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Small-scale farming in semi-arid areas: Livelihood dynamics between 1997 and 2010 in Laikipia, Kenya

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A B S T R A C T

The rural population of semi-arid lands in Kenya face multiple challenges that result from population growth, poor markets, land use and climatic changes. In particular, subsistence oriented farmers face various risks and opportunities in their attempt to secure their livelihoods. This paper presents an analysis on how livelihood assets and strategies of smallholders in Laikipia County, Kenya, have changed within the last decade and discusses the implications for development interventions. The analysis is based on bi-temporal data from 170 semi-structured household interviews in 1997 and a follow-up survey of 30 households conducted in 2010. Well-being indicators were developed and livelihood portfolios compared. The results show a striking persistence in low asset endowment for the majority of smallholders from an aggregated perspective, whereas transitions into and out of better livelihood conditions become evident from a household perspective. The investment in, and accumulation of, conventional buffer or productive assets, such as grain stocks, livestock or land, does not shield households from adverse shocks and stresses as smallholders were shown to easily slip back into poverty. Household portfolios display particular constraints for smallholders in expanding natural resource related activities and a substantial decrease in livestock numbers. While off-farm activities could possibly increase well-being, the prevailing low income levels and high insecurity for the majority who are engaged in off-farm employment, limits the ability to increase livelihood assets in the area.

1. Introduction

Securing rural livelihoods and well-being in the rural areas of Africa continues to be challenged by dynamic socio-ecological conditions and low adaptive capacities (Misselhorn, 2005; Lay et al., 2008; Thornton et al., 2010). Poverty reduction thus remains one of the greatest challenges for development and has been revived as a central topic in the development discourse as well as in the Kenyan national agenda and in the Millennium Development Goals (GoK, 2007). Half of the Kenyan population is estimated to live below the poverty line, which for the rural areas was set at an equivalent of US$ 0.68 per day (UNDP, 2006). The population in arid and semi-arid lands, which constitute 80 per cent of Kenya, is among the most vulnerable. They face new challenges as a result of rapid changes in an array of socio-economic, political and ecological conditions. Massive population growth since independence in 1963 as well as land use changes and land degradation respectively have led to dramatic socio-ecological changes (Kiteme et al., 2008). Livelihoods are further exposed to economic liberalization, new governance structures, food insecurity and ethnic conflicts among others. The expected increasing frequency of droughts and floods (IPCC, 2007) pose new threats to their livelihoods.

In rural Kenya, livelihoods are mainly based on crop cultivation and livestock keeping. The smallholders are most affected by and at the same time shape their own region's development (Wiesmann, 1998). The necessity to understand their capacity to cope with a difficult and changing environment as well as their ability to take advantage of opportunities has been widely acknowledged. This is yet again made clear with the severe drought that hit the Horn of Africa in 2011 leaving an estimated thirteen million people in need of humanitarian aid, despite early warning system predictions. Longer-term solutions for such crisis through the assistance in

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sustainable livelihoods and people's resilience are called for. Analysing livelihood strategies is an integral part of development research and practice that aims to increase both livelihood resilience and actors' adaptive capacities.

In general, livelihoods are defined as the capabilities, assets and activities required for a means of living (Chambers and Conway, 1992). The assets are classified into five categories: human, natural, financial, physical and social capital. Resilience applied to livelihoods refers to the capacity to tolerate disturbance without the livelihood collapsing and to the ability of local actors to cope with stress and shocks (Adger, 2000; Carpenter et al., 2001). Livelihood insecurity is often associated with vulnerability, that is, the exposure to threats and the inability to cope, as it is the poor who are first affected by stressors and who have the least capacity to cope and adapt (Chambers, 1989; Bohle et al., 1994; Adger, 2006). However, poverty is measured in either non-dimensional economic or multi-dimensional ways (Chambers, 2006). Using monetary terms only, the Government of Kenya defines the poor as those who cannot afford basic food and non-food items having less than KSH 1239 (~US$ 14) per adult equivalent per month (GoK, 2000). As it is widely discussed that income alone does not necessarily provide a reliable measure of well-being, the use of assets as a measure should complement income and consumption-based measures of welfare and wealth (Carter and Barret, 2006; Moser and Felton, 2007; Addison et al., 2009). In this study, the term well-being is used to capture the wider dimensions not captured when using poverty in monetary terms. Marschke and Berkes (2006) argue that an analysis of well-being sheds light on livelihood realities on a local level and complements resilience analysis.

In light of recent calls for more effort on understanding livelihood dynamics (De Haan and Zoomers, 2005; Addison et al., 2009; Scoones, 2009), this paper contributes to the current livelihood debate with an inter- and intra-household comparison over thriteen years. The longitudinal analysis and focus on livelihood dynamics is one way to comprehend longer-term change (Scoones, 2009). Looking at the same households over time allows a better understanding of the conditions that keep people in poverty and on what enables them to improve their situation and inform policies (Kristjanson et al., 2010). Furthermore, De Haan (2010) calls for more longitudinal studies within actor-oriented livelihood research. The focus on how households respond to continuous change helps understand local development and highlights individuals' active or proactive role in enhancing and securing their livelihoods (De Haan and Zoomers, 2005). This study takes up this actor-oriented approach (Wiesmann et al., 2011) based on Bourdieu's (1997) forms of capital and Giddens structuration theory (1984) and action theory (2009). While recent studies on livelihood dynamics have focused on livelihood strategies (Marschke and Berkes, 2006) or livelihood trajectories (Sallu et al., 2010), this paper aims to analyse the (changing) composition of assets in order to deepen the understanding of how smallholder livelihoods have changed over the past decade. The accumulation, loss or substitution of assets directly and indirectly translates from livelihood strategies, from the formal and informal institutional setting and the shocks and stresses that farmers face. The focus on assets is therefore a way to analyse livelihood dynamics and further allows linking these with smallholders' well-being.

Based on a retrospective approach, quantitative and qualitative data on asset endowments for 30 households collected in 1997 were repeated in 2010. With a comparative bi-temporal perspective households' combination and substitution of assets, that can be called their portfolio of assets, are assessed. Dynamics and stability within these portfolio compositions are analysed at household level as well as from an aggregated perspective. A greater understanding of the distribution of poverty within a population, differentiating between permanent and transitory conditions (Addison et al., 2009), is addressed through the development of a well-being indicator that allows for a comparison between households and within households over time. Standardised criteria such as education level, income from farm and off-farm activities, level of subsistence, livestock, housing material and community participation are integrated in the composite indicator. Although health issues also play an important role for well-being, it could not be integrated due to data gaps.

2. The study area

Laikipia County lies on the north-western, semi-arid foot zone of Mount Kenya. Located on a high plateau with an altitude between 1600 and 2300 m a.s.l. it spans a total area of 9700 km^2 (Kiteme et al., 2008). The area experiences three rain seasons including the long rains (Mar–June), continental rains (Aug–Sept), and the short rains (Oct–Dec). Long-term climate data in the region reveal climate variability between years (annual rainfall trend 1930s to 2000s); and that the climate outlook during this period is more or less the same (considering a 30 year period cycle). The rains are unreliable and unpredictable in terms of onset, duration and termination. Seasons experiencing total rain failure during continental rains have increased from 4 (1961–1982) to 6 (1986–2000) (Gichuki et al., 1998; CETRAD and CDE, 2007). These climatic changes and variability impact greatly on all natural resources and particularly water that continues to become scarcer. Furthermore major river systems in the area indicate a significant decline (from 9 m^3/s in 1960s to less than 1 m^3/s in 2000s) even when the rainfall regime has not shown any significant change to impact on these river flows. This revelation could be attributed mainly to regional land use changes associated with increasing population and growing demand for river water to support irrigation production (Kiteme et al., 2008; Gichuki et al., 1998). With a high variability and unreliability of rainfall and declining water resources coupled with the worsening problem of land degradation and high erodibility of soils, local actors in the area face harsh ecological conditions, of which water availability has been identified as the most limiting factor for agriculture (Wiesmann, 1998). The situation is likely to worsen as climate models in the area predict increasing variation in rainfall patterns affecting freshwater availability. Not only the amount in total rainfall, but its inter- and intra-annual variability will increase and adversely affect peoples' livelihoods (Notter et al., 2007).

A deeper understanding of recent land use change requires integrating the historical dimension of cultural landscape transformation. Land ownership and tenure have undergone two major changes over the past century. The Maasai were the traditional inhabitants of the area that became known as the *White Highlands* during the colonial period, when land use shifted to extensive farming, reserved for European settlers (Kohler, 1987). With Kenya's independence in 1963 land distribution programmes led to internal migration particularly to the region north-west of Mount Kenya (Kohler, 1988; Kiteme et al., 2008).[1] This high influx of people led to population increase from 60,000 in 1960 to over 400,000 residents in 2009 in Laikipia County (KNBS, 2009). Land use changed respectively from predominant extensive ranching to small-scale mixed farming (Wiesmann, 1998).

The transformation in land use systems is reflected in the following pattern: Towards the mountain, on the highlands and mountain foot-slopes, smallholder farming becomes denser and large-scale horticulture enterprises have been established (Ngigi

[1] The 2008 post-election crises in Kenya did not directly affect the study area.

et al., 2007). A larger proportion of the population live in this area. A network of towns and local trading centres developed, with Nanyuki being the biggest town with a current urban population of 31,826 (KNBS, 2009). The further away from the mountain, the drier the area and small-scale farming is replaced by pastoral range lands, large ranches, tourist lodges and game parks (Wiesmann et al., 2000; Ngigi et al., 2007). The growing number of water abstractions for irrigation, livestock and domestic purposes (Aeschbacher et al., 2005) has led to growing competition for this scarce resource. Moreover, strategies to secure livelihoods often induce further limitations for land use potentials as has been experienced e.g. with the widespread practice of charcoal production (Fig. 1). Potential conflicts between users rise with the land use changes and related growing pressure on already scarce natural resources.

The largest numbers of settlers in the area come from the Kikuyu and Meru tribes who belong to the Central Bantu ethnic group (Wiesmann, 1998). They originate from high potential areas on the eastern and southern slopes of Mount Kenya and migrated to Laikipia due to population pressure in their home areas and settlement programmes that offered land for sale in the area in the 1960s and 70s (Kohler, 1988). Land holdings are typically around 1.2–2.4 ha in the area. Kohler (1988) argued that plots of this size are by far not big enough to secure subsistence under the given agro-ecological conditions. The potential for sustainable smallholder farming in the area is therefore rather limited.

3. Methods

3.1. Data collection

A standardized questionnaire, primarily comprising semi-open questions, was developed by Wiesmann (1998) within the Laikipia Research Programme (LRP) in 1997. Based on this questionnaire, in-depth interviews were held with 170 smallholder households representing a random sample of ten per cent of the households from eleven settlement areas that represent the region's ecological gradient and are all within the boundary of sustained rainfed agriculture (Wiesmann, 1998). Owing to time limitations and the particular focus of the study, pertinent sections of the questionnaire were adopted for follow-up in the 2010 survey. Repeat interviews were conducted with thirty farmers in five settlement areas, namely Ngenia, Mia Moja, East Laikipia, Nyakairu and Burguret (Fig. 2) that were randomly selected depending on their availability. A bias cannot be ruled out as households that moved away or deceased could not be included in the analysis of livelihood dynamics. The interviews were held with the respective household head by research assistants in the local language Kikuyu.

3.2. Well-being index

In order to enable an overall comparison of livelihood portfolios, a well-being index was developed. The participation of rural stakeholders in identifying and weighting indicators enables an assessment that is relevant to local actors within their socio-ecological context. Specific indicators correlating with well-being were identified for the rural Kenyan context (Table 1). Regional studies from Kenya have shown that the purchase of land and dairy cattle, investments in off-farm activities and ownership of permanent housing (brick building with corrugated iron roof) are associated with households that are relatively well-off (Krishna et al., 2004; Eriksen et al., 2005; Ifejika Speranza, 2006). Note is taken that an index can only give a partial picture of livelihoods due to human subjectivity.

In order to further substantiate the relative importance of the various indicators, eight local researchers and farmers participated in an exercise to weight the well-being indicators according to their perceived importance for a typical household. Each participant made a comparative score of a particular indicator against all the other indicators, ensuring that the total score for all indicators did not exceed 100. In order to enable a clearer

Fig. 1. Charcoal production has led to dramatic land cover changes in Laikipia (M. Nüsser, 06.Feb.2009).

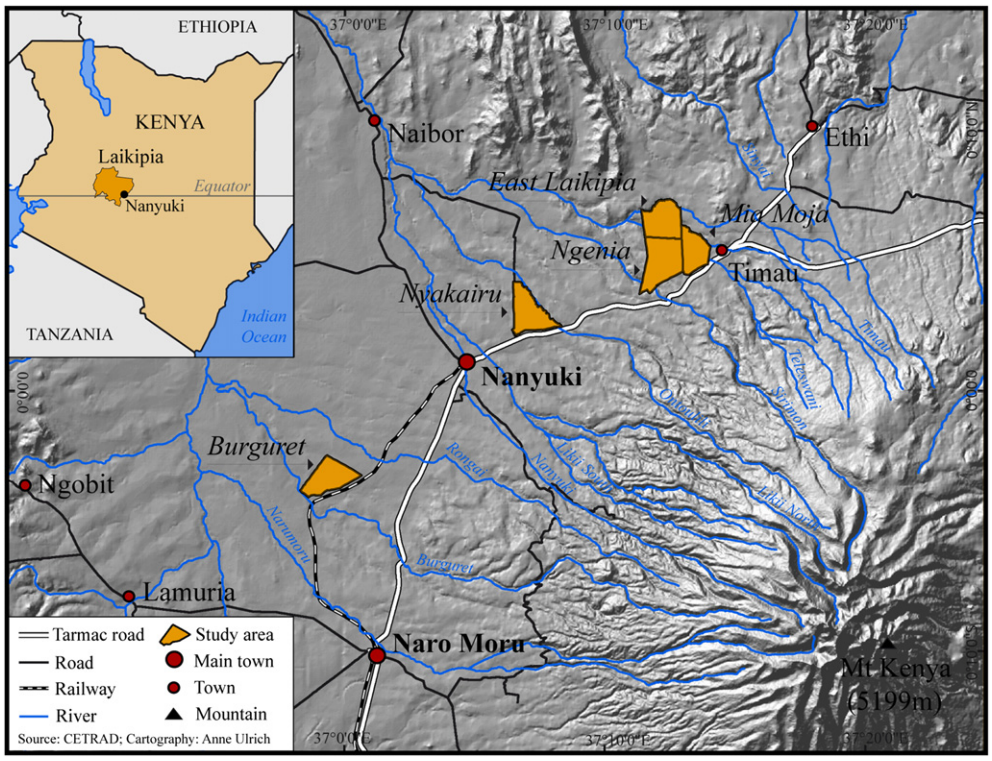

Fig. 2. Location of study areas in 1997 and 2010.

classification of each household's performances within the index, a more direct sub-indicator classification for each indicator was developed. Within the region's context a basic classification of what indicates a higher or lower level of well-being was established. For purposes of analysis the classification were given points from one up to five, with one being the lowest score and five the highest (Table 1).

Household results are scored per indicator, and these are then summed up according to the weights the indicators are given $(\sum_{i}^{n} \gamma_i \cdot p_i)$.[2] This way, performances may be compared on an inter- and intra-household basis within and between the two research periods. The index is used for an overall assessment. Interviewed smallholders shifted in and out of categories and are therefore not per se the same households for each category in 1997 and 2010. The categorisation of households allows for a detection of differentiated asset endowment and livelihood strategies related to the overall well-being.

3.3. Data analysis

Livelihood portfolios, and the differentiation of households into groups categorised according to well-being status, are used to identify continuity and/or change in smallholders' livelihood assets and strategies, enabling change detection in differences as well as similarities between households that are relatively poor with those that are better off (Carney, 1998; Ellis, 2000). This can improve the understanding of pathways into and out of poverty. As transfer and change does not only happen 'between' capitals but also 'within' capitals (e.g. shift from livestock to crop production), and as not all assets are solely to be associated with only one capital (e.g. livestock as natural and financial capital), a differentiation between the selected eight indicators representing major aspects of smallholder livelihoods is used. Different shapes within the portfolio portray different asset endowments, priorities and/or needs. The increase or decrease of each indicator is thereby shown on a star graph. The centre represents a minimum and the outer margin represents the maximum of endowment. The same scoring as for the well-being index is used to scale each indicator. Thus households may reach between a minimum of one and a maximum of five points accordingly. The method has the advantage that outliers do not deform the average scale.

4. Results

4.1. On-farm activities

All households interviewed cultivated maize, the staple food in Kenya. Together with beans and potatoes this constitutes the basic mix of crops for these smallholders. They diversify on-farm production growing basic crops and keeping at least some livestock.

Farm plot size remained the same as 1997 and ranged from 0.4 to 6 ha, with two thirds of households having 1.2 ha of land or less. The average plot size was similar in 2010 (2 ha, standard deviation (sd): 1.5) as to what it was in 1997 (1.9 ha, sd: 1.2). Distribution of land allocated for crop and garden production within the households was also similar to that of 1997. More than one third use less than 1 ha for crop farming, whilst only around 10 per cent use more than 1.5 ha. Crop-land accounts for 56 per cent of land use in 2010, which has not changed compared to 1997.

Out of thirty households, seven grew horticultural products such as kale, spinach, cabbage, snow and garden peas, tomatoes or napier grass in 2010. The production of wheat declined both in numbers of households growing it and the overall amount harvested when compared to the 1997 data.

[2] i = indicator; p = performance of household (points 1–5); γ = weights; n = number of indicators.

Table 1
Performance in well-being indicators shows if households are comparably better (or worse) off.

Capital[a]	Indicator	Weight (%)	Comparably worse off			Comparably better off	
			1 point	2 points	3 points	4 points	5 points
H	Education level	16	No one has completed secondary school	Majority has not completed secondary school	Majority has completed secondary, but also low level prevalent	Majority has completed secondary, at least one with medium/higher training	Overall high level of education, at least one with college degree
N	Land size (acres)	21	<2	2–3	3–6	6–10	>10
N/F	Subsistence production (months)	10	<3	4–6	7–9	10–12	>12
N/F	Livestock (LSU)[b]	13	<1	1–2	2–3	3–4	>4
F	Farm income (KSH)[c]	13	<10,000	10,000–20,000	20,000–30,000	30,000–50,000	>50,000
F	Estimated level of off-farm income	7	No off-farm income	At least one person with casual employment	At least one person in regular casual employment or informal sector	At least one person in permanent employment (or self-employed)	At least one person in skilled, high return employment
P	Housing material	15	Mud house	–	Wooden house	–	Stone house
S	Community participation	5	No participation	–	Participation in one group	–	Participation in more than one group

[a] Human (H), natural (N), financial (F), physical (P) and social (S) capital.
[b] Factors for livestock unit: *1 milk cow; *0.7 oxbull; *0.5 heifer; *0.2 calf; *0.15 dairy goat; *0.1 goats and sheep; *0.02 chicken.
[c] Income (Kenyan Shilling) measured in present value, base year 2009.

In 2010 one third of households grew their agricultural produce for home use only. The majority that produced crop and garden products for market sold their harvest to brokers, others sold to neighbours or at local markets. For more than one third of households, income from crop and garden products is worth less than KSH 10,000 (~US$ 110) per year.[3] With the variable and erratic rainfall patterns experienced in Laikipia, farmers repeatedly mentioned that it is impossible to refer to a "*normal*" year of production, which makes it difficult to compare production levels over the years.

As in 1997 (Wiesmann, 1998) this study measured livestock numbers in standard livestock units (LU).[4] The number of livestock units decreased from an average of 2.9LU (sd: 2.2) in 1997 to 1.8LU (sd: 1.3) in 2010. For most households livestock units have reduced by more than half (mean of reduction is 65% (sd: 27)) (Fig. 3). Although better-off households still own more livestock in absolute terms in 2010, they experienced the most severe decline. In contrast those households with fewer livestock in 1997 showed an increase in livestock units by 2010.

Twelve households lost some of their livestock to theft. These cases do not correspond to the households that experienced declines shown in the comparison between 1997 and 2010, and therefore do not deliver a conclusive explanation for the decline in livestock numbers. However, considering the number of households directly affected and the severity of some losses (11 sheep or 5 cattle stolen), livestock theft ("*cattle rustling*") poses a considerable threat to smallholder livelihoods in Laikipia.

Population growth has led to increased competition for already limited natural resources in the area. Much common land has been converted to freehold tenure systems resulting in a reduction in access to grazing land, and consequently forcing smallholders to reduce their livestock numbers (Wiesmann, 1998; Campbell et al., 2002).

Following the reduction in available grazing land many households expressed an interest in investing in stall-fed dairy cattle. Despite the losses that households experienced, many still identified livestock keeping as important as crop production for the generation of a cash income and as a strategy to bridge food deficit periods.

Wiesmann (1998) categorised income levels in the area into low (less than KSH 10,000), medium (more than KSH 10,000) and high (more than KSH 30,000) annual income for a household. By using purchasing power parity for 2009 these figures translate to a value of around KSH 35,000 (US$ 400) and KSH 100,000 (US$ 1100) per household per year respectively. The data shows the same income distribution in 2010 as in 1997 and reveals in both years that more than two thirds within the sample were low income earners. In 2010 two households were the exception, managing a farm income of up to KSH 90,000 (US$ 1000) and KSH 170,000 *US$ 1900) per year.

While from an aggregated perspective income levels persist at a low level, examination of the data at individual household-level points towards substantial transitions. Approximately one third have increased their income substantially compared to 1997, whereas almost the same number of households have less income and another third has hardly changed. The households with the highest increase in income have land sizes above ten acres, and in addition to the basic crop mix also grow horticultural products.

Given the increasing pressure on an already low natural resource potential, the income and production possibilities from on-farm activities is limited further. This is reflected in results that show the number of months that households can live off their own

[3] KSH = Kenyan Shilling; present value, base year is 2009.
[4] Factors for standard livestock units: *1 milk cow; *0.7 oxbull; *0.5 heifer; *0.2 calf; *0.15 dairy goat; *0.1 goats and sheep; *0.02 chicken.

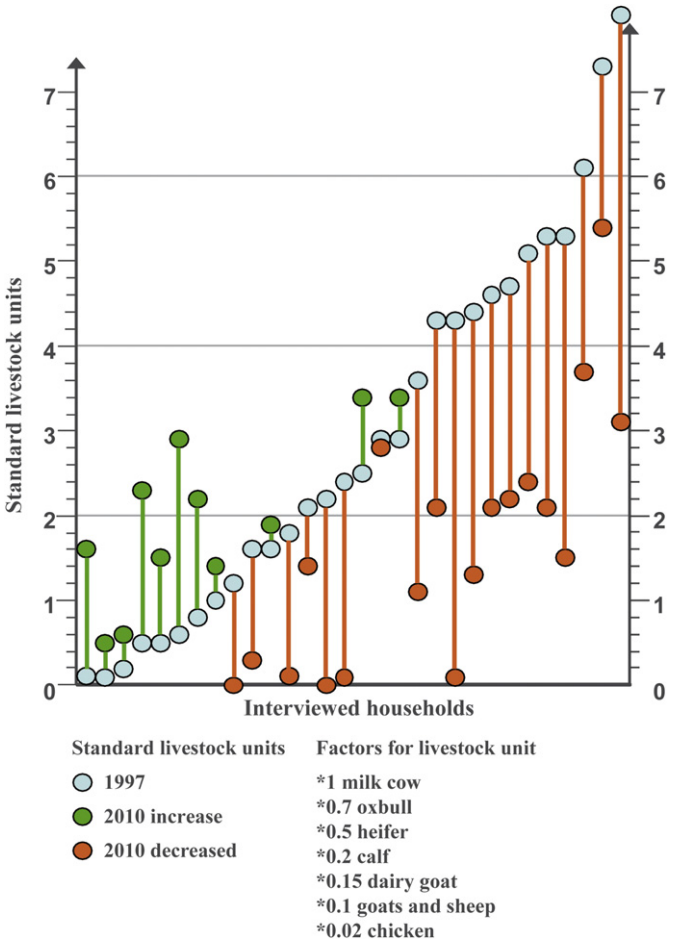

Fig. 3. Livestock units in 1997 and 2010.

production (annual food self-sufficiency). During *bad years* the data shows that all, except two households, could not live off their own food production for more than three months. Considering that several farmers referred to the last good year as being as far back as 1998 strengthens the conclusion that only a low level of subsistence is possible within the given ecological and climatic conditions and with current land sizes.

4.2. Off-farm activities

With this in mind rural households have little choice but to diversify their economy into off-farm activities in order to generate additional income. Wiesmann (1998) and Kohler (1988) define off-farm activities as all income generating activities that are not done on the own farm. In the study, all except two smallholders diversify their sources of income with at least some sort of off-farm activity.

The lack of quantitative data on earnings from off-farm activities makes it difficult to determine the importance within the households overall strategy. As levels of income vary tremendously, it is appropriate to establish a typology of activities that would enable a comparison between different levels of off-farm activities. On the basis of classifications by Kohler (1988), Brown et al. (2006) and Holdener (2007) this study distinguishes different levels of income generated by off-farm activities with regard to required skill and associated earnings. Main categories found are (1) permanent employment with further subdivision of (1a) high return and (1b) low return activities; (2) casual employment that is further distinguished into (2a) regular and (2b) occasional employment; and (3) no off-farm activity. With permanent employment the amount of income is substantial; the activity is crucial for the household and offsets the risk of agricultural production (Kohler, 1988). Permanent employment can still be distinguished between low return, unskilled employment and high return, skilled employment. High return employment is, for example, found within the public services. Pensions are also associated with continuous high return employment in Kenya (Brown et al., 2006). Contract work or casual employment is associated with a lower level of income and higher insecurity, and is by far a less effective strategy to balance or spread risk. In addition, high demand for labour for casual work typically collides with high labour demand on one's own farm. Very low off-farm remittance can be assumed where only one or two household members are involved in casual employment. In this category, focus is on farm activities, which is then supplemented with income from occasional labour.

In 2010 diversification of incomes through off-farm activities was adopted in all except two households (compared to twelve in 1997). Within households the number of persons engaged in off-farm activities increased from 33 to 54. This general trend in the importance of off-farm activities is tempered, however, with the majority being casual employment associated with low earning potential and high work insecurity. Fewer people are now employed in the public sector than a decade ago. As in 1997, permanent employment and employment in the public sector are typically taken up by family members who do not live on the farm. Self-employment, often through work in the informal *jua kali* sector, (i.e. making household products through recycled metal and wood) has shown a marked increase.

For asset accumulation off-farm activities play an important role. For a list of assets (livestock, radio, tv, bike, motorcycle, car, tractor, water tank, solar panel, etc.) off-farm activities accounted for 68 per cent of such investments in 2010, the majority out of these (89 per cent) due to permanent employment and pensions. Casual employment thus does not play a significant role for asset accumulation. The prevalence of low income job opportunities with insecure working conditions explains interviewees' general perception of a low level in amount and frequency of remittances from off-farm activities. These income opportunities were less important in covering expenses related to daily goods and services, education and asset accumulation in 2010 compared to 1997.

While male adults are still the dominant group engaged in off-farm activities, the number of women working off-farm more than doubled in the observed time period. Women constituted almost 40 per cent of those engaged in off-farm activities in 2010 compared to 20 per cent back in 1997. The reasons for this change may be attributed to the associated risks of a livelihood based on farming, as well as increased off-farm opportunities. For example, the growth in numbers of commercial horticultural farms have made them one of the largest employers in the area (Kiteme et al., 2008), of which women account for 75 per cent of the labour force. Most of the opportunities are on a casual basis and of all the households interviewed none of the women had a permanent off-farm job.

4.3. Social networks, physical and human capital

The low level of income and resulting food insecurity was highlighted by the increasing relevance of relief aid in the area. More than two thirds of the sample had been given relief aid within the last six months before the study, in each case due to the occurrence of drought and resulting crop failure. The majority received relief aid more than once. Although most people could rely on their children or other relatives in tough times, almost one third of all households reported they could not rely on anyone at all.

In order to reduce their vulnerability to shocks, new risk reduction mechanisms were established, for example with community groups that enable investments and assistance through a monthly saving and distribution scheme. The number of households that joined community groups grew in the past decade. The changing livelihood priorities of communities were reflected in the changing aims and objectives of community groups. In 1997 the main focus was clearly on water projects, leading to the formation of water user associations and water groups. Thirteen years later, community participation in water projects played a reduced role for households. The focus shifted towards the opportunity to gain financial assistance and credit. The majority of the groups were the so called "*merry-go-round*" self-help groups, where the aim is to provide members with credit for investments. These were almost always groups comprised of women. Most of their investments were on items for the household, for example on kitchen utensils or water tanks. Community groups were their answer to the difficulties they encounter in accessing credit through commercial banks. However, these groups are exclusive to households that can afford to pay a monthly fee, and many poorer households were therefore unable to participate. Nineteen out of thirty interviewees expressed lack of financial capital as their reason for less community participation. Other reasons included poor health status and strict regulations on participation.

In 2010, seven households lived in stone built houses, compared to only two in 1997. The majority still lived in mud built houses in 2010 and none had access to electricity. Two thirds of households did not have access to piped water and reported not to be satisfied with established local water projects. Their critiques included lack of running water, unreliability of water supply, water rationing, or cost. All, except two smallholders, mentioned that water availability is limited due to the exploitation of other users. As an explanation, more than two thirds of the farmers argued that upstream users abstract too much water, thereby reducing river flow. Other reasons were pollution, population growth and general lack of water. Thus, water accessibility was limited for many smallholders.

Half of the respondents had been directly targeted and/or influenced by development interventions. There were three main thrusts of development interventions: education, agriculture, and water. The main focus for education was on school-fee sponsorships and the construction of classrooms, for agriculture it was through the improvement of agricultural practices through the introduction of new methods and technologies, and for water the aim was to improve access through the supply of water tanks and pipelines.

Some of these development interventions appeared to be ineffective. For example the data shows that for the most common water project, the provision of water tank supply systems, only one out of six systems was functioning at the time of the study.

Furthermore, fewer people had completed secondary school in 2010 (26%; $n = 73$) than was the case in 1997 (40%; $n = 82$). Of all household members only 4 per cent managed to go beyond secondary school in 2010 (it was 3 per cent in 1997). The study showed that those family members not living on the plot are more likely to have a better education than those that do. For all a similar picture emerged, with fewer people having a basic level of education and what appears to be a reduction in the opportunity for a medium or higher level of education ending with a certificate, diploma or university degree.

4.4. Household strategies and portfolios

Diversification of livelihood strategies was found to be crucial for households. Main strategies were crop- and livestock-based agriculture, engaging in off-farm activities (including permanent and casual employment), relying on remittances from relatives (mainly adult children) and support from social groups (e.g. self-help groups). It became evident that the most important mechanism employed by smallholders to cover the lean months with insufficient food are through the sale of livestock and livestock products. Subsequent coping mechanisms are off-farm based, and in descending order include casual employment, relief aid, and remittances from children.

The 1997 and 2010 asset portfolios illustrate the changing composition of household asset levels over the thirteen year interval in a general overview (Fig. 4). It becomes difficult to discern the smaller changes that have taken place in the levels of education, land size, subsistence, and farm incomes. A general increase in off-farm employment, housing material and community participation can be noted. There was a decrease in livestock assets.

In an attempt to have a closer look at the household dynamics with respect to livelihood strategies and income over the time period, the households were categorised according to the locally developed well-being indicators outlined above (Fig. 5). Distinctions were made along the following lines: (1) households that are comparably better off and receive three or more points in the well-being index, (2) households that are comparably worse off and are below two points in their weighted average of well-being indicators and (3) those which might be considered average and lie in between two and three points on the scale. The analysis of those who successfully moved out of poverty may offer important information for use in planning development interventions.

In 1997, the biggest differentiation between well-being categories was in natural resource related activities – such as land size, livestock units and farm income – as well as in education; while there was almost no variation with regard to housing material and level of off-farm remittance. The *bottom* ranked households were particularly poor in farm income, livestock and education and barely achieved a minimum standard as the majority had less than one livestock unit, had less than KSH 10,000 (US$ 110) income from their farm annually and none in the household had completed secondary school. For households that were relatively better off, their investments lay in education and natural resource related activities. Those households that are classified as somewhat in the *middle* appeared to invest more in community participation and livestock.

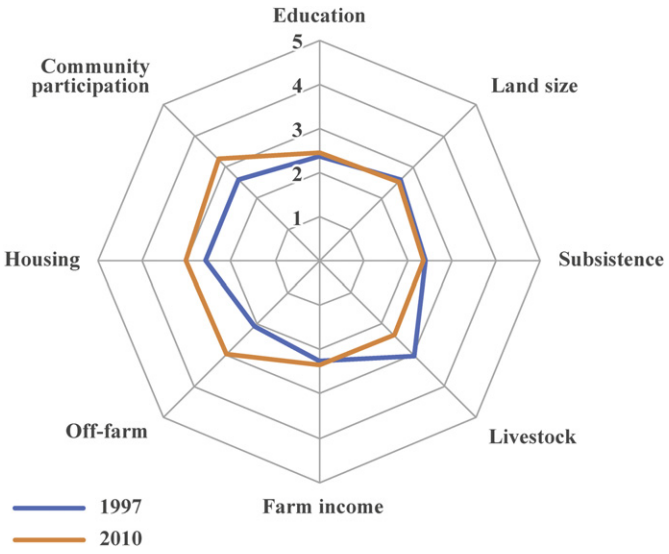

Fig. 4. Asset portfolios of interviewed households in 1997 and 2010.

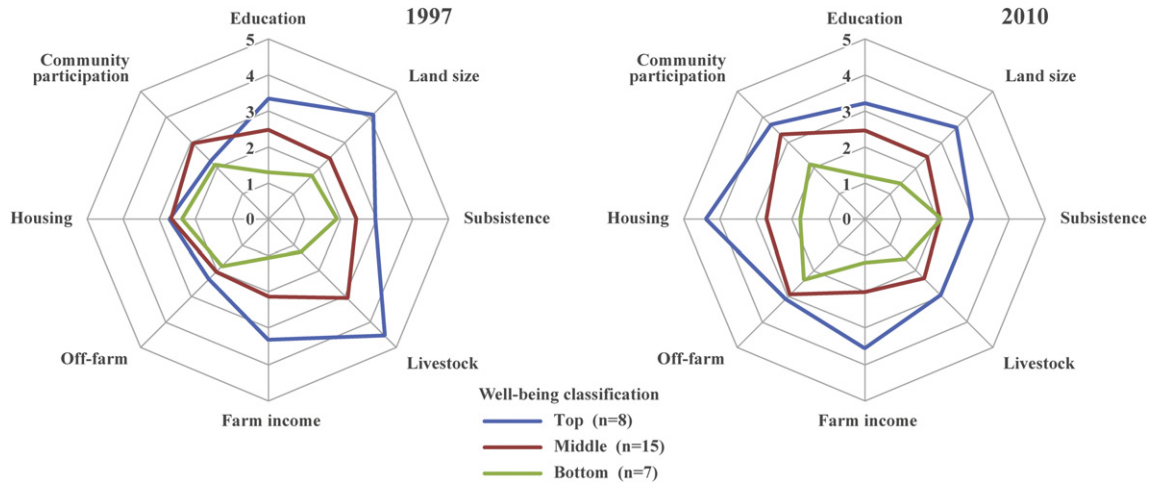

Fig. 5. Asset portfolios of interviewed households categorised according to their well-being.

In 2010, the overall gap between well-being categories seems to have widened, particularly for housing material and community participation. Exceptions to this are the measures of subsistence farming and livestock, where all households achieved a similar, however, low level. This suggests that better-off households are either constrained in their capacity to expand these livelihood aspects or that they do not want to expand. The biggest changes in sources of livelihood occurred with livestock; only *bottom* ranked households have more, whereas the *middle* and *top* ranked households have by far less livestock as discussed in 4.1.

More than half of the interviewees reported that the household's overall situation has become worse. The main reasons given were mostly related to human capital, with examples such as: death in the family or poor health, a lack of education for their children and that their children were still dependants. The second was financial capital, namely the lack of liquid capital. And thirdly, the effect of natural resources shocks in the form of drought. Reasons for improvements were put down to improvement on human capital in the form of benefits of education and independence of children. Successful farming activities and increased loan possibilities further helped households to improve their livelihoods. For some, improvements were moderate as one household described their situation, that today they at least have enough to eat.

The largest constraint that most households faced in trying to improve their lives was the lack of water; over half of the respondents mentioned this as their primary limitation. One third of households said that a lack of financial capital was their main constraint as it meant that they were unable to invest in planned ventures. Two households said that poor health was their main limiting factor to improved livelihoods. Other constraints mentioned once were: land degradation, market price fluctuation, a lack of market for their produce, political instability, livestock theft, and the lack of adequate storage capacity for their harvest.

4.5. Asset endowment on macro and micro level

On a national level, poverty rates have stayed virtually unchanged in Kenya and this is reflected in the Laikipia study results. A retrospective look at the aggregated data shows that the mean well-being score in 1997 was 2.57 and in 2010 was 2.61. However, looking more in-depth reveals a different situation, where dynamics contrast with this overall picture of persistence. The analysis shows a wide variation in results across households (Fig. 6). The majority of households do not reach a '*basic*' level in their respective assets status (which is measured as three points in the index). For the most part the same proportion of households situations either improved, worsened or did not change. Pathways in *and* out of poverty are evident with households having fallen into and others managing to escape from poverty. In 1997 as well as in 2010 an equal number of eight households could be considered as relatively better off in the local context. These households, however, are not the same. Despite their initial favourable situation in 1997 only half could expand or maintain their asset base. This highlights their vulnerable situation and begs the question on how best to improve well-being for the longer term.

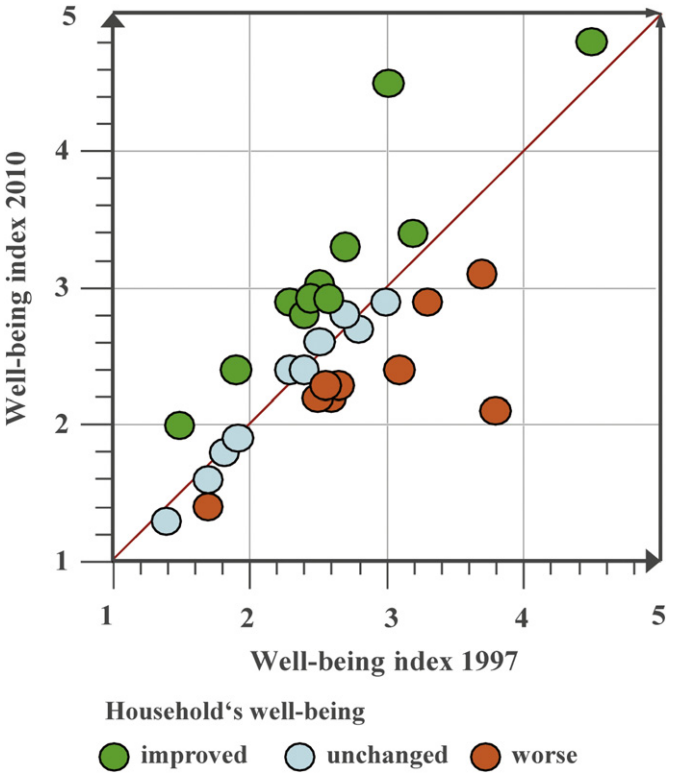

Fig. 6. Households' well-being in 2010 compared to 1997.

5. Implications for development interventions

The study has shown substantial dynamics into and out of better livelihood conditions from a household perspective, whereas a striking persistence of low asset endowments became evident from an aggregated perspective. These findings have various implications for development interventions at household and local-economy levels.

First, preventing the farmers from falling back into poverty should be an explicit aim in addition to measures to support them to escape poverty. In line with Addison et al. (2009) and Kristjanson et al. (2010), development interventions should necessarily address both transitory and chronic poverty. To address transitory poverty, unemployment insurance and benefit, re-skilling, microcredit, temporary safety nets and health services have been proposed (Addison et al., 2009).

Second, effectively reducing chronic poverty requires more structural measures such as increasing availability and access to non-agricultural employment. Considering that the natural resource base has several limitations (semi-arid low agricultural potential, lack of perennial water sources etc.) and these limitations are further heightened by problematic socio-economic processes (increased migration, increasing competition between unequal actors over natural resources, lack of enforcement), one potential pathway out of poverty will be to improve human agency through investing in human capital of smallholder households. This approach also draws from the finding that permanent employment positively correlates with higher education levels in the study area. The Kenyan government has laid the foundations by making primary and secondary education free. However, low household income is a deterrent (Lewin, 2009); and it is not sufficient to ensure wider access to the poor because other direct costs of schooling, the opportunity costs and how low income families perceive economic returns from such education, determine participation (Asayo, 2011). As such, a pro-poor targeting in education is crucial.

Third, Technical and Vocational Education and Training (TVET) including the existing youth polytechnics can provide local actors the necessary capacities to diversify out of dependence on a volatile farm production. The available labour in the study is generally unskilled manpower which implies access to low-paid insecure jobs. While we do not have comprehensive information on the types of employment opportunities available in Laikipia, raising the skills of local actors is likely to reduce the barriers of engaging in more economically rewarding employment. One way to achieve this is to revise the current TVET in Kenya to reflect the prevailing reality in the formal and informal labour market (King, 2005; Oketch, 2007). In the meantime, it is crucial, that the government of Kenya, international development agencies, and NGOs ensure that any intervention in the study areas has a capacity-building component.

Fourth, development interventions should not only focus at the household level but also at the meso- and macro-levels. While we did not focus on structural conditions such as rural infrastructure, access to resources or limited diversification options, responses from the farmers highlight the limitations they pose. In a similar poor region in Kenya (Kakamega district), Lay et al. (2008) found that the limited markets for non-agricultural products constrain households in employing their available resources (including education) more productively. It is therefore important to improve the constraining structural conditions to reduce the limitations that they pose on rural livelihoods.

The case whereby five out of six water tanks constructed or purchased through external interventions no longer function raises questions on the effectiveness and sustainability of such interventions. This is consistent with other studies (Frost et al., 2007) that have shown similar pessimistic views on the impacts of livelihood interventions. Why is such fundamental infrastructure not maintained by the local actors, and not contributing to their well-being? Identifying why this is the case will provide some insights as to how to improve local actor adoption, management and use of available infrastructure.

Moreover, the fact that households now keep fewer livestock than in 1997 does not mean that livestock has become less important for the households. The households rather identified livestock keeping (in particular, dairy cattle) as their most important strategy against food deficit periods and expressed the wish to invest in dairy farming. In addition, income from livestock turned out to be similar as in 1997. We thus argue that the conditions under which livestock can be kept has worsened, making it more difficult for households to achieve this livelihood. This suggests interventions that help reduce losses that occur due to e.g. drought, diseases, theft or social obligations such as funerals (Kristjanson et al., 2010). The increasing settlement density also means fewer natural resources at disposal. There is thus the need for a strategic approach that explores the various development scenarios in a participatory manner with the local actors, while linking household-level dynamics to structural conditions.

6. Conclusion

This paper examined the changing composition of asset portfolios of smallholder households in semi-arid areas in Kenya over a thirteen year time frame using a composite indicator. The indicator proved to be a useful tool for comparison of livelihood assets and strategies over time and space, and can be easily adapted for any given local context where previous livelihood data exists.

The study revealed both continuity and change in the composition of asset portfolios. Subsistence agriculture still plays an important role for smallholder livelihoods, whereby mixed farming based on both crop and livestock production persists and stems from the combination of risk averse and utility maximising strategies (Wiesmann, 1998; Wiesmann et al., 2011). Income from farm-activities continue to be at a very low or low level due to small average farm sizes, unreliable rainfall, poor access to markets and insufficient access to financial capital. The rural population experience constraints in expanding their natural resource related activities, as indicated through the limitation to crop farming and tremendous loss of livestock for the majority of households. These findings support other studies that found a high loss of livestock in agro-pastoral regions in Kenya (Kristjanson et al., 2010).

Despite an increasing number of household members working off-farm, the uncertainty of labour markets and the minimal wages paid cannot secure livelihoods nor build resilience. Thus for an improvement of smallholder livelihoods that aims to increase their resilience to short-term shocks and long-term stresses, higher paying and more secure forms of off-farm activities are needed. Under the current conditions, off-farm opportunities clearly do not enable the poor to find a path out of poverty. This confirms the findings of Barrett et al. (2001) that unskilled labour does little to reduce risk exposure or increase expected income for households.

Furthermore, the study's findings show a striking persistence of asset endowment and well-being for smallholder households at a low to very low level. Poverty and food insecurity are persistent when looked at from an aggregated perspective. At the same time, a household perspective reveals the dynamics of fluctuating livelihood conditions. The changing livelihood portfolios and improving asset endowments for some households indicate the flexibility and diversity with which smallholders secure their living under the changing socio-ecological conditions. The finding that households can easily fall into poverty is similar to those in other rural areas in Kenya (Krishna et al., 2004; Place et al., 2007; Kristjanson et al.,

2010). The dynamics inherent in the overall well-being status of smallholder households may be interpreted as one main problem for development, as livelihood assets can too easily be lost. The findings strengthen the argument of Marschke and Berkes (2006) that building resilience does not only involve the household level but higher political levels of organisation. Scoones (2009) also concludes that given conditions of extreme vulnerability, sustainability and resilience may not emerge through local adaptation alone. There appears to be a lack of opportunities for "*secure*" investments for smallholders. Even when households are comparably better off they remain extremely vulnerable. The investment in and accumulation of conventional buffer or productive assets, such as grain stocks, livestock or land, does not shield households from adverse shocks and stresses as smallholders were shown to easily slip back into poverty. Safety nets are missing in the rural context of Laikipia. Safety-net oriented development interventions as proposed by Addison et al. (2009) in addition to the earlier mentioned measures are thus necessary at household and rural economy levels.

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