_Food availability concern (%)	67

established and monitored by the government at all levels, such as Farmers Council for example, Village Citizens Council. Only 10% of respondents acknowledged their participation in public organizations, by which they meant Village Citizens Council (Table 2).

Natural capital of the household consists of the land leased from the state. All land resources in Uzbekistan are the property of the state, which regulates and monitors the land use. Most of the available arable land resources are devoted to agricultural production either by the farmers (registered legal entities) or by *dehqons*. Whereas the farmers lease the land from the state for the period of up to 50 years, *dehqons* get the land for life-time inheritable use. According to the Land legislation *dehqons* may lease land of the maximum size of 0.12 ha for house buildings/dwellings and additional 0.12 ha for cultivating agricultural crops, which however depends on the availability of 'free' land in the given district or region. Households mainly use land plots as backyard kitchen gardens or a specified area within the main farmland of the farmers, and are free to choose their crops and sell at their own discretion. Most of the land owned by respondents is cultivated via surface irrigation (87%) and average land holding per person is about 0.07 ha.

Despite most of the households are predominantly poor, most of them would like to have additional plots in particular for production of fodder crops. In reality, due to constant growth of population (1.5% per year) on the one hand and due to limited available land resources on the other hand it is very difficult to get such additional land plots from regional administration. In such cases, agricultural area (cotton fields mainly) would have to be taken out of agricultural production and transferred to households, which is not desirable by the administration.

Traditionally, livestock are considered to be a good, reliable and fast paying off investment option. Many rural households, which plan to have weddings or other big celebrations or if the household has teenagers ready to attend or already enrolled at universities, the family can fast sell the cattle and get the required funds to cover expenses for celebrations or educational fees. Thus, livestock for households is one of the essential sources of food and income. However, for most of them the number of livestock and their variety is constrained by the income and fodder availability. Only 0.67 unit of livestock accounts for one person in surveyed households. Most widespread kind of livestock among respondents in Karauzyak district of Karakalpakstan is milk cows (present at 67% of households), since milk is a significant part of the daily nutrition of rural people. Non-milk cows are the second most popular animals and present at 44% of households. Among small ruminants the most widespread are goats, especially she-goats (20%). Sheep and rams are bred by few households and horses and mules are present at 14% of households.

Enhancing food security is one of the key challenges that impacts livelihood strategy of rural households. Most of the surveyed households (67%) worried if they were capable of securing sufficient food products every month. Households applied different strategies to mitigate or resolve issues with food products availability during last 30 days. The most applied strategy is to get food for debt from local shops or get help from relatives, friends or community members – 57% of households rely upon this. Another way of dealing with this issue was to spend savings for food, which is applied by 45% of households. In a little more than quarter of households (27%), elder members consumed less food so that children could have enough food. Nearly quarter of households (24%) met their demand for food at the expense of decreasing healthcare costs. The same number of households sold poultry for this reason. There are households that had to sell small ruminants (18%) and cattle (11%) to buy food.

Main factors discriminating agricultural livelihood types in study area

The PCA results revealed 8 factors with total Eigen values of at least 1 (Table 3). The 8 factors beard 81.1% of initial total variance. The factors were named after variables with greater loadings and most correlated to the factors as shown in Table 4. The most discriminating factors of household-farms in study sites, with at least

Table 3: Total variance explained by extracted components, using Principal Component Analysis (PCA) as extraction method. Only PC with Eigen value >= 1 are retained. Note: The Principal Components with Eigenvalues less than 1 are not showed.

PC	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumul.[a] %	Total	% of Variance	Cumul.[a] %	Total	% of Variance	Cumul.[a] %
1	3.83	19.17	19.17	3.83	19.17	19.17	3.71	18.54	18.54	3.83	19.17
2	2.83	14.15	33.32	2.83	14.15	33.32	2.16	10.81	29.35	2.83	14.15
3	2.41	12.05	45.37	2.41	12.05	45.37	1.99	9.94	39.29	2.41	12.05
4	2.02	10.09	55.46	2.02	10.09	55.46	1.99	9.92	49.21	2.02	10.09
5	1.55	7.74	63.20	1.55	7.74	63.20	1.98	9.88	59.09	1.55	7.74
6	1.43	7.14	70.33	1.43	7.14	70.33	1.76	8.80	67.89	1.43	7.14
7	1.12	5.61	75.95	1.12	5.61	75.95	1.38	6.91	74.80	1.12	5.61
8	1.03	5.15	81.10	1.03	5.15	81.10	1.26	6.29	81.10	1.03	5.15

Table 4: Rotated Component Matrix (i.e., loadings) using Varimax rotation method and Kaiser Normalization of first eight PCs

Livelihood asset	Variable	Principal components							
		1-Land PC (19%)	2-Mark. PC (14%)	3-Inc. PC (12%)	4-Age. Exp. PC (10%)	5-Lab. PC (8%)	6-Liv. PC (7%)	7- Off Inc. PC (6%)	8-Soc. PC (5%)
Human	$H_{HEADAGE}$	0.003	-0.101	0.072	**0.821**	0.28	-0.03	0.072	-0.001
	$H_{HEADEXP}$	-0.11	-0.109	-0.055	**0.802**	0.386	0.042	0.036	0.052
	H_{NBEDUC}	0.347	0.02	0.363	0.035	0.381	0.473	0.005	-0.057
	H_{SIZE}	-0.08	-0.026	-0.041	0.106	**0.839**	0.015	0.17	0.147
	H_{LABOUR}	0.013	0.007	-0.121	0.166	**0.741**	-0.018	-0.146	-0.09
	H_{DEPEND}	0.087	-0.202	-0.151	**-0.718**	0.226	-0.165	0.04	0.038
	$H_{NONAGROINC}$	-0.009	-0.183	0.433	0.116	0.422	0.088	0.45	-0.412
Physical	$H_{DFMARKET}$	-0.009	**0.982**	0.054	-0.001	-0.013	-0.045	0.061	0.029
	$H_{DLMARKET}$	0.009	**0.974**	0.093	-0.021	-0.021	-0.042	0.064	0.03
	H_{CAR}	0.46	-0.194	-0.049	-0.185	0.134	0.289	-0.074	-0.351
	$H_{GSFACILITY}$	0.698	-0.201	0.12	-0.116	0.123	-0.014	0.127	-0.168
Natural	$H_{HOLDINGS}$	**0.969**	0.057	0.013	0.01	0.012	-0.015	-0.027	0.122
	$H_{HOLDINGCP}$	**0.963**	0.074	0.013	-0.025	-0.113	-0.048	-0.053	0.07
	$H_{CULTLANDCP}$	**0.963**	0.074	0.013	-0.025	-0.113	-0.048	-0.053	0.07
	H_{LUCP}	0.084	-0.11	0.001	0.19	-0.154	**0.839**	0.019	0.151
	H_{LUHA}	-0.226	0.018	-0.015	-0.036	0.096	**0.837**	-0.027	-0.151
Financial	$H_{SHRFINC}$	-0.046	-0.15	**-0.911**	-0.091	0.117	-0.001	-0.077	-0.066
	$H_{SHREMITINC}$	0.052	0.034	**0.858**	0.05	-0.088	0.015	-0.478	0.015
	$H_{SHNOFFINC}$	-0.023	0.157	-0.152	0.045	-0.019	-0.024	**0.921**	0.068
Social	$H_{SATCSDM}$	0.071	0.009	0.055	-0.01	0.073	0.012	0.041	**0.905**

Note: ***Mark*** *= Market,* ***Inc*** *= Gross Income;* ***Age Exp*** *= Age and Experience;* ***Lab****= Labour;* ***Liv****=Livestock,* ***Off Inc****= Off-farm income,* ***Soc****=satisfaction with social activity. Numbers in parenthesis are percentages of total variance of original variables explained by the principal components. Bold and underlined are the high loadings, indicating most important original variables representing the principal components and used for clusters analysis*

10% of initial total variance, were PC1, PC2, PC3, and PC4, which were highly correlated with Natural capital ($H_{HOLDINGS}$ with loadings b=0.97), Physical capital ($H_{DFMARKET}$ with loadings b=0.98 and $H_{DLMARKET}$ with loadings b=0.97), Financial capital ($H_{SHRFINC}$ with loadings b=0.91 and $H_{SHREMITINC}$ with loadings b=0.86), and Human capital ($H_{HEADAGE}$ with loadings b=0.82 and $H_{HEADEXP}$ with loadings b=0.80). The PC1 was named Land PC, the PC2 – Market PC, the PC3 – Income PC, and PC4 – Age Experience PC. These four factors represented 19%, 14%, 12%, and 10% of initial total variance, respectively. Other discriminating factors were PC5 to PC8, which carried less than 10% of initial total variance (5-8%) each. The PC5 was most correlated with human capital (H_{SIZE} and H_{LABOR} with loadings b=0.84 and b=0.74 respectively). The PC5 was named Labor PC, and it carried 8% of initial total variance. The PC6 was most correlated with Natural capital (H_{LUCP} with loadings b=0.84) and named Livestock PC. It carried 7% of initial total variance. PC7 was correlated with financial capital ($H_{SHNOFFINC}$ with loadings b=0.92) and carried 6% of initial total variance. This PC7 was named off-farm income PC. The last PC (#8) is mostly related to social capital and is clearly correlated with $H_{SATCSDM}$ (b=0.90), carrying 5% of initial total variance.

Agricultural livelihood types in study area

The typology analysis results revealed three agricultural livelihood types based on the survey results in given sites. The Table 5 highlights keys variables for which the three agricultural livelihood types were found different. In addition, the Table 6 compares average land use and crop yield per cluster for the main group of crops, vegetables, in the study site.

Livelihood type I: Educated, land-poor, livestock- and poultry-rich, off-farm-income-oriented farms

This agricultural livelihood type I represents 10% of the study sample. This type is characterized by its clear orientation to off-farm activities for income generation. In each household there is at least one member (1.44 on average) who has a university degree (bachelor's or higher). This results in a higher average number (1.89) of members who have non-agro income sources. Those with university degrees work usually at local public organizations such as schools, hospitals, kindergartens. And this type has the least degree of dependency rate (0.4) among all types.

Consequently, land holdings per household is the smallest in this type – 0.06 ha, or 0.01 ha per person. This type of household-farms use their small land plots (77% of total area, on average) mostly for cultivating vegetables and watermelons. At the same time, this livelihood type is better endowed with livestock (1.61 per person) and poultry (1.59 per person) than other two types. However, they mostly use livestock and poultry for own consumption and not for marketing purposes to generate income. Also this type has more cars on average (0.22) than other types.

As a result this type is much less dependent on farm income (6.4%) and income from remittances (6.7%), which means that, they rely upon off-farm income – 86.9%.

In terms of social networking, this type is fully satisfied with community activities, and there is one community leader in this type (11% of households). As a result, 78% of households in this type have a reliable informal source of borrowing within a community. We can only assume (since there is no data on absolute income values) that this type is better off than other two ones, based on its education status, social roles and income sources.

Livelihood type II: Farm-income-dependent, less educated, land-poor, poultry-turned farms

The agricultural livelihood type II represents 16% of the study sample. The main features of this group of farm-households are:

- Lack of higher education among members of the households (19%). This makes harder for this group to find high-paid jobs;
- Small amount of land plots: 0,17 ha per household or 0.03 ha per person. Reliance upon farming urges this type of farm-households to optimize their land use. As a result this type has the highest average yield of vegetables (68% of land use) among all types, which is 6.7 ton per ha. Consequently, this type of households sells some share of vegetables in local markets.
- Dependence upon farm activities (54% of total income) and remittances (16%) as income sources.
- This type has the highest rate of dependency (0.49).
- Households have more poultry (0.94) than livestock (0.54).
- This type is less socially active than other ones. However, few households in this group are not satisfied with how community decisions are made and executed.

Livelihood type III: Land-rich, poultry-turned, off-farm-income-dependent farms

This type III represents the majority of the study sample - 74%. The key indicators that distinguish this type of farm-households are the highest availability of the land and diversification of land use, rather high social activity.

Land holdings per household is 0.45 ha, or 0.09 ha per person in this type. Contrary to previous two types,

Table 5: Descriptive statistics of the agricultural livelihood types in Karauzyak. Key variables for which there are significant differences among types are highlighted in bold.

Livelihood asset	Farm type (Size)	Type 1: Educated, land-poor, livestock- and poultry-rich, off-farm-income-dependent farms **9**					Type 2: Farm-income-dependent, less educated, land-poor, poultry-turned farms **16**					Type 3: Land-rich, poultry-turned, off-farm-income-dependent farms **71**				
	Variable	**Mean**	**Std. Error**	**Std. Dev.**	**95% Conf. Interval**		**Mean**	**Std. Error**	**Std. Dev.**	**95% Conf. Interval**		**Mean**	**Std. Error**	**Std. Dev.**	**95% Conf. Interval**	
					Lower Bound	**Upper Bound**				**Lower Bound**	**Upper Bound**				**Lower Bound**	**Upper Bound**
Human	$H_{HEADAGE}$	49.22	3.64	10.91	40.84	57.61	49.31	2.68	10.70	43.61	55.01	49.37	1.31	11.07	46.75	51.99
	$H_{HEADEXP}$	26.11	3.51	10.52	18.03	34.20	26.38	2.24	8.96	21.60	31.15	23.04	1.49	12.59	20.06	26.02
	H_{NBEDUC}	**1.44**	0.53	1.59	0.22	2.67	**0.19**	0.14	0.54	-0.10	0.48	0.66	0.11	0.92	0.44	0.88
	H_{SIZE}	5.78	0.57	1.72	4.46	7.10	6.13	0.44	1.75	5.19	7.06	5.34	0.19	1.64	4.95	5.73
	H_{LABOUR}	3.78	0.57	1.72	2.46	5.10	3.56	0.45	1.79	2.61	4.52	3.13	0.16	1.36	2.80	3.45
	H_{DEPEND}	0.40	0.07	0.22	0.24	0.57	0.49	0.04	0.17	0.40	0.58	0.45	0.02	0.17	0.41	0.49
	$H_{NONAGROINC}$	**1.89**	0.31	0.93	1.18	2.60	1.44	0.29	1.15	0.82	2.05	1.52	0.12	1.00	1.28	1.76
	$H_{EXTSERV}$	0.44	0.18	0.53	0.04	0.85	0.56	0.13	0.51	0.29	0.84	0.54	0.06	0.50	0.42	0.65
Physical	$H_{DFMARKET}$	22.67	1.86	5.57	18.39	26.95	20.25	1.30	5.21	17.47	23.03	20.58	0.61	5.11	19.37	21.79
	$H_{DLMARKET}$	21.67	1.72	5.15	17.71	25.62	20.00	1.40	5.59	17.02	22.98	20.58	0.61	5.16	19.36	21.80
	H_{CAR}	**0.22**	0.15	0.44	-0.12	0.56	0.06	0.06	0.25	-0.07	0.20	0.11	0.04	0.32	0.04	0.19
	$H_{TRACTOR}$	0.11	0.11	0.33	-0.15	0.37	0.00	-	-	-	-	0.04	0.03	0.26	-0.02	0.10
	$H_{TRACTANIM}$	0.11	0.11	0.33	-0.15	0.37	0.13	0.09	0.34	-0.06	0.31	0.20	0.06	0.52	0.07	0.32
	$H_{GSFACILITY}$	0.00	-	-	-	-	0.13	0.09	0.34	-0.06	0.31	0.15	0.04	0.36	0.07	0.24
Natural	**$H_{HOLDINGS}$**	**0.06**	0.02	0.05	0.02	0.10	0.17	0.06	0.24	0.04	0.30	**0.45**	0.09	0.73	0.28	0.62
	$H_{CULTLANDCP}$	**0.01**	0.00	0.01	0.00	0.02	0.03	0.01	0.03	0.01	0.05	**0.09**	0.02	0.15	0.06	0.13
	$H_{SHCOTTON}$	0.00	-	-	-	-	0.00	-	-	-	-	0.00	-	-	-	-
	$H_{SHCEREAL}$	0.00	-	-	-	-	0.00	-	-	-	-	0.00	-	-	-	-
	$H_{SHMFCRP}$	**77.22**	14.60	43.81	43.55	110.90	68.14	10.49	41.97	45.78	90.51	**47.88**	5.07	42.70	37.77	57.98
	H_{LUCP}	**1.61**	0.51	1.53	0.43	2.79	0.54	0.15	0.59	0.22	0.86	0.54	0.09	0.75	0.36	0.72
	H_{LUHA}	142.40	19.41	58.23	97.64	187.17	21.44	6.25	25.01	8.12	34.77	12.59	1.86	15.67	8.88	16.30
	H_{PUCP}	**1.59**	0.55	1.65	0.33	2.86	**0.94**	0.30	1.18	0.31	1.57	1.02	0.14	1.19	0.74	1.30
Financial	**$H_{SHRFINC}$**	6.44	3.31	9.94	-1.20	14.08	**54.06**	6.94	27.76	39.27	68.86	**6.45**	1.21	10.18	4.04	8.86
	$H_{SHNOFFINC}$	86.89	5.79	17.38	73.53	100.25	29.69	5.01	20.04	19.01	40.37	**91.58**	1.50	12.64	88.59	94.57
	$H_{SHREMITINC}$	6.67	5.53	16.58	-6.08	19.41	**16.25**	7.58	30.30	0.10	32.40	1.97	1.07	9.04	-0.17	4.11
Social	$H_{LEADCOM}$	**0.11**	0.11	0.33	-0.15	0.37	0.00	-	-	-	-	0.03	0.02	0.17	-0.01	0.07
	H_{PUBORG}	0.00	-	-	-	-	0.00	-	-	-	-	**0.14**	0.04	0.35	0.06	0.22
	$H_{SATCSDM}$	**1.00**	-	-	-	-	1.13	0.09	0.34	0.94	1.31	1.13	0.04	0.38	1.04	1.22
	H_{ACSBRW}	**0.78**	0.15	0.44	0.44	1.12	0.63	0.13	0.50	0.36	0.89	0.69	0.06	0.47	0.58	0.80

Table 6: Primary land use and yield performance of identified ALSs (average per ALS)

Agricultural Livelihood System	Land use (ha) Vegetables	Crop yield (ton/ha) Vegetables
ALS 1: *Educated, land-poor, livestock- and poultry-rich, off-farm-income-oriented farms*	0.054	1.1
ALS 2: *Farm-income-dependent, less educated, land-poor, poultry-turned farms*	0.039	6.7
ALS 3: *Land-rich, poultry-turned, off-farm-income-dependent farms*	0.026	5.1

this type uses less than half of its land for cultivation of vegetables (47.9%). The other half of the land is used mainly for fodder crops, beans, watermelons and fruits. However, regardless of the available land, only 6.5% of total average household income comes from farm activities. Whereas, as in type I, off-farm activities generate 92.6% of total income - the highest share among all types. This sounds somewhat controversial, given land, livestock (0.54 per household) and poultry (1.02) availability in this type. Also, the type III uses land much more efficiently than type I: the average annual yield of vegetables is 5.1 ton per ha (vs. 1.1 ton/ha of type I). Based on income shares, we can assume that prevailing majority of products from farming activities are consumed within households and not marketed for income. Another feature of this type is its social activity: 14% of it participates in public organizations, with 3% that have community leaders.

CONCLUSION

Under the severe climate of cold winter and hot summer, the productivity of crop, livestock and fishery in Karakalpakstan are low. Reflecting such conditions, the level of livelihood in the area is also low and the area is considered to be one of the most depressed regions in the Republic of Uzbekistan. Gross Regional Production (GRP) of Karakalpakstan, where study area is located, in 2014 amounted to 3,632 billion UZS, which constituted ca. only 2.5% of the GDP of Uzbekistan. GRP per capita in 2014 in Karakalpakstan was 2,047 thousand UZS. Average monthly salary in 2014 hardly reached 211 thousand UZS (one of the lowest economic indicators in Uzbekistan).

Surveyed villages apply certain livelihood strategies prominent in rural areas of Uzbekistan and Karakalpakstan, including: (1) subsistence agriculture, (2) seasonal labor migration, (3) official jobs at state-funded or budget organizations, (4) some entrepreneurial (non-agricultural) activities. There are very few jobs available in the community. Most people are employed by farmers or do seasonal work at farms, cultivating cotton. Though, this activity doesn't generate much income: people get paid with cotton by-products, such as cotton stems.

According to the Land legislation dehqons may lease land of the maximum size of 0.12 ha for house buildings/dwellings and additional 0.12 ha for cultivating agricultural crops, which however depends on the availability of 'free' land in the given district or region. Households mainly use land plots as backyard kitchen gardens or a specified area within the main farmland of the farmers, and are free to choose their crops and sell at their own discretion. Most of the land owned by respondents is cultivated via surface irrigation.

Crops are vital for households to survive in rural areas. Since most of the households own small plots of land they usually cultivate food crops such as vegetables, watermelons, fruits and beans. Majority of the surveyed households cultivate food crops (vegetables, beans, fruits, etc.) for own consumption; cultivate fodder crops to feed their livestock, and limited amount of fruits and vegetables for sale.

With regards to livestock production the most widespread kind of livestock among respondents in Karauzyak district of Karakalpakstan is milk cows, since milk is a significant part of the daily nutrition of rural people. Non-milk cows are the second most popular animals and present at about half of households. Among small ruminants the most widespread are goats, especially she-goats. Sheep and rams are bred by few households and horses and mules are present at even fewer households. Because of subsistence type of agricultural production of the surveyed households, many of the surveyed households possess poultry. It is undeniable that men are key decision-makers regarding livestock production.

The principal component analysis revealed 8 factors that differentiate household-farm. Among them the most discriminating factors were related to land holdings, income shares, and experience in agriculture.

The cluster analysis resulted in three agricultural livelihood types for household-farms in the study site.

The agricultural livelihood type I (educated, land-poor, livestock- and poultry-rich, off-farm-income-oriented farms) comprises 10% of the study sample. As

the name suggests, this type of households is characterized by its adherence to off-farm activities (86.9% of total income) for income generation with more highly educated members. Land holdings per person are 0.01 ha. At the same time, this livelihood type is better endowed with livestock (1.61 per person) and poultry (1.59 per person) than other two types. However, they mostly use livestock and poultry for own consumption and not for marketing purposes to generate income. It can be assumed that the type I is better off than other two ones, given its education status level, social roles and income sources.

The agricultural livelihood type II (farm-income-dependent, less educated, land-poor, poultry-turned farms) represents 16% of the study sample. This type depends on farm activities (54% of total income) and remittances (16%) as income sources. Members of the most of the households (81%) don't have a university degree and this makes it harder to find high-paid jobs. This group is regarded as land-poor since land holdings per person are 0.03 ha. But, this type uses available cropland more efficiently than others: average yield of vegetables is the highest among all types, which is 6.7 ton per ha. And households in this type have more poultry (0.94 per person) than livestock (0.54).

The agricultural livelihood type III (land-rich, poultry-turned, off-farm-income-dependent farms) is dominant and represents the majority of the study sample – 74%. The key factors that distinguish this type of farm-households are ample land holdings (0.09 per person) and diversification of land use (cultivation of vegetables accounts for only 47.9% of total land use). However, large land holdings didn't convert into higher farm income: only 6.5% of total average household income accounts for farm activities. This sounds a bit dissonant, given rich land, livestock and poultry availability in this type. Considering income shares, it is assumed that prevailing majority of products from farming activities are consumed within households and not marketed for income.

According to the local government, Karauzyak district faces some problems including: availability and access to water, irrigation water; underdeveloped industry; lack of working places; population is passive in terms of seeking addition income sources, improving livelihood. In the view of local administration efforts of both national and international organizations should be geared towards solving these issues.

In contrast, opportunities for growth in household-farms appear to be limited by very small farm sizes. Leasehold of land in these household-farms means that increasing farm size through land purchase is impossible and, indeed, even informal land rental for these farms is said to be rare. Further, their use for subsistence and thus as safety nets encourages risk avoidance strategies through diverse cropping patterns. And while this means that household needs are usually covered, it also means that marketed surpluses are small and, as a result, cash earnings are limited.

It is apparent that actions aimed at rural economic growth will have agriculture at their core, but emphasis on the wider rural economic development will also be important since, worldwide, experience shows that agricultural growth alone is insufficient to raise rural income substantially. This is because agricultural earnings accrue mainly to those with access to the key factors of production (land and water) and because the linkages between agricultural growth and incomes in the rural sector as a whole are weak. As a result, addressing non-agricultural incomes and, hence, non-agricultural income sources is essential in rural growth.

ACKNOWLEDGEMENT

The study was undertaken in the framework of the CGIAR Research Program on Dryland Systems (CRP DS) Project "Establishing Innovation Platform for multi-stakeholder process on fostering and improving resilience of the agro-pastoral livelihood system".

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