A Quantitative Analysis of Poverty and Livelihood Profiles: The Case of Rural Rwanda

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Abstract

The paper applies a quantitative methodology to study poverty and livelihood profiles on the basis of a large set of variables. It takes the context of post-conflict rural Rwanda for a case study. By means of exploratory tools (i.e. principal component and cluster analysis), it combines variables that capture natural, physical, human, financial and social resources together with environmental factors to identify household groups with varying livelihoods. The paper further explores how these clusters differ with regards the incidence of poverty, livelihood strategies and their respective crop preferences. The paper concludes that Rwandan rural policies should adopt distinct and appropriate interventions for impoverished peasant groups, each having their own particular livelihood profiles.

Key words: Livelihoods, rural poverty, poverty reduction policy, cluster analysis, Central Africa, Rwanda.

0. Introduction

The overall image of Rwanda's post-war economic recovery is quite positive. After an initial post-war boom, average annual growth between 1996 and 2001 remained high at 8.56%. The actual translation of growth into poverty reduction, on the other hand, has been disappointing (Ansoms, 2005 and 2007), and has jeopardized Government hopes for a purely growth-led poverty reduction strategy. The Rwandan Government, however, aims for a pro-poor effect by, "looking for growth in the sector where the poor are located" (GoR, 2002). The first PRSP (Poverty Reduction Strategy Paper) document recognized the rural sector's crucial importance to Rwanda's economic future by presenting the agriculture and livestock sectors as "the primary engines of growth" (GoR, 2002:30). This ambition reappears in the new EDPRS (PRSP-2) policy which sees equitable growth, sustainable development and poverty reduction, with rural development as a key priority (GoR, 2007).

This is hardly surprising given that the primary sector employs almost 90% of Rwanda's active population and generates about 45% of its GDP. Moreover, rural poverty is more extensive and severe than that in urban areas. Based on a poverty line of 250 Rwf per adult equivalent per day (US$ 0.44 at nominal 2006 prices), 56.8% of the rural population are considered poor, of whom 36.8% are extremely poor (i.e. living below the food poverty line of less than 175 Rwf per adult equivalent per day, GoR, 2007).

However, the Rwandan 'poor' are not a homogeneous group nor is the problem of rural poverty a single problem that can be solved with a uniform package of policy measures. The contribution of this paper lies in the identification of different livelihood profiles for rural households in Rwanda. By means of analytic tools (e.g. principal component and cluster analysis), it combines variables that encompass natural, physical, human, financial and social resources in combination with

environmental factors to identify specific household groups or clusters with different livelihoods. The paper further explores how these clusters differ with regards to poverty incidence, livelihood strategies and their crop preferences. An understanding of the differences behind specific livelihood profiles, and the institutional constraints these groups face, is a prerequisite for effective rural policy implementation.

1. In search of a methodology to classify livelihood profiles

The livelihood approach finds its roots in a paper by Chambers and Conway (1992). They define **sustainable rural livelihoods** as, "the capabilities, assets (stores, resources, claims and access) and activities required for a means of living" (Chambers and Conway, 1991: 6). The approach has been taken up by many scholars as a framework for poverty and/or vulnerability analyses (Ellis, 2003; Bird and Shepherd, 2003; Bebbington, 1999; Moser, 1998 and Chambers, 1995). In addition, it has been transformed into a practical tool by and for development practitioners like UNDP, Oxfam, Care and DFID (Hoon et al., 1997; DFID, 2001 and Solesbury, 2003).

The livelihood approach has been innovative in several ways. First, the focus of analysis has shifted away from aggregate variables concentrating on approximations of overall well-being, often scaled down to income or consumption measures (De Haan and Zoomers, 2005). The framework also breaks with the tradition in rural development research to focus on natural resources as the crucial element in living conditions (Bebbington, 1999). Instead, the livelihood approach aims to capture the multiple interactions between peoples' resources and strategies which are dependent upon the social and institutional environment(s). In this paper, the combination of a household's resources and livelihood strategies will be referred to as the household's 'livelihood profile.'

Second, the livelihood approach accentuates the ability of social actors to play an active role in shaping their own livelihoods. It breaks with the rather pessimistic view of earlier micro-level (household) studies which often nurtured an image of 'the poor' as passive marginalized victims (De Haan and Zoomers, 2005). Bebbington sees peoples' assets, "not simply [as] resources that people use in building livelihoods; [they] give them the capability to be and to act" (Bebbington, 1999:2022). According to Moser (1998), "the poor are managers of complex asset portfolios." This idea also approximates Sen's notion of agency (1985) which he regards as central in valuing human life. The notion of agency is relevant in all social experiences, even in cases of extreme coercion. Agency determines and is determined by a person's access to strategic resources and is embodied in social relations, closely linked with power relations and shaped through institutional structures (Long, 2001).

Both characteristics of the approach bring us to a third attribute: the livelihood approach inserts a dynamic dimension into the analysis of well-being and poverty. Indeed, the multiple links and interactions between resources and strategies may evolve over time. De Haan and Zoomers (2005) have developed the idea of 'livelihood pathways' that situate patterns of livelihood assets and activities in the negotiation process between social actors. These pathways change over time in a non-uniform and non-predefined way, but their course is embedded within an institutional and social context.

These conceptual inputs clearly imply that 'the poor' cannot be defined as a homogeneous or rigid group; they are heterogeneous and dynamic; both in terms of material well-being and agency. Bastiaensen et al. refer to the poor as, "those human beings who, for one reason or another, almost systematically end up at the losing end of the multiple bargains that are struck around available resources and opportunities" (Bastiaensen et al., 2005:981). At the same time, there are different degrees of winning or losing that may account for different degrees of poverty. Certainly in populations where over half are classified as 'poor' according to aggregate well-being measures, it becomes crucial to look at the diversity hidden behind aggregate poverty figures and to link this with the diversity in livelihood profiles. Furthermore, one should consider and analyze how particular forms of poverty predetermine peoples' livelihood pathways.

Such analyses imply a high degree of complexity which is more often more present in in-depth qualitative research than in research based upon quantitative analysis. Traditionally, quantitative research on living conditions often used the tool of regression analysis in which a dependent variable (e.g. often income or consumption as proxies for overall well-being) is estimated, based on the value of one or more independent variables (i.e. different types of production factors, assets, and strategies). Such a methodology has the advantage of identifying the strength and significance of the relationship(s) between variables. On the other hand, it gives little insight into the heterogeneity of livelihood profiles in a large population.

Other empirical quantitative endeavors attempt to account for livelihood diversity by comparing different settings. Bouahom et al. (2004), for example, compare how nine different villages in Laos respond differently to the transition from subsistence farming to more diversified livelihoods. Moser (1998) enlarges her geographical scope to four urban settings spread over different continents, comparing the changes in asset portfolios (i.e. defined by labor, human capital, productive assets, household relations and social capital) over a longer time period characterized by deteriorating macroeconomic conditions. This case-study approach allows one to make interesting comparisons between settings. On the other hand, the external validity of the research is limited.

Alternatively, one may look at livelihood heterogeneity at the household level. The external validity of research findings may be assured by departing from a regionally or nationally representative survey to identify and compare the profiles of different household groups. A crucial question is, however, which variable(s) is (are) used to differentiate those groups.

Several research papers on livelihoods analysis use income as the discriminating variable. Highly acknowledged is Ellis' methodology which has been applied to several countries (e.g. Malawi, Tanzania, Uganda and Kenya). Various papers look further at the diversity in income-generating portfolios for different groups (Ellis et al., 2003; Ellis & Mdoe, 2003; Ellis & Bahiigwa, 2003 and Freeman et al., 2004). Bird & Shepherd (2003) link income groups to the likelihood of pursuing certain livelihood strategies (e.g. farming, off-farm activities, entrepreneurial activities, etc.- Bird & Shepherd, 2003: 602). McKay and Loveridge (2005), although not explicitly referring to livelihood literature, have done a similar exercise for the Rwandan case.

They compare the income strategies and nutritional status of different income groups between the early 1990s and 2000. Overall, the methodology used in these studies has the disadvantage that the differentiation between groups is still based upon one aggregate and one monodimensional proxy for overall well-being. Groups are defined based upon income categories, after which a combination of assets and strategies, relevant for a person's livelihood profile, are inserted into the analysis.

An alternative approach combines survey data with insights from participatory poverty assessments (PPAs) to identify criteria for establishing livelihood profiles (e.g. see Carter and May, 1999). It is not, however, a straightforward task to assign all the households included in a quantitative survey to one specific qualitatively-defined PPA category (and certainly not when the household in question combines several livelihood strategies). This is illustrated in a paper by Howe and McKay who, referring to the Rwandan case, recognize that, "distinctions between the groups [identified by a PPA exercise] are not always clear at the margin, given some similarity in certain characteristics across groups" (Howe & McKay, 2007: 203). They link survey material to the combined characteristics of the three poorest PPA categories (out of six) to identify the chronically-poor households' livelihood profiles.

A third alternative to identify household groups with heterogeneous livelihood profiles – and one that takes into account a wide variety of relevant variables - is to use cluster analysis (e.g. see Orr and Jere, 1999; Orr and Mwale, 2001; Jansen et al., 2006A; Jansen et al., 2006B and Petrovici and Gorton, 2005). This paper adopts a similar factor and cluster methodology to identify different livelihood profiles in rural Rwanda. The identification of population sub-groups (i.e. clusters) is based upon proxies for the different asset types identified by the livelihood framework, next to proxies for the regional context and aggregate well-being (section 3 of the paper). Further validation of the clusters is provided by illustrating how the identified clusters differ with regards to their poverty profiles (section 3), their income-generating livelihood strategies and their crop preferences (section 4). This leads into a discussion of policy implications with which the paper concludes.

2. The data

This paper combines data from several complementary sources. The (Rwandan) Household Living Conditions Survey (EICV) was executed between July 2000 and June 2001 and relied on a nationally-representative sample of 5280 rural households. The Food Security Research Project (FSRP)[i] gathered agricultural production and land use data over 3 years (i.e. between 2000 and 2002), each time for both seasons (season A: September – February, season B: March – August). This survey drew from a subsample of the EICV survey covering 1584 households.

For the principal component and cluster analysis done for this paper, we chose overlapping samples from EICV 2001 and FSRP 2001A representing 1433 cases. We use weights that reflect the probability of being sampled. Multivariate outliers are identified based on the Mahalanobis distance[ii] (critical value of 37.697; $p \leq 0.001$). Based upon this criterion, a total of 55 identified outliers are excluded. Further, the remaining sample contains 158 cases for which only incomplete information is available. They are also excluded leaving 1220 cases in the analysis. The combined EICV-FSRP sample is representative of the rural inhabitants of Rwanda.

Through the selection of variables, we have tried to identify those elements necessary to capture each type of the 5 capital types identified within the livelihood framework (i.e. natural, physical, human, social and financial capital), in addition to variables accounting for regional differences and aggregate incomes and expenditures.

Natural capital: Proxies for natural capital include cultivated land surface by household (FSRP 2001, season A), and owned and borrowed livestock measured in tropical livestock units (TLUs - FSRP 2001, season A).[iii]

Physical capital: Proxies for physical assets should include affordable transport, secure shelter and buildings, adequate water supplies and sanitation, clean and affordable energy, and availability of information (DFID, 2001). For the purpose of this analysis, an aggregate physical asset index was calculated as the sum of the household's scores (i.e. 0 = insufficient, 1 = OK, 2 = good) on six variables: availability of transport, availability of rooms per adult equivalent, quality of outside walls, quality of roof, and quality of sanitation and energy for lighting (EICV 2001).[iv] The range of the asset index lies between 0 and 12 and is normally distributed. Variables accounting for access to an adequate water supply and access to information were not included as no satisfactory proxies could be identified.

Human capital[v]: Proxies for human assets are the age of the household head, the gender of the household head, the number of adults aged between 14 and 60, and the maximum number of years of education the most educated household member has (EICV 2001).[vi]

Social capital: Social asset proxies include a variable for the number of household members participating in tontines (i.e. rotating savings and credit associations, EICV 2001)[vii] and in other economic associations (FSRP 2000, season A).[viii]

Financial capital: Turning to financial assets, there are two variables that could serve as proxies - having savings and having access to credit. The "participation in tontines" variable is an imperfect proxy for both. Other variables accounting for the household's savings or loans were not included in the analysis as they are highly dependent upon the timing of the interview. Moreover, the rationale behind having debts might differ: some households may use these loans to invest in a productive activity whereas others may need credit primarily to survive.

Regional context: In addition to the asset variables, four variables are included as proxies accounting for the regional context. "Remoteness" is measured at cellule level and is defined as the approximate physical distance to the nearest registered road (i.e. either a district road or a national sand or asphalted road). "Public service proximity" is also measured at the cellule level, calculated as the sum of the Z scores of 3 variables accounting for the physical distances to the nearest market, school and health center. Further, the analysis includes the average provincial cost of living index based on prices from July 2000 until June 2001,[ix] and an index accounting for the average soil quality at the cellule level. This soil quality indicator, developed at the Laboratory of Soil Science, Ghent University, is based on the soil profile database and soil map of Rwanda at a scale of 1:50.000 (Imerzoukene and Van Ranst 2001). It captures the characteristics of physical and chemical soil fertility and offers a record of soil quality for crop production.[x]

Aggregate variables: Like Petrovici and Gorton (2005), we too include both income and expenditure variables on a per capita basis.[xi] Incomes are generally lower than expenditures, meaning that a lot of 'true' income is not captured within the survey. This phenomenon is not uncommon in survey data (Deaton, 1997).

3. Identifying livelihood clusters based upon asset portfolios

The tool of principal component analysis allows one to create a new set of variables (i.e. principal component scores) which capture the character of the original variables in a simplified way by reducing the number of variables (as the original variables can be replaced by component scores). This method of substitution also solves the problem of high correlations between the original variables (Hair et al., 1998) which may distort further analysis.

Our sample size (1220 cases) is sufficiently large in terms of cases-per-variable ratio: the availability of over 80 cases per variable exceeds the most stringent minimum of 20-to-1 cases-per-variable (Hair et al., 1998). Principal component analysis further assumes the presence of a certain degree of interrelation between the variables considered. This is confirmed by Bartlett's test of sphericity which identifies the correlation matrix as being significantly different from the identity matrix (696741.5; df = 105; $p<0.001$). Further, the Kaiser-Meyer-Olkin measure of sampling adequacy (0.649) confirms the appropriateness of principal component analysis.

Using the latent root criterion that rejects all components with a value less than 1, we consider a 6-component solution. This solution accounts for 61.2% of the variance in the data set which is acceptable for the social sciences (Hair et al., 1998). Moreover, for the 6-component solution, the communalities of all but one variable surpass the 0.5 level. Therefore, a large part of the variation in the variables is explained: from 48% for the association index up to 80% for the expenditure variable.

An orthogonal VARIMAX rotation is applied to this solution in order to simplify the interpretation of the component matrix. To identify the significant dimensions of each component, all variables with loadings of at least 0.30 in the principal component solution are taken into consideration (Hair et al., 1998). Two variables load on multiple principal components, but this does not complicate the interpretation of the 6-component solution (see Table 1).

INSERT TABLE 1 HERE

The first component can be regarded as the "household's aggregate resources," reporting high positive loadings for both the income and expense variables together with the physical capital index. This principal component is moderately influenced by the education variable (loading positively). The second component is largely influenced by variables that measure different dimensions of "human capital," with significant high positive loadings for the number of adults and the maximum education of the most educated household member. Further, this component's scores are positively influenced if the household head is male. The third component accounts for "natural resources." Households with high scores on this principal component have a relatively large area of cultivated land and considerable livestock holdings by Rwandan standards. The component is positively associated with the age of the household head and is further moderately influenced by the adult working force variable. The fourth component accounts for "quality of location." The regional living cost index (high value = high living cost index) loads positively and the soil quality index (high value = high soil quality) loads negatively on this component. The fifth

component measures the "centrality of location" with high loadings for the remoteness index (high value = very remote) and the public service proximity index (high value = very remote). The final component may be called the "association component" as it has high loadings for both "participation in tontines" and "participation in associations."

The principal component scores accounting for various asset dimensions can be used as input variables in the cluster analysis. This offers the advantage of including fewer variables that are, moreover, mutually independent (guaranteed by the orthogonal varimax rotation). As such, the problem of multi-collinearity that could distort the cluster analysis is avoided (Hair et al. 1998). Moreover, this procedure reduces the problem of arbitrary scale effects by preventing directly-measured variables being inserted into the cluster analysis (Jansen et al., 2006A).

Cluster analysis allows identifying different household groups, characterized by maximum intra-group homogeneity and inter-group heterogeneity. We use the methodology advocated by Punj and Steward (1983) for marketing research, applied by Petrovici and Gorton (2005) and by Jansen et al. (2006A, 2006B) for quantitative livelihood research. In a first step, Ward's (hierarchical) clustering method, based on squared Euclidean distances, is used (Aldenderfer and Balshfield, 1984). The dendrogram derived from this algorithm permits the use of visual examination to determine the optimal number of clusters. For our analysis, the seven cluster solution provides the optimal balance between parsimony and homogeneity. In a second step, the data are clustered through a K-means iterative partitioning analysis (Aldenderfer and Balshfield, 1984; Everitt, 2001). A cross-tabulation between the results of the hierarchical and the iterative clustering methods indicates that 24% of all cases (294 out of 1220 cases) have been reassigned to another cluster with the K-means procedure. The final seven-cluster solution is presented in Table 2.

Households (HHs) in **Cluster 1** are **"rural entrepreneurs"** and are doing very well in terms of income and consumption. Mean expenses lie far above the 2001 poverty line of 64,000 Rwf per adult equivalent per year (2001 prices). Households in this category are generally small in size and are headed by a younger male household head. They have at least one well-educated member (almost 6 years of education on average). Further, the land availability of this cluster lies close to the overall sample mean. Given their small household sizes, these households are quite well equipped with natural resources in adult equivalent (ae) terms (both in terms of land and livestock). In addition, rural entrepreneurs score extremely well in terms of physical capital (i.e. quality of housing and sanitation, availability of transport and energy). Access to this type of capital may be an important underlying condition to engage in on-farm and off-farm remunerative livelihood strategies besides subsistence farming. Rural entrepreneurs generally live in areas with average living costs and soil fertility. They reside in less remote areas which may be an advantage in their entrepreneurial undertakings.

Households of clusters 2 and 3 are found in the middle range according to aggregate income and consumption measures. **Cluster 2** is the **"association type";** all households in this cluster have at least one member who participates in a tontine and/or an association (31% participate in both types of collective action). Further, cluster 2 households are, on average, headed by a younger person. While the

household average in this cluster of land available for cultivation is lower than the total sample average, cluster 2 households, by Rwandan standards, still raise considerable livestock. With average expenditures still above the overall poverty line of 64,000 Rwf per adult equivalent, the investment in social capital by associating with others seems to be correlated with somewhat better living standards. From the analysis, however, we cannot deduce the direction of the causality between the two variables.

Cluster 3 can be considered relatively **"resource-rich"** in terms of natural resources**.** Households of this cluster cultivate larger plots of land than the average (although one should take into account the high standard deviation for this variable). Nonetheless, they are still small to medium-scale farmers. Though the average farm (1.62 hectares) is very large when compared to the sample mean, it is not when compared with the landholdings of large Rwandan cattle farms or private rural entrepreneurs (who are not included in this sample). When considering available land in adult equivalent terms, cluster households are relatively well accommodated. Households of this cluster, generally headed by an older adult male include, on average, 4.17 adults. This suggests that these are nuclear households that consist of several sub-units; or young adults who will soon leave to start their own family(s). When young male adults leave, this may involve a division of land. At this stage though, the larger surface of cultivated land allows them to raise more livestock in comparison with other clusters (also in adult equivalent terms). Households of this cluster are, on average, well equipped in terms of physical capital (e.g. quality of housing and sanitation, availability of transport and energy, etc.), and they often have at least one member with a high level of education. Over one-third participate in either a tontine and/or an association. In terms of income and/or consumption, these households are still among the better-off in comparison with the next four clusters, although average expenses fall below the poverty line of 64,000 Rwf.

The characteristics of the natural resource-rich cluster (#3) contrast strongly with those of the next two clusters. **Cluster 4**, the largest in the overall sample, can be typified as comprising households that are **"resource-poor in fertile regions."** Mean soil fertility is the highest of all clusters. In addition, these households are, on average, located somewhat closer to public services and reside in provinces with low average living costs compared to other clusters. On the other hand, cluster 4 households are extremely resource-poor in terms of landholdings and have, on average, very limited livestock holdings. The average availability of natural resources, in per capita terms, is the lowest of all clusters. Also interesting is that households of this cluster are nearly always male-headed and are the least inclined to participate in any form of group or association. Their lower than average incomes and expenditures indicate that these households endure difficult living conditions.

Cluster 5 is referred to as **"resource-poor/centrally-located."** In line with the preceding cluster, the average land and livestock holdings of these households are extremely limited. But in contrast with cluster 4, average soil quality is the lowest of all clusters. This suggests that the "centrally-located" often depend upon other activities for income generation (see Section 4). Over 30% of those in this cluster attend associations and/or tontines. Engagement in off-farm activities may be facilitated by the fact that these households live most frequently in less remote areas closer to public services than households of other clusters. On the other hand, their

central location does not seem to pay off in terms of overall living conditions as the aggregate incomes and expenditures of this cluster are low.

The resource constraint is not the most problematic aspect for **cluster 6** households. In terms of land, livestock (per adult equivalent) and soil fertility, the cluster average is comparable to the overall sample average. However, households of this cluster live in **"isolated"** regions: very remote areas, far from the nearest road (nearly twice as far as the average household included in the sample) and extremely far from public services. Their relative isolation clearly is an important institutional constraint: average expenditures are considerably below the national poverty line of 64,000 Rwf. In addition, "isolated" households are the least equipped in terms of physical capital (low mean physical capital index). They are also quite deprived in terms of educated human capital (i.e. maximum years of education are the second lowest of all clusters).

Cluster 7 is the **"female-headed"** group, in most cases headed by older women. The human resources of this cluster are very limited. The average labor force (number of adults) present in the household and the maximum education of the household members is the lowest of all clusters. The average of land available for cultivation in the cluster is lower than the sample average. In terms of livestock, female-headed households are seriously deprived. The gender aspect, specific for this cluster, seems to be an important institutional constraint in creating favorable living conditions. It is beyond the scope of our analysis to identify which gender-related constraints these households confront. But in general, they relate to limitations in access to land (no customary land rights), access to large livestock (traditionally a man's affair), access to markets (too much time spent on subsistence production and on managing the household, often no other adults available to divide tasks), access to the physical labor force (households generally have few adult members), access to remunerative jobs on the labor market, etc. (see Newbury and Baldwin, 2000). The mean income and expenditures of a household in this cluster are among the lowest of all clusters; however, standard deviations are high.

INSERT TABLE 2 HERE

The seven clusters have now been ranked from the least to the most poor, based on the percentage of households living below the absolute and relative poverty lines. Two consumption poverty lines have been defined to measure absolute poverty. A food poverty line of 45,000 Rwf (in 2001 prices) per adult equivalent per year represents the cost of a basket of food securing the minimum necessary caloric intake (2500 kcal per adult equivalent per day). A second absolute line of 64,000 Rwf represents the minimum requirements of food and non-food consumption (GoR 2002). Relative poverty lines, on the other hand, are generally defined as a fraction of a central tendency in society, for example, the median or mean of the society's income/consumption distribution (Muller, 2006). We apply the same cut-off points as Petrovici and Gorton, one at 30% and one at 50% of mean per capita expenditure (Petrovici and Gorton, 2005).[xii]

The Chi-square tests confirm that the difference between the clusters in terms of poverty incidence is significant for all absolute and relative poverty lines (see Table 3). The poverty problem is least prominent among "rural entrepreneurs" (# 1) as nearly all these households fall in the non-poor group. The two other relatively better-

off clusters, the "association" (# 2) and "natural resource-rich" (# 3) households, have significant numbers of extreme poor (over 30%) and poor (over 25%) when considering the absolute poverty line. On the other hand, when turning to the relative poverty line (taking mean consumption as a standard), over 70% of these households fall in the non-poor category. For the remaining clusters, more than 70% have living standards below the absolute poverty line. Most problematic is the situation for the "female-headed" cluster (i.e. #7), of which over half live below the absolute food poverty line and can be categorized as the 'extreme poor.'

INSERT TABLE 3 HERE

A similar picture appears when comparing clusters in terms of material wealth, assessed through ownership (or the lack) of seven different objects (see Table 4). "Rural entrepreneurs" (# 1) have the highest chance of owning each of these objects. Households in the relatively better-off "association" and "natural resource-rich" categories also figure among the better-off clusters. Interestingly, cluster 3 households (resource-rich) have a higher chance of owning these objects than those of cluster 2 (association). Among the poor clusters, the "resource-poor/centrally-located" (# 5) are still relatively well equipped (e.g. look at the relatively high percentage owning a radio). In comparison, cluster 4 and 6 households ("resource-poor in fertile regions" and "isolated" respectively) own, on average, fewer of the seven listed assets. The situation is, however, most problematic for the "female-headed" (# 7) households which on average own very few of the listed assets.

INSERT TABLE 4 HERE

4. Linking assets to livelihood strategies

To examine the predictive validity of the cluster solution, we look at cluster differences with regards to additional variables not included in the previous analysis. We opt for variables capturing households' access to particular livelihood strategies. Livelihood strategies are the activities/actions to which households have access in shaping their livelihoods. Whether or not a household has access to (or is locked into) certain strategies is dependent upon the assets they possess and is influenced by the institutional environment around them. In other words, "rural households design livelihood strategies to suit their asset endowments and account for the constraints imposed by market failures, state failures, social norms, and exposure to uninsured risk" (World Bank 2007: 72). In turn, livelihood strategies determine the household's capability of acquiring certain assets.

4.1 Agricultural activities

Table 5 illustrates that all clusters depend, to a great extent, upon agricultural production. When considering the market-orientation of households in their on-farm activities, we find that nearly all households in the sample rely, to a considerable extent, upon subsistence food production, regardless of which cluster they fall into. The main cultivation strategy is multicropping – practiced on more than half of all lands. Rwandan peasants generally like to combine different crop types (between 7 and 8 on average) on their property(s).

The six main food crops are: beans (cultivated by 96% of all households); bananas (80-84%[xiii] of all households); sweet potatoes (76-87% of all households); maize (72-76% of all households); cassava (62-65% of all households) and sorghum (56-62% of all households) – see Tables 6a and 6b. Some of these crops are marketable (e.g. bananas, sorghum, and cassava and maize in some regions). However, the preferred strategy of Rwandan farmers, regardless of which cluster they fall into, is to produce for their own needs (i.e. self-sufficiency) before directing 'surplus' production to the market. So while at least two-thirds of the households in all clusters engage in agricultural trade, the relative importance of this trade is at most one-third of the monetary value of total agricultural production (based upon means).

This is not a matter of a blind preference for subsistence agriculture, but rather the result of constraints peasants face when focusing on agricultural production solely for trade. This is confirmed by qualitative field work undertaken by the author in 2007. Firstly, producing a few specific crops for the market, even with excellent soils, entails considerable risk for small-scale peasants. Lacking safety nets or cash reserves, farmers are obliged to diversify their risks as much as possible, given the many challenges they face. One of their strategies is to diversify the crop types they cultivate. Secondly, small-scale peasants have very limited bargaining power on the market to negotiate a good price for their crops. Market price fluctuations and regional price differences increase the unpredictability of profits when investing in a market-oriented crop type (Ansoms, 2009). Indeed, Table 5 shows that there is a large difference between median and mean monetary income from agricultural sales which indicates large intra-cluster variations (cf. a large standard deviation).

INSERT TABLE 5, 6a and 6b HERE

Let us now consider the differences between individual clusters' agricultural activities. Although resource-rich peasants, on average, possess more than twice as much land as rural entrepreneurs, they produce less (in terms of monetary value). This may be due to measurement error (i.e. measurement of crop sales is more accurate than measurement of subsistence production). But it is more likely linked to the way in which their lands are used. The resource-rich use one fifth of their land (median value) for alternative purposes with low (direct) monetary value (e.g. fallow land, forest land, grassland, housing, etc.). This is much more than any other cluster. Rural entrepreneurs, on the other hand, have less fallow land. This cluster is the most active in agricultural production for sale (over 90% of all households) and also generates the highest incomes in comparison with others. Nearly all cluster 1 households grow and sell bananas for which they use nearly one fifth of their land (median value).

All together, rural entrepreneurs and the natural resource-rich are much more active in agricultural trade (91% and 79% respectively) and generate much higher profits from it than all other clusters (see Table 5). It is surprising, for example, that the association households of cluster 2 trade less often (69% of all households) and generate much lower incomes in comparison with clusters 1 and 3, despite the facilitating role an association's structure could play in such exchanges. Other particularities of the association cluster are that these households have a more than a median preference for pulses and cereals, and prefer – more than other clusters – the

monocropping system. They may be due to the frequent adoption of monocropping by associations in joint cultivation activities (Ansoms, 2009).

Resource-poor clusters 4 (in fertile regions) and 5 (in central regions) still have a considerable percentage of households engaged in agricultural trade (more than two thirds). Nonetheless, their incomes are much lower than those of the first three clusters. This, of course, is related to the land scarcity and the very low surpluses remaining for the market. Cluster 4 households engage more than the median in crop types that require good soils, for example: maize (between 83% and 86% of all households covering nearly 8% of their land) and potatoes (nearly 50% of all households covering 7 to 13% of their land).

This stands in strong contrast to the households of cluster 5, more centrally located but in regions with the lowest average soil quality of all. These households concentrate more than the median on resilient crop types that still grow in relatively poor soil (e.g. cassava, sweet potatoes and sorghum). Furthermore, cluster 5 households have the strongest preference of all for multicropping, another strategy that helps them deal with poor and/or infertile soils. In addition, land scarcity discourages the practice of leaving land fallow for a time (less than half of all households keep fallow land). As a result, available arable land risks further degrading.

Turning to cluster 6, relative isolation does not seem to inhibit agricultural sales; over 70% are involved in this activity. On the other hand, remoteness may affect the bargaining position of these households: the monetary value of their agricultural trade is extremely limited. Households in this cluster devote less land than the median to pulses. Beans, for example, only cover 14-15% of available land, which is much lower than that for other clusters (excluding cluster 3). Instead, households of cluster 6 concentrate (more than median) on sorghum (between 62 and 66% of all households), cassava (72% of all households), sweet potatoes (between 86 and 94% of all households) and bananas (between 86 and 88% of all households). Clear explanations for these crop choices are not straightforward.

Finally cluster 7, with “female-headed” households, has the lowest overall monetary value of agricultural production (including subsistence production) of all the clusters examined. Moreover, they seem to have more difficulty than others from engaging in agricultural trade: although almost two-thirds occasionally trade (the income generated is among the lowest of all clusters). Though female-headed households tend to produce fewer crop types than average, their crop choices and preference for multicropping are in line with the overall sample mean.

Turning to another aspect of agricultural trade, the percentage of households extracting an income from their livestock is highest for the “natural resource-rich” (50.4%), the “rural entrepreneurs” (36.9%) and the “association” clusters (30.6%). Net income from livestock breeding is limited and even negative for a considerable group of households (see Table 5). This may seem surprising given that the proportion of households keeping some livestock (at least half of the households in all clusters) is much larger.

In fact, livestock is kept not so much as an income-generating activity, but rather as a buffer for self-insurance and as a source of manure for the land. The type of livestock most preferred is different for each cluster (see Table 7). In general, goats are most popular with one third of all households raising one or more; however, between clusters differences are considerable. Other small livestock like pigs (13% of all households) and sheep (12% of all households) are less prominent in the rural setting – much depends upon regional preferences. One fifth of all households raise large livestock. Here the differences between clusters are great. Though more than 60% of those in the resource-rich cluster own a cow, no more than 30% of those in other clusters do so (and only 9% of households in the female-headed cluster). Keeping chickens is a much more modest and popular form of raising animals: over 30% of all households do this (the proportion of female-headed households doing this is much lower).

INSERT TABLE 7

4.2 Off-farm activities

Looking at the data from off-farm activities allows us to distinguish between self-employment, non-agricultural skilled and unskilled jobs and agricultural wage labor. Indeed, these categories are still quite broad: non-agricultural skilled labor may, for example, include jobs in the formal sector with high salaries but also the work of skilled plumbers and carpenters. Agricultural employment may include both fixed employment for NGOs and very low-paid occasional employment on other peasants' lands. All this cannot be captured with the data from the available aggregate categories here. Nonetheless, Table 5 illustrates that there are clear differences between aggregate employment categories.

"Rural entrepreneurs" (cluster 1) are most active in off-farm activities: nearly half generate revenue beyond their farms. If engaged in the off-farm sector, entrepreneurs generally undertake activities in the non-agricultural sector (22.6% generate a non-agricultural revenue) or set up their own enterprises (22.1%). They are much less active in the agricultural (wage) labor force than most other clusters. The association cluster (# 2) has more than 37% of its households involved in off-farm activities. When engaged in the off-farm sector, most of them work either in their own off-farm enterprises (almost one-fifth of all association households are self-employed) or as agricultural laborers (14.4% are engaged in this type of work).

Other clusters relatively active in off-farm activities are the two resource-poor clusters: 33.3% for the centrally-located (# 5) and 30% for those in fertile regions (# 4). As with the association cluster, households of these clusters are mostly active in the agricultural labor force and/or in their own off-farm enterprises. But the centrally-located households also engage quite regularly in unskilled off-farm activities. Indeed, these households have the advantage of their central location which brings considerable off-farm income-generating opportunities within reach.

For all other clusters, far fewer than 30% engage in off-farm activities. Only one-quarter of the "natural resource-rich" cluster (# 3), for example, engage in off-farm activities. It seems strange (anachronistic) that the potentially large adult labor force of these households does not allow for more intra(inter)-household labor

specialization and expansion beyond agricultural activities. On the other hand, the relatively abundant availability of land allows these households to concentrate on agricultural production for subsistence and trade on local markets. If active outside their own farm(s), household members of cluster 3 mostly engage in off-farm self-employment.

The two remaining clusters (i.e. # 6 "isolated" and # 7 "female-headed"), if active at all off their farms, most often turn to the off-farm unskilled labor market, particularly for agricultural jobs. For the "isolated" households, income from wage labor is the lowest of all clusters. Indeed, remoteness seems to be an important institutional constraint for these households on the wage labor market. Engagement in off-farm self-employment is a more remunerative activity for this cluster. Households of the "female-headed" cluster are the least active off their farms. Less than one in five is involved in off-farm activities, and the revenue generated only accounts for a small percentage of overall income.

Differences between wages for different types of jobs are considerable. In general, the mean and median non-agricultural wage rate is significantly higher than the wage rate for agricultural employment (except for cluster 7 with "female-headed" households; but the percentage of households involved in non-agricultural jobs is extremely small). Next to agricultural and non-agricultural labor earnings, EICV data allows calculation of the earnings rate for rural households involved in their own off-farm enterprises. For the total sample, both the mean and median of the non-agricultural wage rate are somewhat below 80% of pay per hour generated in own off-farm enterprises. The agricultural wage rate is only a fraction of what can be earned as an independent off-farm entrepreneur or by working in the non-agricultural labor force.

Next to wage rate differences for different jobs, inter-cluster wage differences are also interesting to compare, even though the means and medians may differ significantly and the standard deviations are high. Inter-cluster differences are the highest for off-farm self-employment and non-agricultural jobs. However, intra-cluster variations are also high for these activities. Wages differences between clusters for agricultural jobs – certainly when considering the median wages – are somewhat smaller.

The average hourly wage is highest for the "rural entrepreneurs" (# 1). It is also significant for the "natural resource-rich" (# 3) and the "resource-poor/ centrally-located" (# 5). Indeed, centrally-located households are better able to capitalize on their location to negotiate a higher pay rate for all activities than can households in other poorer clusters (i.e. clusters 4, 6 and 7). The "resource-poor in fertile regions" (# 4) earn considerably less per hour. The "isolated" cluster (# 6) is also confronted with a bargaining constraint related to their isolation and more limited mobility, which result in low market wage rates. However, those active in off-farm employment can earn well. The agricultural wage rates of the "female-headed" cluster (i.e. # 7) lie close to the sample mean, however, they receive the lowest hourly pay rate in non-agricultural jobs. Indeed, very few households of cluster 7 engage in this activity as it is typically done by adult males.

5. Policy implications and conclusions

The principal aim of this paper has been to identify different livelihood profiles in the Rwandan rural context by means of principal component and cluster analysis. Next to contextual factors, the principal component analysis identified six relevant dimensions related to asset categories in livelihoods analysis (i.e. aggregate wealth, human resources, natural resources, quality of location, and centrality of location and association networks). These components were used as inputs for a cluster analysis which identified seven household groups. These groups or clusters were validated by examining differences in poverty profiles, livelihood strategies and crop preferences. An overview summarizing the key elements of each cluster's profile is presented in Table 8. From this analysis, we can now formulate rural anti-poverty policies appropriate for households' different livelihood profiles and pathways.

INSERT TABLE 8 HERE

The cluster of "rural entrepreneurs" (**cluster 1**) is doing well in terms of income and consumption. This cluster proves that it is possible to live well in the country without sizable arable landholdings. Average cluster landholdings (0.72 hectares) are almost equal to the sample mean (although we should note that these households do better than the sample average in adult equivalent terms). There is, however, a crucial factor to explain the success of this cluster: access to alternative livelihood strategies, particularly in the non-agricultural setting, and engagement in one's own off-farm enterprises. In addition, households in this cluster earn the highest hourly wages of all clusters. This is most likely linked to their educational capital. Policy makers could draw lessons from the relatively comfortable situation of this cluster by investing in education and in strategies that enhance demand for off-farm employment. A more in-depth study of the successful strategies of this cluster could provide additional insights into how poverty traps can be overcome.

We can also draw policy lessons from the livelihood profile of the "association" **cluster 2**. Association links provide households with modest access to credit and insurance. This seems to pay off somewhat in terms of overall income and consumption which are the second highest of all clusters. Many associations (even when involved in other activities) function as a kind of saving and credit mechanism supported by member contributions. Having access to a financial safety net apparently is important. In spite of these more positive elements, the analysis also highlighted that the average consumption of cluster 2 still lies below the poverty line of 64,000 Rwf. The monetary value of aggregate cluster agricultural production is less impressive (e.g. than cluster 1 households). Therefore, there are important challenges for policy makers. The livelihoods of cluster 2 households could improve further with policy measures that provide a lever to the initiatives taken by the associations themselves. Policies could, for example, give financial and technical assistance to associations to encourage the adoption of new agricultural techniques offering high returns and for the development of off-farm entrepreneurial activities.

Policies targeting the relatively "natural resource-rich" **cluster 3** should focus on incentives to increase (household) market production. This should not be done by coercion; on the contrary, it is crucial for policy makers to analyze in detail why these relatively land-abundant households do not produce more for the market. Improving their positions in price negotiations may promote a more entrepreneurial spirit among farmers. This may be achieved by encouraging them to form cooperatives within

which they are active agents and not passive price-takers. Further, as market-oriented production often entails higher risks (in comparison to diversified subsistence-oriented production), better access to insurance and credit facilities may be appropriate. Another issue for policy makers to address is the fate of young adults in these households. The relative land-abundance of households in this cluster can quickly be lost when holdings are divided between several newly-formed families. Orienting these young adults towards other sectors would allow for the survival of relatively larger farms with a lot of potential.

The "resource-poor in fertile regions" of cluster 4 are highly deprived in terms of land and livestock. Given the limited natural resource base of rural Rwanda, it seems unrealistic for policy makers to improve access to land. However, anti-poverty interventions could focus on improving access to off-farm employment, and, particularly for this cluster, the potential of off-farm small-scale enterprises, possibly through collective action. These households have the potential, given their considerable educational capital. However, only 10% of this cluster participates in some form of association; even though such associations could facilitate access to start-up credit and networks offering them outlets for their products and services. Policies could encourage membership in such associations and improve opportunities for those from resource-poor households to find employment outside agriculture.

Cluster 5 households, the "resource-poor/centrally located," are also characterized by very limited access to natural resources (e.g. land and livestock) and extremely-low soil quality. Therefore, the same types of policies described earlier are even more relevant for this cluster: enhance incentives to start their own enterprises and/or engage in off-farm employment. Indeed, access to soil improvement techniques (e.g. manure, fertilizer, etc.) could improve agricultural output. But, nonetheless, these households will need to find income-generating opportunities outside the agricultural sector. Their central location could help these households to participate in entrepreneurial networks and find nearby outlets for their products and services.

Isolation is the most important constraint facing **cluster 6** households. Improved road infrastructure could improve household access to agricultural markets, both for inputs and outputs; and could result in a more market-oriented production mode. Moreover, better linkages to the trade chain could improve the bargaining capacity of this cluster on local markets. In addition, better integration into the local infrastructure should facilitate the search by isolated households for off-farm jobs. Improved quality and availability of public services (i.e. schools and health centers) could further upgrade overall living conditions.

Finally, policies targeting "female-headed" **cluster 7** households (i.e. in addition to those germane proposals raised above) should focus on specific gender-related constraints. These households have a limited adult labor force and an extremely low educational stock. Moreover, traditional roles constrain these households' access to land and paid off-farm activities. Collective action may improve their bargaining positions (e.g. in the local community, on agricultural markets and in off-farm sectors).

The main challenge for rural policies vis à-vis **all clusters** will be to reduce the extremely-high dependence of rural households on subsistence food production.

Given the severe constraints imposed by natural resource shortages, several development paths should be concurrently pursued. One path may be to concentrate on enhancing incentives for rural households to adopt improved agricultural techniques with high(er) rates of return. Next to a direct effect on living conditions, the benefits of higher (anticipated) agricultural growth could trickle down to other sectors. Rural policy makers should be careful, however, to preserve their current convictions (e.g. that land concentration, monocropping and crop specialization are more productive practices than scattered, small-scale production characterized by diverse crop choices and by multicropping). Farmers make crop choices in an active and deliberate way, in line with the climatic conditions of their region, but also in line with the socio-economic conditions they face (see different crop preferences for different clusters). The exact explanations behind these crop choices are often very complex and case-specific. It is therefore difficult to conclude to one single set of policy guidelines (e.g. on which crops to concentrate), even if differentiated per cluster or region. It is important, therefore, that crop choices, new cultivation methods and additional (potentially profitable but risk-prone techniques are not imposed upon the farmers. On the contrary, improved access to credit and insurance could encourage rural households by reducing their risk levels. Finally, policies that strive for equitable agricultural growth should target small- rather than large-scale production modes and should consider seriously the diverse needs of small scale producers.

Another range of policies must concentrate on enhancing the potential of off-farm labor markets and small-scale entrepreneurial businesses to absorb labor surpluses. On the demand side, this may be achieved either in the public sector (e.g. through labor-intensive works) or on the local-level in the private sector. If a considerable body of small-scale peasants can profit from broad-based growth within the agricultural sector (see path 1 above), then their increased earnings may be spent or invested in other sectors. As such, the benefits of agricultural growth may trickle-down and reach wage laborers active in off-farm activities. On the supply side, investment in training and education could upgrade the skills of wage laborers and increase their bargaining power in wage negotiations. Self-employment may be stimulated by providing access to credit and insurance at the most basic level. Credit initiatives should not only reach those who possess collateral, but also those less ‘promising’ rural actors who may have unexplored potential. The risks of investing in such facilities make public sector involvement indispensable.

Overall, we can conclude that policy makers should first identify the institutional access gates and/or barriers for divergent impoverished rural groups (and for the rural population as a whole). They should then analyze how specific policies are or will impact these gates and barriers. Rural policies should aim for a maximum pro-poor effect which, as this paper illustrates, means fighting poverty with unique and appropriate interventions targeted at diverse groups of impoverished Rwandan peasants.

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Table 1: Rotated component matrix

Variable:	Com.	1	2	3	4	5	6
Cultivated land	0.51	0.17	0.09	**0.66**	0.14	0.11	0.07
Livestock owned or borrowed	0.50	0.23	0.21	**0.57**	0.12	0.09	0.24
Age of household head	0.61	-0.13	-0.21	**0.71**	-0.08	-0.12	-0.14
Gender of household head	0.60	0.03	**0.77**	-0.06	-0.04	-0.02	0.05
Adult work force (14-60 yrs.)	0.66	-0.26	**0.64**	***0.40***	0.01	-0.11	0.12
Maximum years of education	0.64	***0.32***	**0.73**	-0.03	0.06	-0.03	0.03
Participation in tontines?	0.71	0.05	0.02	0.06	-0.20	0.01	**0.81**
Participation in associations?	0.48	0.02	0.11	0.01	0.26	-0.09	**0.63**
Public service proximity	0.60	-0.03	0.03	0.00	0.03	**0.76**	-0.15
Remoteness index	0.62	-0.09	-0.11	0.05	-0.03	**0.77**	0.08
Regional living cost index	0.67	-0.06	0.07	0.23	**0.76**	0.08	-0.13
Soil quality in cellule	0.61	-0.04	0.05	0.06	**-0.76**	0.07	-0.14
Physical capital index	0.50	**0.65**	0.13	0.14	0.08	-0.18	-0.05
Income per adult equiv.	0.70	**0.82**	0.01	0.07	-0.03	0.04	0.09
Expenses per adult equiv.	0.80	**0.89**	0.03	-0.04	-0.06	-0.02	0.06

Note: 'Com.' stands for 'communality' and expresses the variation in the variables that is explained by the factor solution. Variable loadings greater than 0.50 are underlined, loadings greater than 0.30 are put in italic.

1220 cases included for which all variable information is available.

Source: Based on own calculations from EICV and FSRP datasets (2000 and 2001).

Table 2: Cluster solution

CLUSTER:	1	2	3	4	5	6	7	Total
Number of cases	96	152	130	263	198	189	192	1220
	8.0%	*12.6%*	*10.1%*	*23.0%*	*16.8%*	*13.8%*	*15.7%*	*100.0%*
Cultivated land (ha)								
Median	0.58	0.47	**1.62**	**0.41**	**0.43**	0.52	0.52	0.52
Mean (1)	0.72	0.62	**1.81**	**0.55**	**0.51**	0.70	0.66	0.73
St Dev (1)	0.51	0.50	1.06	0.46	0.34	0.57	0.54	0.68
(2)	(2,3,4,5,7)	(all)	(all)	(all)	(all)	(2,3,4,5,7)	(all)	
Cultivated land per ae (ha)								
Median	0.19	0.10	**0.23**	**0.09**	0.10	0.13	0.14	0.12
Mean (1)	0.25	0.14	**0.34**	**0.12**	0.13	0.19	0.19	0.18
St Dev (1)	0.20	0.13	0.30	0.11	0.11	0.18	0.17	0.18
(2)	(all)	(all)	(all)	(all)	(all)	(1,2,3,4,5)	(1,2,3,4,5)	
Livestock (TLU)								
Median	0.24	0.30	**1.28**	**0.10**	0.20	0.10	0.10	0.20
Mean (1)	0.53	0.53	**1.49**	**0.26**	0.30	0.34	0.28	0.46
St Dev (1)	0.80	0.74	1..36	0.39	0.38	0.53	0.48	0.76
(2)	(3,4,5,6,7)	(3,4,5,6,7)	(all)	(all)	(all)	(all)	(all)	
Livestock per ae (TLU)								
Median	0.08	0.06	**0.20**	**0.02**	0.03	0.03	0.02	0.04
Mean (1)	0.16	0.10	**0.25**	**0.05**	0.07	0.09	0.08	0.10
St Dev (1)	0.26	0.13	0.25	0.09	0.09	0.14	0.14	0.16
(2)	(all)	(all)	(all)	(all)	(all)	(all)	(all)	
Age of HH head								
Median	**35.0**	38.0	**55.0**	44.0	38.0	38.0	50.0	42.0
Mean (1)	**38.8**	38.9	**55.5**	43.8	39.8	39.0	52.7	44.0
St Dev (1)	15.2	10.8	12.7	12.8	11.7	13.8	15.9	14.6
(2)	(3,4,5,7)	(3,4,5,7)	(all)	(all)	(all)	(3,4,5,7)	(all)	
% female-headed HH	12.2%	14.7%	10.1%	2.7%	7.5%	17.4%	85.6%	21.6%
Adult working force								
Median	2.00	2.00	**4.00**	3.00	2.00	2.00	**2.00**	2.00
Mean (1)	2.10	2.78	**4.17**	2.97	2.81	2.35	**1.57**	2.67
St Dev (1)	0.83	1.14	1.62	1.23	1.16	1.02	0.92	1..35
(2)	(all)	(all)	(all)	(all)	(all)	(all)	(all)	
Max education (years)								
Median	**6.00**	5.00	**6.00**	5.00	5.00	5.00	**0.00**	5.00
Mean (1)	**5.97**	4.49	**5.71**	4.77	4.70	4.05	**1.28**	4.26
St Dev (1)	2.78	2.54	2.72	2.42	2.19	2..58	1..90	2.79
(2)	(all)	(all)	(all)	(all)	(all)	(all)	(all)	
% in tontine	11.7%	**88.7%**	15.1%	3.4%	3.6%	2.4%	4.3%	16.1%
% in association	9.5%	**42.3%**	33.3%	6.7%	28.4%	17.0%	12.1%	20.0%
% in tontine or association	19.9%	**100.0%**	38.6%	10.1%	30.5%	18.5%	15.7%	30.6%
Public service proxy (index)								
Median	-0.85	-0.63	-0.67	-0.91	**-1.11**	**3.39**	-0.65	-0.65
Mean (1)	0.21	-0.51	-0.28	-0.60	**-1.10**	**2.92**	-0.30	-0.04
St Dev (1)	2.47	1.49	1.81	1.55	1.25	2.58	1.68	2.19
(2)	(all)	(all)	(1,2,4,5,6)	(all)	(all)	(all)	(1,2,4,5,6)	
Remoteness index [28–6730]								
Median	736	991	1,077	973	**634**	**2,253**	991	991
Mean (1)	1,067	1,320	1,239	1,059	**743**	**2,449**	1,282	1,284
St Dev (1)	848	976	803	669	538	1,429	831	1,018
(2)	(2.3.5,6,7)	(all)	(all)	(2,3,5,6,7)	(all)	(all)	(all)	
Regional living cost [74–121]								
Median	95.2	94.4	101.5	93.4	**101.8**	100.2	96.7	95.2
Mean (1)	96.0	94.0	99.3	93.3	**99.8**	97.8	96.7	96.4
St Dev (1)	4.5	4.2	3.5	3.7	3.8	4.0	4.7	4.7
(2)	(all)	(all)	(all)	(all)	(all)	(all)	(all)	
Soil quality in cellule [0–1]								
Median	0.37	0.36	0.34	**0.45**	**0.25**	0.32	0.36	0.36
Mean (1)	0.37	0.37	0.33	**0.45**	**0.28**	0.36	0.37	0.37
St Dev (1)	0.11	0.09	0.10	0.11	0.07	0.09	0.09	0.11
(2)	(3,4,5,6,7)	(3,4,5,6,7)	(all)	(all)	(all)	(all)	(all)	
Physical capital index [0–12]								
Median	**8.00**	5.00	7.00	6.00	6.00	**5.00**	6.00	6.00
Mean (1)	**7.61**	5.51	6.52	5.38	5.68	**4.89**	5.53	5.70
St Dev (1)	1.73	1.72	1.61	1.74	1.59	1.78	1.82	1.85
(2)	(all)	(1,3,4,5,6)	(all)	(all)	(all)	(all)	(1,3,4,5,6)	
Income per ae (Rwf.)								
Median	**97,722**	33,868	33,908	25,846	22,945	23,456	24,796	29,130
Mean (1)	**117,444**	40,557	41,470	29,514	27,488	30,872	29,268	38,975
St Dev (1)	71,199	27,061	33,248	20,768	19,529	24,259	24,605	38,876
(2)	(all)	(1,4,5,6,7)	(1,4,5,6,7)	(1,2,3,5,6)	(all)	(all)	(1,2,3,5,6)	
Expenses per ae (Rwf.)								

Median	**144,579**	57,930	56,618	50,146	46,651	45,167	41,297	52,497
Mean (1)	**157,895**	65,321	62,344	51,788	52,162	50,980	50,259	62,783
St Dev (1)	54,568	33,934	31,755	24,140	29,537	27,876	36,515	43,590
(2)	(all)	(all)	(all)	(1,2,3,6,7)	(1,2,3,6,7)	(1,2,3,4,5)	(1,2,3,4,5)	

Notes: High or low scores in comparison to average trends are underlined. (1) Means and standard deviations are adjusted for sampling weights. (2) Statistically-significant differences at 0.001 level between mean of clusters x,y and the column cluster, established by Games-Howell test, suitable for pair-wise multiple comparisons between groups in case of unequal or unknown variances between groups and unequal size of groups (recommended by Cardinal & Aitken, 2005; Field 2005).[xiv]
Source: Based on own calculations from EICV and FSRP datasets (2000 and 2001).

Table 3: Poverty status based on absolute and relative poverty lines for different clusters

CLUSTER:	1	2	3	4	5	6	7	Total
% of HH	*8.0%*	*12.6%*	*10.1%*	*23.0%*	*16.8%*	*13.8%*	*15.7%*	*100%*
Poverty incidence based on absolute poverty lines (Chi-square p = 0.000)								
Extreme poor < 45,000 Rwf	0.0	31.1	35.1	43.6	47.8	50.0	56.7	41.3
Poor 45.000 – 64,000 Rwf	2.5	25.3	25.8	26.5	27.2	23.4	18.7	22.8
Non-poor > 64,000 Rwf	97.5	43.6	39.2	29.9	25.0	26.6	24.6	35.9
Poverty incidence based on relative poverty line (30% and 50% of <u>overall</u> mean consumption) (Chi-square p = 0.000)								
Extreme poor < 30%	0.0	5.4	8.4	13.2	13.4	14.1	24.8	12.7
Poor 30% - 50%	0.0	23.6	20.1	25.6	30.7	30.9	27.5	24.6
Non-poor > 50%	100.0	71.0	71.5	61.1	55.9	55.0	47.7	62.7
Poverty incidence based on relative poverty line (30% and 50% of <u>rural</u> mean consumption) (Chi-square p = 0.000)								
Extreme poor < 30%	0.0	2.0	2.8	6.7	6.8	8.2	15.6	6.8
Poor 30% - 50%	0.0	13.8	12.8	19.9	19.6	23.1	22.5	17.6
Non-poor > 50%	100.0	84.2	84.4	73.5	73.7	68.7	62.0	75.6

Note: 1220 cases included.
Source: Based on own calculations from EICV and FSRP datasets (2000 and 2001).

Table 4: Assets owned by households of different clusters

CLUSTER:	1	2	3	4	5	6	7	Total
% of HH owning a:								
Chair	67.9	54.9	65.9	47.6	46.1	30.2	29.4	46.5
Bed	80.2	43.2	58.7	36.5	43.6	31.6	21.0	41.2
Radio	58.8	38.9	52.3	25.0	37.6	24.5	7.5	31.5
Bicycle	17.6	6.9	13.7	3.5	3.7	2.7	0.7	5.6
Cupboard	14.8	5.1	7.2	4.3	3.1	2.6	2.6	4.8
Lounge suite	7.7	2.1	4.8	1.5	1.0	0.0	0.0	1.9
Sewing machine	1.9	1.8	4.9	2.0	0.6	0.7	0.8	1.7

Note: 1220 cases included.
Source: Based on own calculations from EICV and FSRP datasets (2000 and 2001).

Table 5: Livelihood strategies for different clusters

CLUSTER:	1	2	3	4	5	6	7	Total
% HH with positive income from:								
Own farming activities:	**100.0**	**99.2**	**100.0**	**99.8**	**99.5**	**99.3**	**99.2**	**99.6**
Subsistence production	98.4	99.2	100.0	99.3	97.6	98.3	97.4	98.6
Agricultural sales	91.4	68.8	78.5	71.8	69.2	70.4	65.8	72.1
Livestock (net - only if positive)	36.9	30.1	50.4	18.9	27.8	23.7	16.9	26.8
% of HH with some livestock	*65.7*	*80.4*	*93.0*	*58.3*	*69.6*	*58.5*	*58.4*	*67.1*
Off-farm activities:	**47.1**	**37.3**	**25.2**	**29.6**	**33.3**	**26.8**	**18.1**	**30.0**
Own off-farm enterprise	22.1	19.7	12.7	13.6	10.3	8.5	5.2	12.4
Non-agricultural skilled	11.1	4.9	9.3	3.4	3.6	1.7	1.5	4.3
Non-agricultural unskilled	12.0	3.4	6.4	5.3	11.2	5.8	0.6	6.0
Agricultural	6.6	14.4	4.7	12.8	13.8	14.1	11.5	11.8
Remittances (net - only if positive)	**39.1**	**28.3**	**30.4**	**39.0**	**35.9**	**37.1**	**43.5**	**36.7**
Monetary value (thousands Rwf) of income from:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
Subsistence production (median)	137.4	113.7	145.6	83.2	74.0	83.4	65.7	89.8
Mean	176.9	136.4	162.6	93.9	90.3	91.4	75.0	109.1
St Dev	*142.6*	*109.0*	*105.5*	*63.9*	*70.8*	*61.8*	*65.1*	*91.3*
Agricultural sales (median)	**35.6**	11.4	**30.0**	8.7	6.5	**6.1**	**5.4**	10.1
Mean	**89.0**	34.3	**59.8**	25.8	24.6	**21.7**	**21.8**	35.2
St Dev	*132.9*	*61.6*	*104.4*	*45.3*	*49.8*	*45.8*	*40.6*	*71.6*
Own off-farm enterprise (median)	**201.3**	66.0	60.0	38.5	20.0	62.6	4.5	50.9
Mean	**248.4**	82.4	204.4	70.4	35.5	103.6	28.9	107.7
St Dev	*192.7*	*62.5*	*392.1*	*96.1*	*39.5*	*135.0*	*60.6*	*178.8*
Wage labor -all kinds (median)	**144.0**	**39.6**	**46.8**	24.6	38.4	**12.0**	21.6	28.8
Mean	**188.8**	**85.1**	**89.1**	50.3	46.5	**24.4**	26.7	66.7
St Dev	*176.0*	*96.3*	*91.1*	*73.0*	*42.6*	*31.6*	*23.2*	*96.9*
Pay per hour (Rwf 2001 prices):	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
All jobs (median)	**94.5**	54.5	**65.4**	30.7	**46.0**	31.3	30.7	46.0
Mean	**177.1**	67.5	**107.5**	71.0	**141.7**	50.9	64.9	97.5
St Dev	275.6	64.5	118.4	107.8	**294.7**	61.5	98.1	184.9
Own off-farm enterprise (median)	98.6	76.7	115.1	34.5	55.2	**80.5**	38.4	72.0
Mean	256.6	104.3	159.5	101.7	173.5	**113.3**	130.4	145.9
St Dev	*395.9*	*86.6*	*166.8*	*117.2*	*257.6*	*136.3*	*149.6*	*215.2*
Non-agricultural job (median)	111.1	50.1	102.3	53.9	**56.8**	46.6	10.2	56.8
Mean	148.3	49.9	102.4	86.5	**193.0**	51.7	8.2	113.5
St Dev	*160.2*	*29.3*	*83.7*	*141.0*	*402.3*	*36.9*	*4.6*	*223.0*
Agricultural job (median)	55.2	30.7	50.0	**23.0**	**38.4**	**30.7**	30.7	30.7
Mean	49.0	38.1	63.2	**30.5**	**47.5**	**33.9**	37.3	39.0
St Dev	*14.6*	*25.3*	*77.5*	*24.5*	*29.7*	*17.8*	*20.1*	*30.7*

Note: 1220 cases included. High or low scores in comparison with average trends are underlined. For the calculation of monetary values and pay per hour, only households with positive income from the mentioned source are taken into account when calculating median, means and standard deviation. The calculation of agricultural production (i.e. subsistence production and sales) is based upon a measurement of crop production and on the prices (potentially) received for those crops in this region.
Source: Based on own calculations from EICV and FSRP datasets (2000 and 2001).

Table 6a: Crop choice for different clusters in season 2000B and 2001A

CLUSTER:	1	2	3	4	5	6	7	Total
Number of crops								
Median	8.00	7.00	**8.00**	7.00	7.00	7.00	**6.00**	7.00
Mean	7.29	7.29	**8.06**	6.55	6.72	7.53	**6.64**	7.03
St. Dev.	2.62	2.50	2.34	2.36	2.24	2.21	2.27	2.40
Percentage of land in multicropping								
Median	0.53	**0.49**	***0.44***	0.54	**0.58**	0.50	0.53	0.52
Mean	0.54	**0.49**	***0.44***	0.54	**0.57**	0.52	0.51	0.52
St.Dev.	0.25	0.25	0.23	0.27	0.26	0.23	0.27	0.26
Percentage of HH using land for:								
Pulses								
Beans	97.33	97.89	96.38	93.50	97.98	98.78	95.35	**96.42**
% of land (medium)	*17.37*	*19.53*	***14.96***	*18.95*	***21.45***	***14.80***	*17.63*	*18.11*
Peas	28.72	**50.04**	22.07	32.99	19.73	32.58	28.41	30.69
% of land (medium)	*1.97*	*3.82*	*2.79*	*4.16*	*3.89*	*3.72*	*3.25*	*3.63*
Peanuts	14.73	**7.54**	**17.91**	11.99	***7.51***	***15.87***	11.56	11.96
Soja	21.05	18.45	**28.00**	15.25	**27.16**	**31.11**	**14.46**	21.47
% of land (medium)	*2.70*	*4.20*	*2.17*	*1.98*	*4.19*	*3.56*	*2.73*	*3.14*
Vegetables	**22.02**	18.52	20.17	15.44	18.02	16.46	**9.71**	16.51
Cereals								
Sorghum	53.87	56.10	**68.63**	**45.16**	57.51	**61.91**	58.77	**56.14**
% of land (medium)	*7.77*	*11.99*	***6.90***	*10.94*	*9.81*	*11.17*	*10.18*	*9.89*
Maize	73.84	78.20	70.02	**82.74**	**54.90**	72.95	69.26	**72.03**
% of land (medium)	*6.50*	*6.95*	***4.20***	***7.85***	*5.44*	*5.81*	*6.63*	*6.50*
Wheat	4.31	**18.10**	3.80	10.52	3.05	7.68	8.36	8.31
Eleusine	2.29	6.54	1.43	1.01	0.00	1.87	2.00	1.96
Rice	0.00	0.00	0.00	1.26	0.51	0.65	0.00	0.46
Roots and tubers								
Cassava	65.67	**48.37**	**81.20**	**48.81**	**75.55**	72.20	57.60	**62.48**
% of land (medium)	***15.00***	***8.00***	*11.47*	*12.12*	*12.95*	*12.38*	*11.28*	*11.90*
Potatoes	**54.73**	**58.63**	42.74	48.61	**28.86**	42.42	44.18	44.90
% of land (medium)	*4.87*	*10.10*	*3.71*	*13.43*	*4.39*	*3.57*	*8.53*	*6.76*
Sweet potatoes	78.34	77.05	**83.35**	**66.77**	78.96	**85.74**	74.18	**76.49**
% of land (medium)	*7.42*	*8.61*	***6.48***	*7.30*	*8.32*	*9.69*	*8.23*	*7.83*
Colocase	**35.50**	24.53	**33.10**	25.56	**19.71**	28.74	**20.73**	25.68
% of land (medium)	*1.96*	*1.54*	*2.65*	*1.90*	*2.14*	*2.07*	*2.55*	*2.00*
Yam	0.57	0.00	**3.93**	0.44	0.39	0.91	0.30	0.78
Bananas								
% of land (medium)	***21.79***	*16.31*	*17.25*	***20.17***	*17.45*	*15.51*	*16.91*	*17.73*
Beer bananas	14.11	**4.62**	13.77	**3.16**	***22.05***	12.97	12.19	11.25
Bananas	**86.44**	79.00	**87.99**	**70.79**	82.64	***87.99***	75.37	**79.89**
Other crop types								
Coffee	23.88	21.10	**39.73**	20.32	**38.51**	27.72	27.39	27.86
% of land (medium)	*5.38*	*11.98*	*6.70*	*10.00*	*8.99*	*6.95*	*7.31*	*8.63*
Other food crops	6.36	8.23	10.64	7.80	8.58	7.90	11.13	8.69
Other industrial crops	8.94	6.26	10.67	**10.14**	7.70	1.22	6.39	7.38
Other crops	15.06	16.64	19.94	19.28	7.00	13.87	12.96	14.87
Alternative land use								
Fallow	**62.49**	**60.94**	**65.37**	53.59	**42.20**	**61.78**	58.38	56.39
% of land (medium)	*9.41*	*9.39*	*12.91*	*12.02*	*9.43*	*11.29*	*14.65*	*11.13*
Grass land	5.64	7.43	**15.85**	3.44	2.40	7.65	5.72	6.14
Forest	15.30	26.69	**34.89**	21.79	13.22	23.47	18.11	21.42
Housing	99.13	97.85	98.89	100.00	99.41	99.55	98.92	99.21
Percentage of land (medium) used for:								
Pulses	21.22%	***25.62%***	17.53%	21.37%	**24.54%**	**18.86%**	19.85%	21.57%
Cereals	9.16%	**14.34%**	9.27%	**14.08%**	**8.52%**	12.11%	12.99%	11.52%
Roots and tubers	**24.30%**	21.91%	21.22%	21.99%	22.23%	22.06%	20.02%	21.66%
Bananas	**19.96%**	12.67%	15.41%	***10.14%***	15.75%	14.74%	13.46%	14.09%
Other crop types	0.00%	0.00%	2.69%	0.00%	0.00%	0.00%	0.00%	0.00%
Alternative land use	12.85%	11.71%	**19.32%**	11.53%	10.85%	15.07%	14.15%	12.99%

Note: Information about crop choice is available for 1218 households of the 1220 sample . High or low scores in comparison to average trends are underlined. When calculating the percentage of land used for individual crops, only those households which cultivate these crops are considered.
Source: Based on own calculations from FSRP datasets (2000 and 2001).

Table 6b: Crop choice for different clusters in season 2001B and 2002A

CLUSTER:	1	2	3	4	5	6	7	Total
Number of crops								
Median	8.00	8.00	**9.00**	7.00	8.00	8.00	**7.00**	8.00
Mean	7.98	7.95	**8.81**	7.21	7.66	8.29	**7.74**	7.84
St. Dev.	2.97	2.37	2.53	2.42	2.33	2.39	2.66	2.54
Percentage of land in multicropping								
Median	0.59	**0.47**	0.51	0.56	**0.62**	0.56	0.51	0.54
Mean	0.57	**0.49**	0.52	0.54	**0.60**	0.55	0.54	0.55
St.Dev.	0.23	0.24	0.24	0.26	0.26	0.22	0.25	0.25
Percentage of HH using land for:								
Pulses								
Beans	92.30	97.18	97.16	94.61	97.26	100.00	96.66	**96.51**
% of land (medium)	*15.58*	*15.68*	***14.39***	*13.23*	***20.31***	***13.98***	*17.08*	*15.58*
Peas	31.77	**52.00**	30.53	34.28	32.14	33.69	38.33	36.01
% of land (medium)	*1.93*	*3.74*	*2.37*	*2.35*	*2.74*	*1.89*	*2.68*	*2.61*
Peanuts	22.77	**10.27**	**25.58**	17.70	22.68	18.01	23.24	19.82
Soja	15.21	23.05	**38.64**	21.31	**37.34**	**37.36**	**23.37**	28.18
% of land (medium)	*3.98*	*4.23*	*2.98*	*3.33*	*5.75*	*3.00*	*3.37*	*3.78*
Vegetables	**34.26**	28.57	23.88	23.62	16.65	15.90	**14.71**	21.45
Cereals								
Sorghum	55.73	62.76	**73.66**	**50.16**	66.84	**66.46**	64.85	**61.90**
% of land (medium)	*10.37*	*9.94*	***8.21***	*12.02*	*8.25*	*10.24*	*9.14*	*9.87*
Maize	74.76	80.66	67.90	**86.14**	**60.16**	84.20	77.14	**76.60**
% of land (medium)	*4.39*	*5.44*	***3.41***	***7.99***	*4.24*	*4.39*	*4.63*	*5.33*
Wheat	1.37	**18.82**	8.83	9.53	3.48	10.88	8.79	8.96
Eleusine	2.36	2.41	4.04	1.16	0.00	1.43	1.57	1.62
Rice	0.00	0.00	0.00	0.86	1.57	2.06	0.00	0.75
Roots and tubers								
Cassava	70.53	**47.14**	**76.34**	**51.13**	**79.41**	72.14	67.81	**65.30**
% of land (medium)	***13.95***	***8.77***	*10.80*	*12.51*	*12.24*	*13.58*	*10.30*	*11.67*
Potatoes	**50.45**	**59.22**	39.02	47.49	**20.17**	41.32	41.83	41.92
% of land (medium)	*3.45*	*5.74*	*2.54*	*7.29*	*3.12*	*3.12*	*4.30*	*4.17*
Sweet potatoes	87.46	87.02	**91.97**	**77.45**	90.50	**93.56**	86.78	**86.89**
% of land (medium)	*9.41*	*9.80*	***7.29***	*10.14*	*7.62*	*9.01*	*8.96*	*8.96*
Colocase	**53.41**	44.11	**58.19**	40.27	37.77	51.43	38.05	44.49
% of land (medium)	*2.17*	*2.00*	*3.59*	*2.84*	*2.27*	*2.80*	*2.54*	*2.54*
Yam	1.02	0.42	**4.10**	1.06	2.07	2.25	1.61	1.73
Bananas								
% of land (medium)	***18.32***	*16.53*	*15.08*	***18.31***	*15.33*	*15.37*	*16.33*	*16.56*
Beer bananas	13.95	**5.96**	16.44	**5.96**	16.84	***19.00***	***18.59***	13.41
Bananas	**90.70**	85.16	**89.65**	**75.80**	87.97	85.71	80.25	**83.76**
Other crop types								
Coffee	25.06	25.75	**42.58**	26.10	**37.80**	30.05	28.86	30.73
% of land (medium)	*7.15*	*13.36*	*5.39*	*8.28*	*7.30*	*6.83*	*6.86*	*7.43*
Other food crops	23.53	9.09	16.47	14.04	15.74	16.04	12.31	14.77
Other industrial crops	7.59	8.94	6.89	**15.74**	6.01	3.39	4.90	8.23
Other crops	14.15	20.55	20.60	21.19	11.64	9.93	13.59	16.09
Alternative land use								
Fallow	**64.86**	**69.23**	**68.34**	60.02	**45.14**	**67.08**	59.27	60.69
% of land (medium)	*7.31*	*11.08*	*14.43*	*12.83*	*9.98*	*10.53*	*9.74*	*10.99*
Grass land	8.11	7.99	**16.74**	3.91	6.08	7.83	7.26	7.57
Forest	23.01	29.62	**36.54**	29.47	15.25	23.29	23.54	25.47
Housing	98.25	98.76	98.68	99.24	98.56	98.65	95.24	98.22
Percentage of land (medium) used for:								
Pulses	17.47%	20.16%	18.45%	17.88%	**27.67%**	**18.18%**	20.31%	19.82%
Cereals	9.66%	**12.81%**	**8.38%**	**14.60%**	**7.26%**	11.56%	9.57%	10.75%
Roots and tubers	**24.23%**	23.29%	20.98%	23.59%	22.01%	***25.85%***	22.21%	23.01%
Bananas	**17.89%**	13.16%	13.52%	12.81%	14.25%	13.76%	11.83%	13.69%
Other crop types	0.52%	0.00%	2.65%	0.47%	0.13%	0.00%	0.00%	0.11%
Alternative land use	14.84%	14.37%	**20.96%**	14.03%	11.82%	15.27%	14.69%	14.67%

Note: Information about crop choice is available for 1153 households of the 1220 sample. High or low scores in comparison to average trends are underlined. When calculating the percentage of land used for individual crops, only those households which cultivate these crops are considered

Source: Based on own calculations from FSRP datasets (2000 and 2001).

Table 7: Livestock holdings for different clusters

CLUSTER:	1	2	3	4	5	6	7	Total
Percentage of HH owning:								
Cattle	30.23	19.87	**61.73**	13.18	16.07	15.52	**8.78**	20.40
Goat	38.91	42.73	57.00	21.69	34.28	34.23	25.86	**33.78**
Sheep	9.19	19.32	26.52	11.61	4.39	9.59	7.75	11.80
Pig	12.46	8.50	25.21	7.66	19.54	16.13	7.67	13.08
Rabbit	7.10	18.64	16.56	8.40	13.20	9.86	7.28	11.24
Chicken	32.35	41.81	55.32	24.24	29.77	24.32	17.80	30.17
Other poultry	6.36	5.33	5.13	2.24	3.04	1.25	0.57	2.99
Other livestock	0.41	4.95	0.68	6.92	0.60	0.45	3.00	2.95

Note: 1220 cases included. High or low scores in comparison to average trends are underlined.
Source: Based on own calculations from EICV dataset.

Table 8: Summary profile of clusters

Livelihood asset profile	Livelihood strategies profile	Crop preferences	Policies for poverty alleviation
Rural entrepreneurs: Most well-off households, headed by young males, containing well-educated household member; moderate landholdings.	Highest mean income from agricultural sales and highest % engaged in this activity; highest % active in non-farm activities (47%), mostly in own enterprise and in non-agricultural wage labor; highest pay per hour.	High monetary value of agricultural production in comparison to other clusters; higher % of HHs that produce bananas and more land destined to banana production (than median); more HHs with fallow land than median.	Lessons for other clusters: extensive landholdings are not a 'sine qua non' condition for good standards of living; however, success depends upon other crucial factors such as access to off-farm employment and to self-employment; also education is important.
Association: Association links, often headed by younger male; landholdings below sample average while livestock holdings above sample average; mean expenses just above poverty line.	High percentage (37%) active in off-farm activities, mostly in own enterprise or agricultural jobs; also very high percentage with livestock holdings although percentage with positive income from this activity is limited - underexplored potential.	Less multicropping than average; somewhat more land destined to cereals than median; more HHs with fallow land than median; monetary value of agricultural production – particularly of sales - is low in comparison to first and third cluster (underexplored potential).	Lesson for other clusters: association links provide *risk-insurance and access to credit* which apparently are important for subjective assessment of progress in well-being; policy makers could provide assistance to associations to engage in new agricultural production techniques and off-farm entrepreneurial activities.
Natural resource-rich: Lots of land and livestock, headed by older male, large adult work force; mean expenses just below poverty line.	High revenue from agricultural production of which relatively high % is traded; 36% active in off-farm activities with highest wages of all clusters.	Higher n° of crops than av.; more HHs with fallow land, grass land and forests than median and more land destined to alternative land uses than median.	Enhance market-oriented agricultural production by improving bargaining position in price negotiations and reducing risks related to market-oriented production (e.g. access to risk-insurance, credit, etc.).
Resource-poor in fertile regions: Very poor in terms of natural resources (land – livestock) despite high soil fertility, headed by older male.	Income very dependent upon own subsistence production; if active in off-farm sector - then lowest median pay per hour in self-employment and in agricultural jobs (lower than female-headed cluster).	More land destined to cereals than median; higher % of HHs (than median) that produce crops demanding good soil fertility, (maize, potatoes); lower % of HHs that produce sorghum, cassava, sweet potatoes.	Improve access to off-farm employment opportunities; improve bargaining positions in wage negotiations (by investing in training and education). Explore potential for off-farm small-scale entrepreneurship (enhance incentives to engage in associations).
Resource-poor / centrally-located: Live close to nearest road and public services, poor in terms of land and livestock, headed by somewhat younger male.	Quite active in off-farm sector (one third of all households), and able to negotiate reasonable wages, both in agricultural and non-agricultural sectors.	More multicropping than average; higher % of HHs (than median) that produce crops that still produce in poorer soils (cassava, sweet potatoes, sorghum); less HHs with fallow land than median	Improve access to off-farm employment. Explore potential to involve them in off-farm small-scale entrepreneurship.
Isolated: Living in remote areas, somewhat higher availability of land per ae, headed by younger male; limited stock of physical capital.	75% active in agricultural trade but income from this activity is low; lowest median income from wage labor and low pay per hour in wage labor activities; decent pay per hour if active in self-employment.	Less land destined to pulses than median; households concentrate on sorghum, cassava, sweet potatoes, and bananas; more HHs with fallow land than median.	Enhance access to markets by improving rural road infrastructure. Improve availability of public services (e.g. markets, schools, health centers).
Female-headed: Headed by older female, limited human capital (low adult working force and education).	Highly dependent upon subsistence production; least active in agricultural trade and in off-farm sector of all clusters.	Lower n° of crops than average; land distribution over different crops is quite close to median; monetary value of agricultural production is lowest of all clusters.	Remove gender-related constraints that prevent these households from engaging in agricultural trade and off-farm activities. Enhancing bargaining position through collective action.
All Severely constrained in terms of availability of land and livestock.	Highly dependent upon subsistence production; 72% are active in agricultural trade, but earnings from this activity are limited; also limited engagement in off-farm sector (only 30% of all households).	Beans, bananas, sweet potatoes, maize, cassava and sorghum are the crops produced by at least 50% of all households included in the sample; households produce between 7 and 8 crops on average, and adopt multicropping on more than half of their land.	Improve integration and bargaining positions on agricultural markets; improve access to risk-insurance /credit to stimulate entrepreneurial activities in off-farm sector; stimulate demand for labor force though labor intensive works and by investing in broad-based agricultural growth.

Footnotes

[i] A joint initiative of Michigan State University, the Ministry of Agriculture and USAID.

[ii] The calculation of Mahalanobis distance was based upon all variables included in the factor and cluster analysis. For an overview of these variables, see further.

[iii] For the land and livestock variables, both FSRP and EICV survey data were available. We consider FSRP data to be more reliable for agricultural assets (e.g. the land variable was measured by FSRP surveyors), while EICV data was based upon estimates made by the household head him/herself.

[iv] Availability of transport: 0 = no transport expenses or owning means, 1 = transport expenses, 2 = owning means of transport. Availability of rooms per adult equivalent: 0 = less than 0.5 rooms per adult equivalent, 1 = 0.5 – 1 room per adult equivalent, 2 = over 1 room per adult equivalent. Quality of outside walls: 0 = walls of non-cemented laterite mud or stone, 1 = walls of cemented laterite mud, 2 = walls of bricks (any type) or boards. Quality of roof: 0 = roof of thatch or straw, 1 = roof of tile, 2 = roof of corrugated iron/concrete. Quality of sanitation: 0 = no toilet, 1 = open pit latrine, 2 = closed pit latrine/flushed toilet. Quality of energy for cooking: 0 = firewood, 1 = wick lantern/candle, 2= oil or gas lamp/electricity.

[v] A potential proxy for "health," measured by a variable as to whether a member of the household had been sick between February 2001 and March 2002, was not included. This period does not correspond well with the data from the EICV and FSRP 2001A. Moreover, the interpretation of "being sick" may differ widely for each respondent.

[vi] The "maximum level variable," as a measure of a household's level of education, has proved optimal for estimating total household income (Jolliffe, 2002) While this paper does not focus exclusively on clarifying income, both education and income variables are included the analysis.

[vii] This variable can also serve as a proxy for access to credit.

[viii] This variable generally captures membership in an association(s) other than tontines. Associations are either cooperatives, syndicates or other types of economic associations of which over 85% of the members are engaged in agricultural and/or livestock-breeding activities.

[ix] Taking provincial boundaries as a basis for the determination of living costs is a huge oversimplification of the complexity of local price levels and trends. Nonetheless, without more detailed data, the considerable differences in price levels between provinces calculated in this fashion are useful.

[x] This soil quality index was calculated by multiplying the scores (values between 0 and 100) attributed to five soil characteristics: soil texture (A), soil depth (B), topsoil sum of basic cations (C), pH (D) and organic carbon content (E).

[xi] The expenditure variable was calculated by the statistics department providing the EICV data. Income is defined as the value of consumption of self-produced food plus gross revenue from sales of agricultural products minus total expenditure on agricultural inputs plus revenue from net sales of livestock and livestock products, agricultural wage income, non-agricultural unskilled wage income, non-agricultural skilled wage income, non-farm enterprise income, income from rents, net income from remittances plus total miscellaneous income. Both income and expenditure variables are deflated by the cost of living to control for variations in the timing and location of the interview. McKay and Loveridge (2005) highlight the importance of excluding the most extreme income outliers (mainly the consequence of the short recall period for consumption of self-production in the EICV survey resulting in over- or underestimation). Consequentially, extremely large or small (even negative) income values have to be excluded from the analysis. Prior to analysis, negative income values were excluded. Other cases were excluded based on extreme values for the multivariate Mahalanobis distance.

[xii] Applying these 'marks' to the Rwandan context gives a set of relative poverty lines based upon overall mean consumption (25,301 and 42,169 Rwf); and an alternative set of relative poverty lines based upon rural mean consumption (19,849 and 33,082 Rwf). The calculation of these poverty lines is based upon the entire EICV sample, including 6420 households living in both rural and urban environments.

[xiii] The percentages refer to two different cultivation cycles: season 2000B and 2001A on one hand, and season 2001B and 2002A on the other hand.

[xiv] Methodological note: Levene's statistic (i.e. a test for homogeneity of variances) is significant for all variables included in the cluster analysis. This means that there is a significant difference between the variances of the different clusters. The F-test of ANOVA could still be robust if the clusters would have approximately the same size, but this is not the case. We are therefore obliged to use tests that do not assume equal variances between groups. There are four tests available in SPSS: Tamhane's T2 test, Dunnett's T3 and C test and the Games-Howell test. We opt for the last as it is recommended by the sources cited above.