

**Changing livelihoods on the slopes of Mt. Kilimanjaro, Tanzania:
Challenges and opportunities in the Chagga homegarden system**

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Abstract

Mt. Kilimanjaro area with the old Chagga agroforestry system has been one of the most productive agricultural areas in Tanzania. Today the area is facing several challenges that affect people's livelihoods. To study implications of low coffee price, population pressure and ensuing land use change on the farming systems and livelihoods of the people of the southern slopes of Mt. Kilimanjaro, Tanzania, an interview survey was conducted. A multivariate regression analysis was used in studying and testing the interrelationships between farm production and some socio-economic variables (assets). From nine different independent variables only land size and farmers age had statistically significant influence on revenue from the main crops grown. This suggests that families have so many different combinations of assets and farm-specific temporally varying strategies and objectives that it is not possible to find clear patterns of assets and strategies that would lead to successful livelihood outcomes. Due to sinking coffee prices in the world market, farmers have been looking for alternatives to earn cash. As land scarcity hinders both expansion of cultivation and expansion of animal keeping, more intensified and diversified production and off-farm activities have become crucial. There is an urgent need for technical research and experimentation on new agricultural options for the area and a need of understanding and creation of marketing channels.

Keywords: population growth, land scarcity, small-scale farming

Introduction

Mt. Kilimanjaro area, with the old Chagga coffee-banana homegarden system covering the upper southern slopes of the mountain and food production on the lower slopes and adjacent plains, has been one of the most productive agricultural areas in Tanzania. Today the area is, however, facing several serious challenges that affect people's livelihoods. Due to subdivision of homegardens between the sons of the family, farms have become very small. Over the years sons who have not inherited homegarden land from their fathers have established their homesteads on the much drier lower slopes and plains (Fernandes et al., 1984; Maro, 1974). Global climate change affecting the glaciers of the mountain (Hastenrath and Greischar, 1997), change of indigenous vegetation to exotic species, and cultivation of the immediate riverbanks is believed to have contributed to the drying up of rivers and irrigation channels (Anderson, 1982; Fernandes et al., 1984; Kisanga, 1998¹; Zongolo et al., 2000²). Further, low coffee prices in the world market have rendered the traditional coffee-banana farming system unprofitable.

This study on the livelihoods on the southern slopes of Mt. Kilimanjaro was undertaken as part of a project 'Socio-ecologic dynamics of land use change on East-African highlands'. It was based on DFID sustainable livelihoods framework (Carney, 1998; DFID, 2001³) the aim being to conduct a people centred survey simultaneously investigating people's assets, objectives and livelihood strategies. "Livelihood comprises the capabilities, assets, both material and social resources, and activities required for means of living" (Carney, 1998). Assets or capital endowments (human, social, natural, financial and physical capital) are the basic livelihood building blocks, the capacity that people use in striving for the objectives or the livelihood outcomes. Government and private sector structures, laws, policies, institutions and the culture influence the livelihood strategies people adopt to achieve livelihood outcomes. Strategies may never be articulated, but they nevertheless influence people's choices of which activities to combine, which outcomes to pursue, and which assets to invest in (Ashley and Hussein, 2000⁴). The aim of using this framework was to try to identify crucial assets or combinations of assets (human, social, natural, physical and financial capital) that enable the farmers to have strategies in order to gain better livelihood outcomes i.e. more income, increased well-being, reduced vulnerability and so on. The study also looked at on perceived problems that farmers face in striving to achieve improved livelihood outcomes. The results were when possible compared with a socio-economic study by Maro (1974) and a study by Fernandes et al. (1984). The overall aim was to study current opportunities that the Chagga have, and to identify new opportunities to enhance coping strategies of the Chagga.

Study site

The study area which covers Kirua Vunjo, parts of Kilema and Marangu divisions on the southern slopes of Mt. Kilimanjaro (3.29 to 3.45 S latitude and 37.40 to 37.60 E longitude) (Figure 1) was selected based on the criteria that it represents the parts of slopes on the mountain with no large estate farming that would affect the land use patterns and interactions between the lowlands and highlands. The transect passes through three distinct agro-ecological zones, 1. the lowlands (Extensive livestock farming belt), 2. the midlands (Maize-bean belt) and 3. the homegarden area (Coffee-banana belt, highlands). The scarcely populated lowlands extend up to about 900 m with rainfall between 400-900 mm. Midlands are the transition zone between the homegarden area and the lowlands reaching up to 1200 m with rainfall varying between 1000 and 1200 mm. The extremely densely populated homegarden zone covers all the southern slopes of the mountain between 1200 m and 1800 m

above sea level. Rainfall in the homegarden zone varies from 1200 to 2000 mm per year (Moshi Rural District Council).

The Chagga farming system is an old traditional agroforestry system (e.g. Fernandes et al., 1984; Ok'ting'ati et al., 1984; Ok'ting'ati and Mongi, 1986). It consists of a highland coffee-banana farm (*Coffea arabica*, *Musa* spp.) with multiple other food crops intercropped, and a lowland maize (*Zea mays*), millet (*Eleusine coracana*) and bean (*Phaseolus vulgaris*) field. Livestock in the highlands is kept under stall-feeding. In the lowland area where there is still plenty of land, free-range livestock keeping is practiced. Fodder grasses for animal feed are widely grown in homegardens and in midland. Trees are used to provide shade for coffee, as live fences, for fodder and mulch, for bee forage, for anti-pest properties and for timber and firewood. Many farmers keep beehives. In addition hens play an important role. Hens are usually the first investment that a young farmer can make. The main cropping in the lower and middle belt is done during the long rains from March to August, a second crop can be grown during the short rains if irrigation is available (Aminu-Kano et al., 1992⁷; Zongolo et al., 2000²).

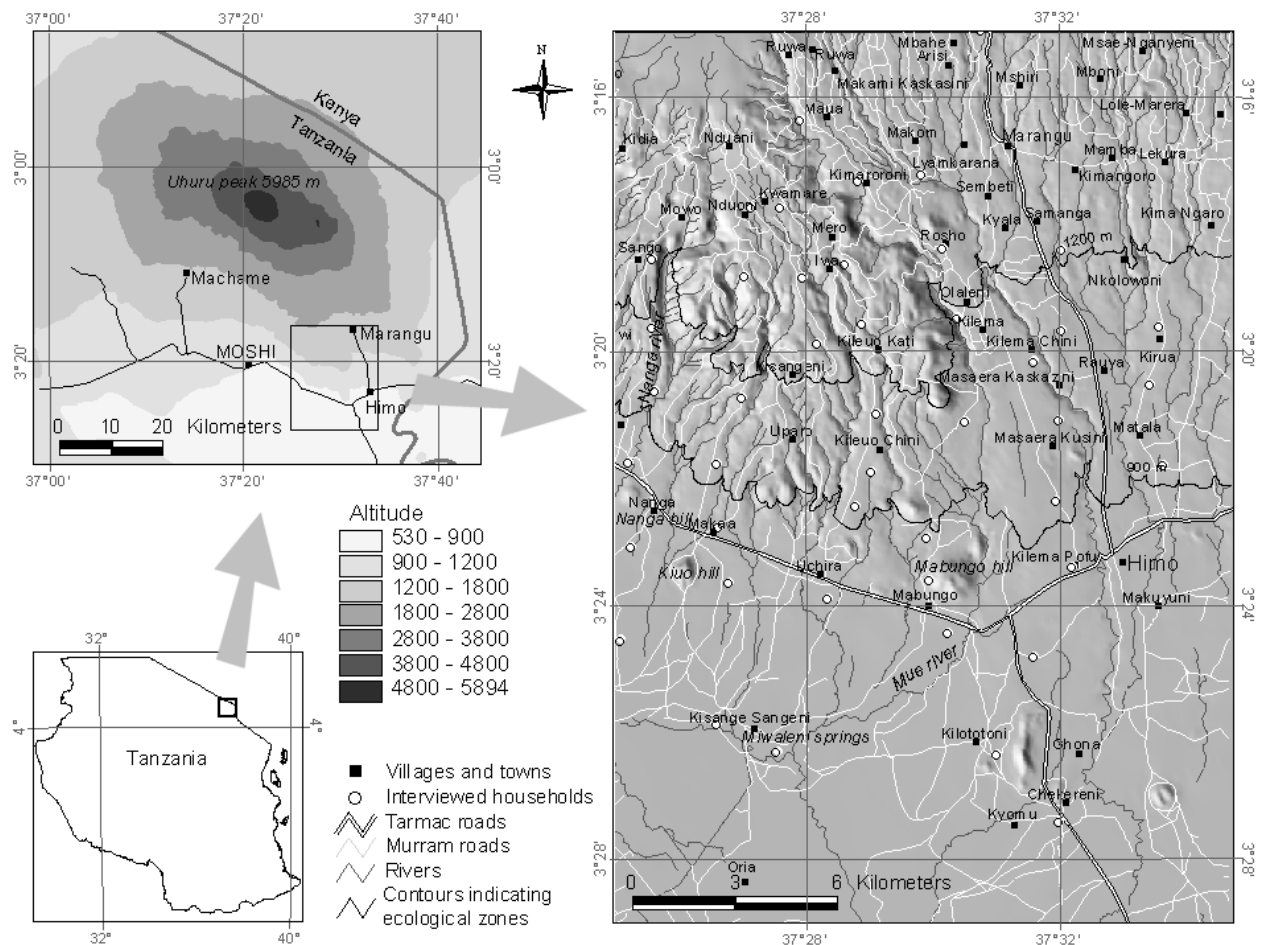


Figure 1. The study area of the livelihood survey on the slopes of Mt. Kilimanjaro, Tanzania.

Highland farms are considered owned by the Chagga society though they are used by individual farm families (Moore, 1969; Moore and Puritt, 1977). Fields in the lowlands are all individually owned and can be sold and bought without it becoming a clan issue. There is also a long tradition of plot renting. It used to be customary to loan land to a needy relative or any other person to farm until the owner needed it. There was no rent except a token beer party held every third year (Maro, 1974). Now a rent of one sack of maize after the harvest is paid to the owner of the plot.

Population growth in the area has been dramatic since the beginning of the 20th century. Density of population in 1920s was 26 people km⁻². Between 1921-1948 population more than doubled. In 1948 average density was 50 people km⁻², but some areas already had very high population density. Kibosho had 280, Uru 198 and Marangu 218 people km⁻² (Swynnerton, 1949). Today's (2000) population density figures for Moshi rural district are 650 people km⁻² in the upper belt and 250 people km⁻² in the midlands and lower belt (Moshi Rural District Council). As population growth increases the scarcity of land relative to labour, land is used more intensely and diversely and labour use gets intensified. This has its impact on the landscapes. Results of a land use analysis of Kirua Vunjo on the southern slopes of the mountain by Soini (2003)⁵ looking at change that happened between 1961 and 2000 show the expansion of cultivation to more marginal land down the slope, the disappearance and extreme fragmentation of natural bush land and appearance and expansion of settlements. Today riverine woodland often consists of only a row or two of trees.

Methods

Forty five households were interviewed between March and May 2001, fifteen households from each altitudinal zone, lowlands, midlands and highlands. Adjusted grid sampling was used to select the households. One by one kilometre sample areas were drawn on a map of the study area. One household was selected from each square. A rule of selecting the second house on the left after entering the square was kept until about two thirds of the households were interviewed. After that, selection was adjusted in order to have five old families (above 50), five middle aged families (36-50) and five young families (up to 35 years) from each zone. This was done selecting the closest household to the second on the left representing the desired age group. This method of stratified random sampling gives the advantage of using analysis methods based on the assumption of independent observations, yet representing households and livelihoods of a variety of people at different stages of life.

A multivariate regression analysis was conducted in order to identify key assets that play an important role in livelihood outcomes. Independent variables such as fertiliser use, number of crops grown, contribution from outside the farm, off-farm job, land size, farmers age, labour on farm (number of dependants 10 year old or older), whether the farmer owns improved cattle or a highland plot were used. Fertiliser use can be affected by farmer's education level, by off-farm income or by farm size, and in the same way farmer's education level may correlate with having an off-farm job. These relations were studied separately. An analysis was also done to test whether the problems farmers perceive as biggest hindrances for productive farming, can be statistically verified of having an impact on farm production.

To acquire a single dependent variable of farm crop production for the purpose of the analysis, values of crop yields on a farm were calculated using mean prices between on-season and off-season, given by farmers. The revenue from various crops was summed together and divided by the cultivated area of the farm producing a variable, 'revenue per

hectare'. The crops included were maize, beans, coffee, banana, groundnuts, sunflower, millet and rice. Farm revenue was selected as a dependent variable due to the fact that most farmers consider farming as their occupation and source of livelihood, and other activities are taken up because income from farming is not sufficient. Farm revenue feeds to other livelihood outcomes such as general well-being, empowerment, health, reduced vulnerability and more sustainable use of natural resource base.

Chagga households

Table 1 summarises basic information on farmers' education, off-farm activities, plots and housing.

A Chagga farm is a very independent family enterprise. The only collective action is the weekly communal works for men which often involves road repairs or furrow maintenance. All men are obliged to take part in this. In central Kenyan highlands most of the adults belong to groups, and often belong to more than one. Further, most of the groups take on multiple activities (Place et al., 2002⁶).

Table 1. Some farmer and farm characteristics in Kirua Vunjo, Kilema and Marangu on Mt. Kilimanjaro, Tanzania, according to the interview survey of 45 households.

| Socio-economic indicators | Quantity |
|---|------------------------------|
| Primary school education (seven years) | 90% |
| Vocational training (school and on-the-job, typically in farming, carpentry, mechanics and tailoring) | 33% |
| Off-farm job (both casual and permanent) | 55% (fathers), 15% (mothers) |
| Average number of persons living in a household | 6.2 |
| Plots in different agroecological zones | 42% |
| Average number of plots per family | 2.5 |
| Average plot size | 0.6 ha |
| Farmers renting a plot | 51% |
| Average distance between the main farm and other plots | 5 km |
| Average total cultivated area | 1.74 ha |
| Households covered by irrigation | 27% |
| Farmers living in a stone house/mud house | 60 / 40% |

Generally, there is a wide variety of housing conditions. Stone house symbolises wealth. It is considered the most important and desirable farm asset. More stone houses exist on the upper slopes than in the lowlands. The other typical house type is a mud and pole walled small house with a corrugated iron sheet roof. Only in the lowlands, few kilometres from the tarmac road, most of the houses are mud walled and grass thatched.

Challenges and coping strategies

Especially lowland farmers are suffering from decreasing water supply or complete drying up of furrows and rivers. Access to irrigation water varies according to a scheme and time of a year, from half an hour once a week, three times a week up to no regulation at all. GPS mapping of the furrows by the author shows that irrigation furrows do not cover even a small area like Kirua Vunjo division uniformly. Very few channels reach all the way down to the plains. In these conditions prolonged droughts are difficult to cope with. One third of the farmers can just cut down usual expenditures and eat previous harvest to carry through a drought, others rely on casual work, selling hens or even selling livestock. One typical coping strategy is to travel long distances to look for cheaper food from elsewhere where the harvests were better. Also additional help from children working in towns becomes crucial.

Those who have lent animals to others might take the animals back. It is difficult to trace any single asset or a combination of assets that would be crucial to determine whether a farmer can rely on savings alone through a prolonged drought. Neither farm production from main crops nor having an off-farm job correlates with the strategy of relying on savings only through a drought.

Even though farms have become smaller over time, they have been divided more often or into more units than before due to the fact that new land has not been available in any other way in the area since 1960s-1970s (Table 2). The average size of an inherited plot is 0.56 ha, but half of the farmers who had inherited a farm had inherited less than an acre (0.4 ha), some even less. Most of these extremely small farms were found in the lowlands. Farmers on these farms rely on cultivating rented plots and doing casual work on others' fields. It is extremely difficult to these poor farmers to get the capital to buy land. Especially during long droughts and family disasters one can, as a last resort, offer one's land for sale. More well-off farmers use these circumstances to expand their lands. It seems to be considered shameful to admit that one has needed to sell land. Only three out of 45 farmers interviewed had sold land, but 13 farmers were cultivating a plot they had bought themselves. 17% of all plots (115) were obtained by purchase. This can also imply that people who sell land move out of the area.

Table 2. Inheritance, subdivision, renting and buying of land on the southern slopes of Mt. Kilimanjaro, Tanzania, based on Maro (1974) and an interview survey of 45 households in 2001.

| Relation to land | 1970* | 2001 |
|---|--|------|
| Farmers living on inherited farms | 82% homegardens 23 % lowland farms | 70% |
| Farmers who inherited a sub-division of the original farm | 50% | 84% |
| Farmers renting a farm | 43.5% | 51% |
| Farmers who have bought land | 11% lowland field bought 6% homegarden bought | 29% |

*Maro, 1974

Sixty nine percent of farmers complain that farm extension is no more available. Due to lack of efficient extension there is little information on best practices and new crop options. There is also little follow-up of bylaws on prohibitions on riverbank cultivation, cultivation on steep slopes, or cutting of wood in the riverine forests. Table 3 is a summary of the agricultural adaptation methods farmers use in order to compensate decreasing land size and low coffee price. Most (87%) of the farmers interviewed mention lack of funds or credit to invest for farming, to buy pesticides, fertilisers and/or seeds for better yields as one of the biggest problems in farming on the slopes of Mt. Kilimanjaro. Farmers claim that farm inputs were more easily and cheaply available earlier, during the period of socialism in Tanzania (1967-1983). The intensive farming system would require more inputs in order to keep the productions levels. Quantitative studies from other homegarden sites have suggested negative nutrient budgets in homegarden systems (Beer et al. 1998; Fassbender, 1993; McGrath 1998; Nair et al. 1999). But it is difficult to invest into farming as times of supply and demand of cash do not often coincide. To an average rural household in the area, cash is most available from August to December. This is the time when harvesting starts and crops can be sold. The most difficult months for the farmers are from January to June when school fees are to be paid and farmers do their planting and weeding. Even though the whole family takes part in farming, cash is often needed to hire casual labour for the fields. On the very upper slopes of the mountain this peak time for cash demand extends up to August-September. This is because there are additional costs for a highland farmer who cultivates a lowland farm when

transport of people and harvest is needed. As credit is generally not available, farmers often find it difficult to make ends meet.

Table 3. Intensification and diversification methods farmers use to adapt to low coffee price and decreasing plot size in Kirua Vunjo, Kilema and Marangu on Mt. Kilimanjaro, Tanzania according to the interview survey of 45 households.

| Intensification/diversification method | Percentage of farmers applying |
|--|--|
| Practicing spacing (planting maize and beans in rows) | 47% |
| Contours, 'fanya juu' and 'fanya chini' structures* | 44% |
| Using improved maize seeds, either mixed with home seeds or alone | 71% |
| Applying manure and compost | 26% of the fields |
| Applying commercial fertilisers (CAN and Urea) | 50% (only on lowlands-midlands) |
| Changing trees to more valuable species (in the process often moving trees from centre to the borders to make space for crops) | 18% |
| Spacing coffee and banana and planting banana in deep holes filled with compost | 9% |
| Changing banana varieties | 4% |
| More valuable livestock breeds to increase milk production | 26% of all farmers 58 % of highland farmers |
| Growing groundnuts/vegetables | 24% |

*Contours are not a new innovation in the area as the colonial government already introduced them (Grove, 1993; Maro, 1974)

Due to the continuous decline of coffee prices on the world market since 1960s and the rise of production costs, farmers have started to devote their attention to other income generating activities. There is a clear pattern of declined coffee production observable from different studies (Table 4). Coffee production in the Kilimanjaro region as a whole has dropped from more than 17000 Mg of coffee in 1981/82 to less than 9000 Mg in 1999/2000 (Tanzania Coffee Board, Moshi). The increase on banana production over time may be explained by increased banana plants on farms. Other activities substituting coffee include sale of other farm products, milk, beans, vegetables (Aminu-Kano et al., 1992⁷) and groundnuts (*Arachis hypogaea*). All of these suffer from lack of big enough markets. Maize, besides being the main food crop, is also an important source of cash especially in the lowlands. Typically more than half of banana production is used at home. Sunflower (*Helianthus Annuus*) is grown partly for home consumption, but oil pressed from the seed can also earn cash.

Table 4. Changes in crop production over time on the southern slopes of Mt. Kilimanjaro, Tanzania.

| Crop | 1975/76* | 1980s [#] | 1990s ⁺ | 2001 |
|--------|---|-------------------------|-------------------------|--------------------------|
| Coffee | 924 kg ha ⁻¹ | 412 kg ha ⁻¹ | 186 kg ha ⁻¹ | 270 kg ha ⁻¹ |
| Maize | 2060 kg ha ⁻¹ (planted alone) 1640 kg ha ⁻¹ (intercropped) | | | 2280 kg ha ⁻¹ |
| Banana | 4 bunches per week | 7 bunches per week | | 7 bunches per week |

*Mlambiti, 1984, [#]Fernandes et al., 1984, ⁺Aminu-Kano et al., 1992⁷

One third of the farmers sell some tree products, the most typical products being avocados, mangos and timber. Some may also sell fodder when they cut a tree, selling the tree as a whole. Farmers were asked to mention five most important tree species grown on their farms.

Table 5 lists the results in the three agro-ecological zones. Already in the 1980's O'kting'ati and Mongi (1986) found that the Chagga were net purchasers of lumber and poles. The current study shows that despite Chagga homegardens being an agroforestry system, only one third of the farmers have enough firewood from their own land, and timber requirements are even more difficult to meet with only twenty percent of the farmers having enough from their own land. Forty percent of farmers say they collect firewood or timber from common land, but resources on common land are getting scarce. This means that farmers need to devote more efforts in being more self sufficient e.g. in firewood and fodder production, growing their own timber and medicinal trees. It is though a common perception amongst old farmers that there are less trees today in the homegardens than earlier. Blot (1999) writes that "The agroforestry system shows a decline of tree cover with the modification of botanical variety". More and more space needs to be allocated for food crops and buildings.

Table 5. The most useful tree species grown in Kirua Vunjo, Kilema and Marangu on the southern slopes of Mt. Kilimanjaro, Tanzania, as perceived by farmers.

| Highlands | | Midlands | | Lowlands | |
|-------------------------------|-------------------|---------------------------|-------------------|------------------------------|-------------------|
| Species | Freq ¹ | Species | Freq ¹ | Species | Freq ¹ |
| <i>Grevillea robusta</i> | 15 | <i>Grevillea robusta</i> | 9 | <i>Mangifera indica</i> | 9 |
| <i>Albizia</i> spp. | 11 | <i>Cordia holstii</i> | 6 | <i>Azadirachta indica</i> | 6 |
| <i>Persea americana</i> | 9 | <i>Mangifera indica</i> | 5 | <i>Cassia siamea</i> | 6 |
| <i>Mangifera indica</i> | 4 | <i>Cedrela mexicana</i> | 4 | <i>Acacia</i> spp. | 4 |
| <i>Margaritaria discoidea</i> | 3 | <i>Albizia</i> spp. | 3 | <i>Senna siamea</i> | 3 |
| <i>Olea welwitschii</i> | 3 | <i>Persea americana</i> | 2 | <i>Leucaena leucocephala</i> | 3 |
| <i>Rauvolfia caffra</i> | 2 | <i>Citrus sinensis</i> | 2 | <i>Euphorbia tirucalli</i> | 3 |
| <i>Cordia holstii</i> | 2 | <i>Azadirachta indica</i> | 2 | | |
| <i>Carica papaya</i> | 2 | <i>Combretum</i> | 2 | | |

¹ Frequency indicates the number of farmers who listed the tree species amongst the five most important trees growing on their plots.

Livestock numbers began to go down since the colonial times when money started to play a more important role and old traditions began to lose their importance (Fernandes et al., 1984). Maro (1974) stated that the number of goats and sheep per family in the highlands declined by 57 % between 1947 and 1970. Fernandes et al. (1984) in the 1980's reported 3 cows and 2 goats per household (homegarden area only). The current study shows 1 cow per highland household, 6 per lowland household; one to two goats in a highland household and 8 in a lowland household. According to the interview many farmers had had their biggest numbers of animals on average of nine years ago, many even more recently. The main reason for decreasing livestock numbers is lack of space and lack of enough fodder. However, the value of livestock production may not have changed as dramatically when better breeds and higher quality feeds are used today. 26% of all cattle in all the interviewed households were grade cattle or cross-breeds of local and grade cattle. The percentage of improved cattle in the highlands was 58%. In 1970's only 12% of the farmers kept grade cattle (Maro, 1974)

Sudden additional expenditures can arise any time. When some important events like weddings and funerals take place in a village, everyone is expected to contribute a few hundred shillings. In order to contribute, farmers often need to sell some of their crop production or a hen. If there is sudden sickness or death in their own family farmers may even sell livestock. Land can be sold in an extreme situation, when there is no other alternative. Farmers with very few assets to depart with are in an extremely vulnerable situation in facing sudden shocks, while an off-farm job often enables farmer to handle

unexpected expenditures without departing with a valuable asset. Farmers who do not have an off farm activity would like to have a small shop, mill, kiosk or a hotel-restaurant. Also buying and selling agricultural products, livestock and hens was considered a profitable activity that would supplement farm production. Farmers with special skills (six out of 45) would like to earn more by carpentry, crocheting, welding, masonry, teaching carpentry or milling. Lack of customers or big enough markets and lack of credit for investments and to get started are two biggest problems in starting an off-farm activity.

Interrelationships of farm assets and production

From the nine independent variables only land size and farmers age had statistically significant influence on revenue per hectare from the main crops grown. Fifty six percent (sig. F change 0.000) of farm total production from main crops can be explained by land size only. Farmers with larger land areas produce higher revenues per hectare. Mlambiti (1985) argued against this in the 1980 when he did his study in the Kilimanjaro area. He stated that for a peasant farmer there is no relationship between yield levels and size of the farm. He also stated that net returns *per acre* are usually higher for small farms than for larger farms. This seems true, though land size is not the only variable explaining this - production is also depend on farmer's age. In general, farmers below 35 years old have 100% higher revenue per hectare from main crops compared to farmers above 50 years old. This means that young farmers cultivate more intensively than either middle aged or old farmers as young farmers have on average much less (0.8 ha) land than the older farmers (2 ha). Farmers between 36 and 50 years old had though the highest production figures *per farm*.

In addition the study looked at correlations between fertiliser use and off-farm income, off-farm jobs and education level and whether more educated farmers use more fertilisers than less educated farmers. None of these variables were correlated. There are many other ways to use off-farm income, not only for farm investments. Similarly, the jobs that are mostly available in the area are not depended on one's education level. Nor does increasing education level reflect on farming techniques, mainly because a more educated farmer is busy with his job outside the farm and leaves his farm management for his wife and children.

There is a clear disconnect between farmers' perceptions on problems and factors affecting crop production and variables shown by the data having or not having an impact on crop production differences between the farmers. Number of persons in the household is perceived as an important asset securing labour force on farm, and lack of labour is mentioned among the most difficult problems. There is though no indication in the statistical analysis that a larger number of persons in a household would lead to more productive and effective farming. The same applies to fertiliser use. Lack of capital to purchase and apply fertilisers is considered the biggest problem in farming, yet there is no indication that farmers who apply fertiliser would obtain better yields. One explanation to this can be that no information on *how much* fertilisers were used was obtained through the interviews. Further, having an off-farm job is considered to allow higher farm inputs and thus leading to higher farm production. There is however no correlation in the statistical analysis between production figures and having an off-farm jobs. These discrepancies between farmers' perceptions and evidence from the statistical data analysis are best explained by the great number of survival strategies or development pathways and combination of assets of the farms, which make it impossible to delineate any clear patterns or combinations of coping strategies and assets that would lead to certain livelihood outcomes which would then reflect on farm revenue. Each family has a unique and changing set of assets and incentives. This has clear implications on

finding suitable development interventions as one or few intervention options would not address the multiple problems and development questions that the area faces.

Discussion and conclusions

In the Chagga setting a statement by Nair (2001) that “homegardens flourish today almost unchanged from the pre-scientific-agricultural days” and “are under no apparent production- or environmental threats” is by no means true. The Chagga farming system has been under change since the early immigrants started to transform the original forests on the slopes of Mt. Kilimanjaro by cutting less important trees, keeping useful tree species, and by adoption of new tree and crop species. (Fernandes et al., 1984; Kisanga, 1998¹; Koponen, 1988; Moore & Puritt, 1977). Large scale adoption of coffee cultivation in the 1930s, led to major modifications of the system. Work load increased considerably, rangelands in the uplands were converted to coffee cultivations necessitating stall-feeding of the cattle, food production in the uplands declined due to the expanding coffee production pushing it gradually to the lower slopes (Maro, 1974; Maro, 1975; Zalla 1982). Since 1960s coffee price in the world market has continuously declined. Many farmers would uproot their coffee trees if it was permitted by the law and if they knew how to use the land profitably in some other way. Despite all the environmental changes and the fact that the cash crop on which the whole system was built on in the 1930s has lost its value, the farming system is trying to function with only little adaptations made. Farms have been subdivided to the point that under present management most of them are too small to sustain a family. Some of the plots have just enough space for a house and cannot function as farms any more. Further, decreasing water supply in rivers and furrows are a serious problem affecting farming on the lower slopes and the adjacent plains. What are then the entry points of development interventions that would by building human, social, financial, natural and physical capital lead through improved livelihood strategies and activities to improved livelihood outcomes?

According to the regression analysis, adding basic education on top of the typical seven years at school does not have any impact on farm productivity or practiced farming techniques. It though became clear from the interviews that most of the farmers miss proper farm extension that could work as a source of knowledge of best practices in small hold farming. High quality extension with current knowledge of best practices and a variety of new opportunities and innovations could be one important entry point to build up capacity in human capital.

Due to land scarcity in the area, expanding cultivation beyond the current extent is not an option. In order to increase natural and physical capital a farmer would need to add value to his existing acreage. This could be done by improved technologies in growing the existing crops, by adopting more diverse a set of crops and higher value crops, and growing high value fruit and timber trees. Anderson (1982) used land use potential groups according to which he gave a number of location specific recommendations for diversification of agricultural production on the whole mountain. Aminu-Kano et al. (1992)⁷ list recommendations which are further ranked by farmers themselves. Recommendations include replacing part of the maize area in the drier areas by sorghum (*Sorghum bicolor*), millet, pigeon peas (*Cajanus cajan*), castor (*Ricinus communis*), cashew nuts (*Anacardium occidentale*), sunflower (sunflower cakes for dairy cows) and cotton (*Gossypium* spp.). Pyrethrum (*Pyrethrum roseum*) growing on the eastern slopes could be increased and the species introduced to the western slopes over 1500m. Wheat (*Triticum aestivum*) which has been grown only on the western slopes could be introduced to the eastern side of the mountain. Tea (*Camellia sinensis*) would do much better than coffee on the acid soils of the

upper slopes. Irish potatoes (*Solanum tuberosum*) and temperate fruit trees could be expanded to many parts of the upper zone. Improved fallows, contour bunds and borderline plants could be used to control erosion and to produce more fodder. Dairy goat keeping should be encouraged as they require less management and fodder than dairy cows, though effects of possible reductions in manure availability should be investigated.

A new opportunity worth investigating would be organic, eco-friendly and fair-trade coffee markets. According to a recent study by Giovannucci and Koekoek (2003)⁸, the market share of sustainable coffees ranges from 0.3 percent to 3.4 percent in European countries and is 1.2 percent in Japan. Despite the low numbers, average sales growth of sustainable coffees has been five times superior to that of coffee produced along conventional methods. Furthermore, the sustainable and development-friendly coffee market in Europe is expected to grow by 55 to 65 percent by 2004. In addition to temperate fruits and sustainable coffee, more investigation on the potentiality of spice production is needed. Cardamom (*Elettaria cardamomum*) is already growing in some homegardens, but currently at an insignificant scale. Even if it is difficult to directly adopt crops from other homegarden systems of the world (Fernandes and Nair, 1990) due to the fact that ecological conditions between different homegarden systems vary enormously, one cannot ignore the fact that spices like black pepper (*Piper nigrum*), cardamom and cinnamon (*Cinnamomum zeylanicum*) are grown successfully on other coffee based homegarden systems (e.g. Nair and Sreedharan; Suyanto et al. 2001).

Making a variety of new opportunities and innovations available to farmers should go hand in hand with creation of markets for the new products i.e. building financial capital. So far lack of larger markets and processing of production has hampered all of the currently available crop options at a larger scale. Processing of farm produce suffering from seasonal overproduction would be a key factor to be looked at. Banana chips and sun dried tomatoes are just two simple examples that could control seasonal price fluctuations and preserve farm produce from being spoiled. Also, different options such as canning temperate fruits and tomatoes, possibility of using avocado oil for cosmetics, making peanut butter locally, processing milk into cheese and yoghurt, should all be carefully investigated. Establishment of small scale enterprise seems like a lucrative option to many farmers on the slopes of Kilimanjaro, but very few have the capital to get started. Having small credits available would be another entry point of building financial capital. Collective action i.e. building social capital could be one way to address these three problems of processing, marketing and credit. Collective action could also work as a means of building physical capital by organising transport for marketing and by collectively purchasing more expensive equipment and tools. In addition, these self-help groups could also work as platforms for farmer to farmer training in best practices. So far people have not seen any benefits in being part of groups. There should though be a way to build social, physical and financial capital together by creating collective action that would appear attractive enough for the farmers to participate.

Growing expectations are forcing the younger generation to look for better and more productive ways to earn their living. As younger population moves out of the area in search of work it leaves behind an ageing population who does not have the physical strength to manage the land efficiently (Fernandes et al., 1984; Kisanga, 1997⁹). The area has already partly become a suburban from where people commute daily to work in the villages and Moshi town. But as education and/or off-farm jobs are not, and will not be, a realistic option

for all of the farmers, many remain as full-time farmers. For that reason the area requires increased efforts to maintain and improve its agricultural productivity. There is a clear and urgent need for technical research and experimentation on new agricultural options for the area and a need of understanding marketing channels for these options in order to provide organizations, farmers and policy makers with sound technical advice on the alternative development pathways.

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Endnotes:

¹ Kisanga D. R. 1998. Study of the impact of some plant species on soil and water management in the slopes of mount Kilimanjaro. A research report presented as part of reconstruction and development in Kilimanjaro area project. Scientific Research Programme, Tropical Mountains, Kilimanjaro. Department of Geography, University of Dar es Salaam. 18 pp.

² Zongolo S. A., Kiluvia S., Mghase G. 2000a. Umbwe Onana PRA report. Traditional Irrigation and Environmental Development Organization, Moshi. 46 pp.

³ Department for International Development (DFID), 2001. Sustainable livelihoods guidance sheets, Section 2.

⁴ Ashley C. and Hussein K. 2000. Developing methodologies for livelihood impact assessment: Experience of the African Wildlife Foundation in East Africa. Working paper 129. Overseas Development Institute, London. 61 pp.

⁵ Soini E 2003. Changing landscapes and livelihoods on the southern slopes of Mt. Kilimanjaro, Tanzania. In Merts O, Wadley R, Egelund Christensen A, eds. Local land use strategies in a globalizing world: shaping sustainable social and natural environments. Proceedings of the International Conference, 21–23 August 2003. Institute of Geography, University of Copenhagen, Denmark. pp 311–335.

⁶ Place F., Kariuki G., Wangila J., Kristjanson P., Makauki A., Ndubi J. 2002. Assessing the factors underlying differences in group performance: Methodological issues and empirical findings from the highlands of central Kenya. CAPRI Working Paper 25. IFPRI, Washington DC. 47 pp.

⁷ Aminu-Kano A., Gundel S., Kilambya W., Lazaro E., Polet G., Ruiz Vega J., Saidi R. 1992. Coming down the mountain: A study of agriculture on the slopes of Mount Kilimanjaro Tanzania. Working document series 21, Tanzania 1992. International Centre for development oriented Research in Agriculture (ICRA) and Selian Agricultural Research Institute (SARI). 111 pp.

⁸ Giovannucci D. and Koekoek F.J. 2003. The State of Sustainable Coffee: A study of twelve major markets. Daniele Giovannucci, Philadelphia. Study sponsored by The World Bank. 199 pp.

⁹ Kisanga D. R. 1997. Environmental Resources and degradation problems in the slopes of mount Kilimanjaro: Peoples' perception and awareness. A research report presented as part of reconstruction and development in Kilimanjaro area project. Scientific Research Programme, Tropical Mountains, Kilimanjaro. Department of Geography, University of Dar es Salaam. 22 pp.

Bibliography

- Anderson G. D. 1982. (Revised edition of 1968 paper). A survey of soils and land use potential of the southern and eastern slopes of Mt. Kilimanjaro, Tanzania. Resource management paper no 1. Institute of Resource Assessment, University of Dar es Salaam and International Development Programme, Clark University, Worcester, Massachusetts USA.
- Beer J., Muschler R., Kass D. and Somarriba E. 1998. Shade management in coffee and cacao plantations. *Agroforestry systems* 38: 139–164.
- Blot J. 1999. Ecology, dynamics and evolution of vegetation in Kilimanjaro. *Mount Kilimanjaro: Land and Environmental Management*. IFRA, Les Cahiers. French Institute for Research in Africa. pp. 78-81.
- Carney D. 1998. Implementing the sustainable rural livelihoods approach. In: Carney D. (ed). *Sustainable Rural Livelihoods: What Contribution Can We Make?* Department for International Development (DFID), London. pp. 3-26.
- Fassbender H. 1993. *Modelos Edafológicos de Sistemas Agroforestales*, 2nd Ed. CATIE, Turrialba, Costa Rica.
- Fernandes E.C.M and Nair P.K.R 1990. Evaluation of the structure and function of tropical home gardens. In: Laudauer K. and Brazil M. (eds). *Tropical home gardens*. United Nations university press, Tokyo, Japan. pp. 105-114.
- Fernandes E.C.M, O'Kting'ati A., Maghembe J. 1984. The Chagga homegardens: a multistoried agroforestry cropping system on Mt. Kilimanjaro (Northern Tanzania). *Agroforestry Systems* 2:73-86.
- Grove A. 1993. Water use by the Chagga on Kilimanjaro. *African Affairs*. 92 (368): 431-448.
- Hastenrath S. & Greischar L. 1997. Glacier recession on Kilimanjaro, East Africa, 1912-89. *Journal of Glaciology* 43 (145): 455-459.
- Koponen J. 1988. People and production in late precolonial Tanzania, history and structures. Scandinavian Institute of African Studies, Uppsala.
- Maro P. 1974. Population and land resources in Northern Tanzania: the dynamics of change 1920-1970. A PhD thesis submitted to the Faculty of the Graduate School of the University of Minnesota.
- Maro P. 1975. Population growth and agricultural change in Kilimanjaro 1920-1970. Bureau of Resource Assessment and Land use planning, Dar es Salaam. 48 pp.
- McGrath D.A. 1998. Ecological Sustainability in Amazon Agroforests: An On-Farm Study of Phosphorus and Nitrogen Dynamics Following Native Forest Conversion. PhD Dissertation, University of Florida, Gainesville, FL, USA
- Mlambiti M. 1985. Agricultural sector analysis for Kilimanjaro region: a basis for decision making and planning. A thesis submitted for the degree of Doctor of Philosophy in Agricultural economics. University of Dar es Salaam.
- Moore S. 1969. Ritual concord and fraternal strife Kilimanjaro 1968-1969. Manchester University Press.
- Moore S & Puritt P 1977. *The Chagga and Meru of Tanzania*. International Africa Institute, London.
- Nair M.A. and Sreedharan C. 1986. Agroforestry farming systems the homesteads of Kerala, southern India. *Agroforestry Systems* 4: 339-363.
- Nair P.K.R, Buresh R.J., Mugendi D.N., Latt C.R. 1999. Nutrient cycling in tropical agroforestry systems: myths and science. In: Buck LE, Lassoie JP and Fernandes ECM (eds), *Agroforestry in Sustainable Agricultural Systems*, pp 1–31. CRC Press, Boca Raton, FL

- Nair P.K.R. 2001. Do tropical homegardens elude science, or is it the other way around? *Agroforestry systems*, 53: 239-245.
- O'king'ati A., Maghembe J.A., Fernandes E. C.M., Weaver G.H., 1984. Plant species in the Kilimanjaro agroforestry system. *Agroforestry systems*. 2: 177-186.
- O'king'ati A and Mongi H.O. 1986. Agroforestry and the small farmer: a case study of Kilema and Kirua Vunjo in Kilimanjaro. *The International tree crops journal*, 3: 257-265.
- Suyanto S., Tomich T.P., Otsuka K 2001. Land tenure and farm management efficiency: the case of paddy and cinnamon production in customary land areas of Sumatra. *The Australian journal of agricultural and resource economics*, (45) 3: 411-436.
- Swynnerton R. J. M. 1949. Some problems of the Chagga on Kilimanjaro. *East African Agricultural Journal* 14:117-132.
- Zalla T. M. 1982. Economic and technical aspects of smallholder milk production in northern Tanzania. Michigan State University, Ann Arbor.