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Tracing divergent livelihood pathways in the drylands: A perspective on two spatially proximate locations in Laikipia County, Kenya

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ABSTRACT

This study traces livelihood pathways within two spatially proximate locations in the dryland setting of Laikipia County, Kenya. Both sites, Thome and Wiyumiririe, were opened up for settlement at roughly the same time, belong to the same administrative unit, and fall under the same national policy remit. Whilst Kenya's policy for arid and semi-arid lands tends towards a 'one-fits-all' solution across geographical regions, the objective of our study, therefore, is to identify and explain the conditions for site-specific variations in livelihood pathways. Building upon a combination of remote sensing analysis, community group discussions and expert interviews the study aims at establishing locally contextualised entry points from which to enhance viable livelihood pathways in the drylands. Our findings show that Thome's contiguity with areas of open access and its position next to a wetland, the Ewaso Narok swamp, has led to heightened insecurity and ongoing conflicts over land-use rights, with livelihoods tending towards an unsustainable use of the environment. Wiyumiririe, in contrast, benefits from a strong government presence as well as good access to several service centres, with its community having sustainably enhanced land-productivity and secured alternative off-farm incomes.

1. Introduction

Drylands rank among the geographically largest, biologically least productive and demographically fastest growing biomes on earth (MEA, 2005). Livelihoods in these semi-arid and arid regions have evolved under variable, unpredictable and extreme environmental conditions (Huber-Sannwald et al., 2012). Within the Millenium Ecosystem Assessment (MEA) it has been stressed that livelihood activities in these regions tend to be more dependent on available ecosystem services than elsewhere. Land-use affects the drylands primarily in the form of land cover modifications, i.e. via subtle and gradual changes within one land-cover class (Lambin and Geist, 2006). Examples include vegetation loss due to overgrazing or thorny bush encroachment due to the abandonment of agricultural land. However, while human activities and environmental dynamics are deeply entwined, "drylands suffer from an exceptionally wide gulf between knowledge and policy or practice, as shown in many interventions that have not succeeded" (Mortimore et al., 2008, p 73).

There is one major reason for this gap in knowledge and practice that challenges the twin objectives of achieving sustainable land-use and improved livelihoods. Many local land-users in dryland areas are marginalized, not only by distance and topography, cultural and lingual barriers or access to resources, but also institutionally in that they are often not party to the policy decisions affecting their livelihoods (Whitfield and Reed, 2012). As a consequence of this multidimensional marginalization, site-specific environmental knowledge and the aspirations of resident populations remain largely unconsidered within expert assessments and management strategies. This is surprising in view of the increased emphasis on the importance of participatory approaches (Kok et al., 2007), which recognize that rural communities should not be imagined as homogenous actors facing similar opportunities and challenges. In other words, even within a small geographical region a high degree of socio-ecological diversity may exist. Nevertheless, external stakeholders often tend to simplify the relationship between land-users and environmental health, where blame for biophysical degradation is often placed on local users (Forsyth, 2003). While such unidirectional explanations still inform policy-making, they have meanwhile been challenged by studies stressing the need to integrate scientific analysis with locally-contextualized understandings (Reed et al., 2007; Stringer and

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Reed, 2007).

Reynolds et al. (2007) have outlined an integrative analytical framework for the identification of problems and the implementation of opportunities in the drylands. Their 'Dryland Development Paradigm' states that issues such as land degradation can neither be framed in terms of a single measure nor solved through a universal policy principle. Rather, a key objective is to examine the close interaction between biophysical and socio-economic factors, which is inherently uncertain and indeterminate. This makes it difficult to establish robust scientific projections of land-use and land-cover trajectories without allowing "people to explore problems in their own words" (Reynolds et al., 2007, 850). Put differently, it is necessary to consider the practices, values and aspirations of local stakeholders. This focus encourages scholars to complement the numerous accounts of negative trends, most prominently on desertification, with studies foregrounding how local people harness their endogenous capacities and capitalise on scientific advances to successfully implement viable livelihood options in the dryland regions of the world. Whilst there are few in-depth analyses, Adeel and Safriel (2008) provide some general insights on a number of positive case scenarios from the global drylands.

In building upon such empirical evidence, Safriel and Adeel (2008) introduced the Dryland Livelihood Paradigm (DLP). This paradigm presents a new take on the much-discussed poverty-degradation spiral in drylands and specifies two possible livelihood pathways with two scenarios each. The first of these pathways portrays dryland communities falling into poverty, often accompanied by conflict and violence. In its first scenario increased population density becomes a problem when it begins to inhibit the ability of a land-use system to meet livelihood needs, resulting in overexploitation, disputes over resources and increased impoverishment. In a second scenario, communities maintain a steady state of production, yet still remain in poverty due to their multidimensional marginalization. In contrast, the second pathway allows communities to establish livelihoods that are both economically and environmentally viable. In its first scenario people adopt strategies to improve the productivity of their land, especially through investments in technological innovations that foster sustainable practices of resource use. The second scenario describes a transition that makes people independent of the agro-ecological potential of their land, for example through off-farm employment.

We adopt the DLP in examining two spatially proximate study sites that were opened up for settlement at roughly the same time. Both sites are located within Laikipia County, a rural area northwest of Mount Kenya. They thus belong to the same administrative unit, and also fall under the same national policy remit. Kenya's policy for arid and semi-arid lands still tends towards a 'one-fits-all' solution across geographical regions (Odhiambo, 2013). With the case example of two spatially proximate areas, the objective of our study, therefore, is to identify and explain the conditions for site-specific variations in livelihood pathways. Through a combination of remote sensing analysis, community group discussions and expert interviews we aim at establishing locally contextualised entry points from which to enhance viable livelihood pathways in the drylands.

2. Study area: Socio-ecological setting and settlement history

The two study sites of Thome and Wiyumiririe Sub-location are located in Laikipia County (Fig. 1). The County covers an area of about 9700 km^2 in north–central Kenya, encompassing a plateau of undulating low hills at elevations between 1500–2600 m a.s.l. It straddles the equator and lies between latitudes 0°52′N and 0°17′S and longitudes 37°0′E and 36°0′E. From its eastern boundary on the leeward slopes of Mount Kenya (5199 m a.s.l.) it stretches southwest to the slopes of the Nyandarua Ranges (otherwise called Aberdare Ranges) with Mount Satima (3999 m a.s.l.) as its highest peak (Nyandarua County), west to the Rift Valley escarpment (Baringo County) and to the arid plains in the north (Samburu and Isiolo Counties). Annual rainfall patterns are bimodal, with the 'long rains' falling between April and June, and the 'short rains' between October and December. However, rainfall is generally erratic and may fall at any time of the year. Both the Nyandarua Ranges as well as Mt. Kenya exert a strong influence on rainfall distribution, ranging from between 750 and 900 mm in the southern part of the County to 300 mm in the lower, northern part (Gichuki et al., 1998). Precipitation also varies in duration along the same gradient. Daily temperatures vary with altitude and season; with a mean temperature of 24 °C, the mean minimum and maximum temperatures are 10 °C and 35 °C respectively (Kohler, 1987). The spatio-temporal distribution and intensity of precipitation is a key variable that influences the agro-ecological potentials of the area. Most of the County falls within the semi-arid and arid agro-ecological zones, with small areas on the foot slopes of the mountains classed as sub-humid (Sombroek et al., 1980).

By the beginning of the twentieth century large swathes of Laikipia were used as pastoral grounds by the Maasai. At that time much of Laikipia was covered with fire-modified Acacia bushland and grassland, which succeeded what was once largely Afromontane cover (Taylor et al., 2005). The community managed land-use system changed with colonization, as the British forced the pastoralists out in the early 1900s and occupied the area, establishing large-scale ranches for beef production under European land management procedures. With Kenya's independence in 1963 came huge pressure to re-settle landless peasants from other, more densely populated areas of the country. This demand for land was met through government endorsed land re-distribution programmes, which in Laikipia led to a radical transformation of land-tenure as several ranches were bought and sub-divided into smaller plots. Such was the demand that many of the prospective settlers purchased land without once having visited its location (Kohler, 1987). As a result largely of in-migration, population numbers in the County increased from approximately 60,000 in 1960 to 399,227 in 2009 (KNBS, 2009). With the agricultural potential of purchased land differing greatly across Laikipia, a settlement pattern that varied both spatially and temporally emerged. Migrants settled more favourable areas first, eventually forming an arc around the eastern, southern and western boundaries of the County (Wiesmann, 1998). Differences in ecological zones have implications for the potential of agricultural use in each area. Wiyumiririe Sub-location was one of the earliest areas to receive migrating settlers. It has a relatively favourable agro-ecological potential, a high population density, it is close to areas of in-migrant origin, and it is located along one of the few major roads in the County. Thome Sub-location, on the other hand, has a lower agro-ecological potential, a low population density, poor road access, and initially received lower numbers of settlers.

Thome, located at an altitude of 1800 m a.s.l, and Wiyumiririe, located at 2200 m a.s.l, are situated within 40 km of each other. Yet, despite their geographical proximity there are some conspicuous ecological differences. This is typical in highland–lowland contexts, where distinct ecological changes occur across vertical gradients within proximate distances. The FAO classification of agro-ecological zones is designed to show the viability of major food crops and population-supporting capacities for the tropics (Sombroek et al., 1980). According to this classification, Thome falls within the upper midland semi-arid Zone 5 with a mean annual rainfall of 600–700 mm, while Wiyumiririe falls into the lower highland semi-arid Zone 5 with 800–900 mm. Flury (1988) further

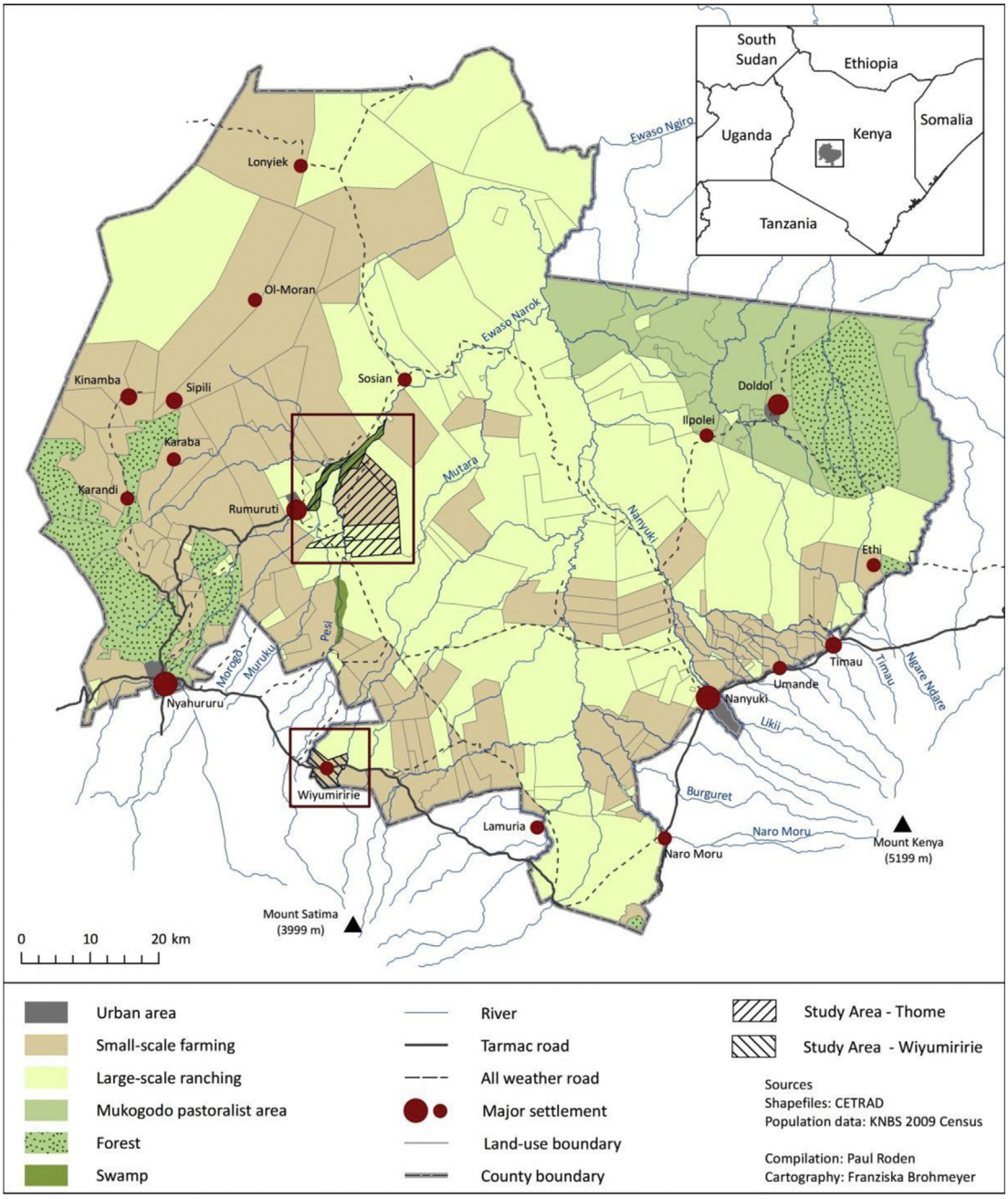

Fig. 1. Laikipia County with the study areas of Wiyumiririe and Thome.

refined this classification to create a suitability grouping for small-scale rain-fed crop production in Laikipia. He added two main criteria: first, the potential risk of crop failure (based on the number of rain days), and second, the land size available per person. Following his classification, Thome is located in the area between marginally 'unsuitable' and 'not suitable', while Wiyumiririe falls under the 'marginally suitable' and 'suitable' classification.

Road access to market centres varies for each study site, with Thome being located at the end of an earth road of poor condition. The closest centre is Rumuruti (14 km), which provides administrative, household and agricultural goods and services. However, Nyahururu (55 km) can be considered the closest vibrant hub of commerce and employment. In contrast, Wiyumiririe is situated on a tarmac road that connects with three major urban centres: Nyahururu (26 km), Nyeri (65 km) and Nanyuki (123 km).

During the national re-settlement scheme landless peasants purchased small parcels of land in Thome and Wiyumiririe between the years 1970–1979 (Kohler, 1987), and to a lesser extent in Thome between 1990 and 1996. Both locations were thereafter only gradually settled. Land parcels varied in size from 0.5 to 5.0 ha, with most plot sizes being 1 ha. These settlement units, which are classified as 'small scale – non-government land purchase' by Kohler (1987), are bounded by other partly restricted land management regimes. Thome is bordered to its north, east and south by private large-scale ranches, and a wetland, the Ewaso Narok swamp, to its west. Wiyumiririe is bordered by the Aberdare Forest Reserve to its south, a private large-scale ranch to its north, and small-scale land units to its east and west (Fig. 1).

Current (2009) population densities within both Sub-locations show that Thome is more sparsely populated than Wiyumiririe, with 39 persons/km^2 in Thome and 300 persons/km^2 in Wiyumiririe. These population densities have remained relatively stable since 1989 for Wiyumiririe, but have increased tremendously for Thome where in-migration has continued to take place. Thome registered a 5.69% per annum increase, from a total population size of 2184 in 1989 to 6612 in 2009. Wiyumiririe recorded a stagnant or negative growth of −0.29% between the two census years: from 7896 in 1989 to 7448 in 2009. These compare to a growth rate of 2.83% for Laikipia during the same period. Most in-migrants to both sites came from the agriculturally high potential and Kikuyu dominated areas of Central Province. Today the ethnic composition in Thome is about 50% Kikuyu and the remaining a mix of Samburu, Turkana, and others, whilst Wiyumiririe is 90% Kikuyu.

3. Methods

We rely upon a combination of remote sensing analysis, community group discussions and expert interviews in the two study sites. We complemented a change detection analysis based on satellite imagery with explanatory narratives provided during participatory group discussions and expert interviews. A fifteen-year interlude was considered a suitable time frame. Moreover, it is a period for which community members can accurately recollect reasons for change.

3.1. Remote sensing

A multi-temporal land-cover change detection analysis was conducted using Landsat 5 TM scenes from two years with a 15 year difference, 21 January 1995 and 30 January 2010, and for 25 January 2014 a Landsat 8 OLI scene (30 m).[1] January was selected as the best month for cloud free imagery. This month is also considered suitable as it falls within 45 days after the last rain spell, thus providing conditions where a relatively high photosynthetic activity is expected (Shisanya et al., 2011). The best available rainfall data, sourced from Laikipia Air Base in Nanyuki (approximately 60 km from each study site), shows that in December 1994 precipitation amounted to a total of 14.5 mm and for 2009 to a total of 65.4 mm. Whilst no measurement data is available for December 2013, the 30-year average monthly rainfall for December is 35 mm. However, one should note that in addition to the high seasonal and inter-annual rainfall variability, Laikipia also experiences significant differences in the spatial distribution of precipitation.

In order to increase the separability of land-cover classes we included the normalized differential vegetation index (NDVI) for each satellite image. An unsupervised classification using the k-means algorithm was run in ENVI Version 5.1 to define 20 classes of land-cover. In the post classification the identity of these 20 spectral classes was determined and combined through a visual interpretation of high spatial resolution Google Earth images (Lillesand et al., 2008) to a total of six land-cover classes, five for Thome and three for Wiyumiririe. These classes were found to broadly correspond with the community identified land-cover classes.

3.2. Community group discussions and expert interviews

Participatory community meetings and expert interviews were conducted to identify and discuss local explanations for specific land-use and land-cover changes. Swahili (the Kenyan lingua franca and official language) was used during the group discussion in Thome, whilst the local Kikuyu language was used in Wiyumiririe, as this is the primary language spoken by more than 90% of the Sub-location's inhabitants. In both cases, three experienced local research assistants helped with the facilitation and translation of the discussions. The first author also is fluent in Swahili and assisted with translations where necessary. In order to ensure an integrative perspective of change, a cross-section of the community was invited to attend participatory meetings (Chambers, 1983). Their representation included a mix of socio-economic status, gender, age and occupation, while all were long term residents of their Sub-location. A total of two meetings were held in December 2010, taking place over two days in each study site. These meetings included 17 and 15 participants in Thome and Wiyumiririe, respectively. The first day was dedicated to understanding the dynamics of socio-economic conditions, and the second addressed changing environmental conditions. This thematic order was intentionally adopted in order to facilitate discussions on people's wellbeing and the status of their environmental surroundings. Several participatory tools were adopted to foster the discussion, including: community sketch maps, seasonal calendars, and pair-wise rankings (Narayanasamy, 2009). Additionally, in-depth semi-structured expert interviews were carried out with the local administrative chiefs employed by the government. These interviews addressed issues on the role of government and other higher-level actors in influencing land-use and land-cover change.

4. Results

The results are presented in the following order: an interpretation of the satellite images is followed by local explanations for the causes of change elicited during the community participatory meetings and through expert interviews. Both sections are structured according to the two different study sites.

The land-use and land-cover categorisations defined during community group meetings were used in the remote sensing analysis, except for the grassland cover in Thome, where the remote sensing analysis identified an important distinction between the relative cover of dense grass and sparse grass or bare ground. Generally, the difference in land-use and land-cover dynamics between Thome and Wiyumiririe are quite distinct; with Thome showing more pronounced spatio-temporal patterns across the different land classes (Figs. 2 and 3).

4.1. Remote sensing interpretation of land-use and land-cover change

4.1.1. Thome

In Thome (79.42 km^2) croplands are found mostly along low-lying areas: next to the wetland and along riverine areas. In close proximity to these strips of crop fields extend areas of grassland, which vary greatly across time and space in terms of their condition. Grasslands range from denser to sparser cover, with bare cover persisting especially near ponds and are indicative of the grazing and trampling pressures that livestock have on vegetation surrounding watering points. Available precipitation data suggests that a combination of both long and short-term effects of rainfall patterns is partly responsible for the high fluctuations within the overall grass cover (Fig. 2). The two years of drought in 2008 and 2009 preceding the 2010 satellite image, were one of the driest periods recorded in Kenya's history, and Laikipia was particularly badly affected (Zwaagstra et al., 2010; see Fig. 4). However, the month of December 2009 was unseasonably wet, with that month recording 65.4 mm against a 30-year average of 35 mm. This high rainfall evidently contributed to the relatively high vegetation index exhibited within the two grassland classes (Table 1).

[1] Satellite imagery sourced from: earthexplorer.usgs.gov.

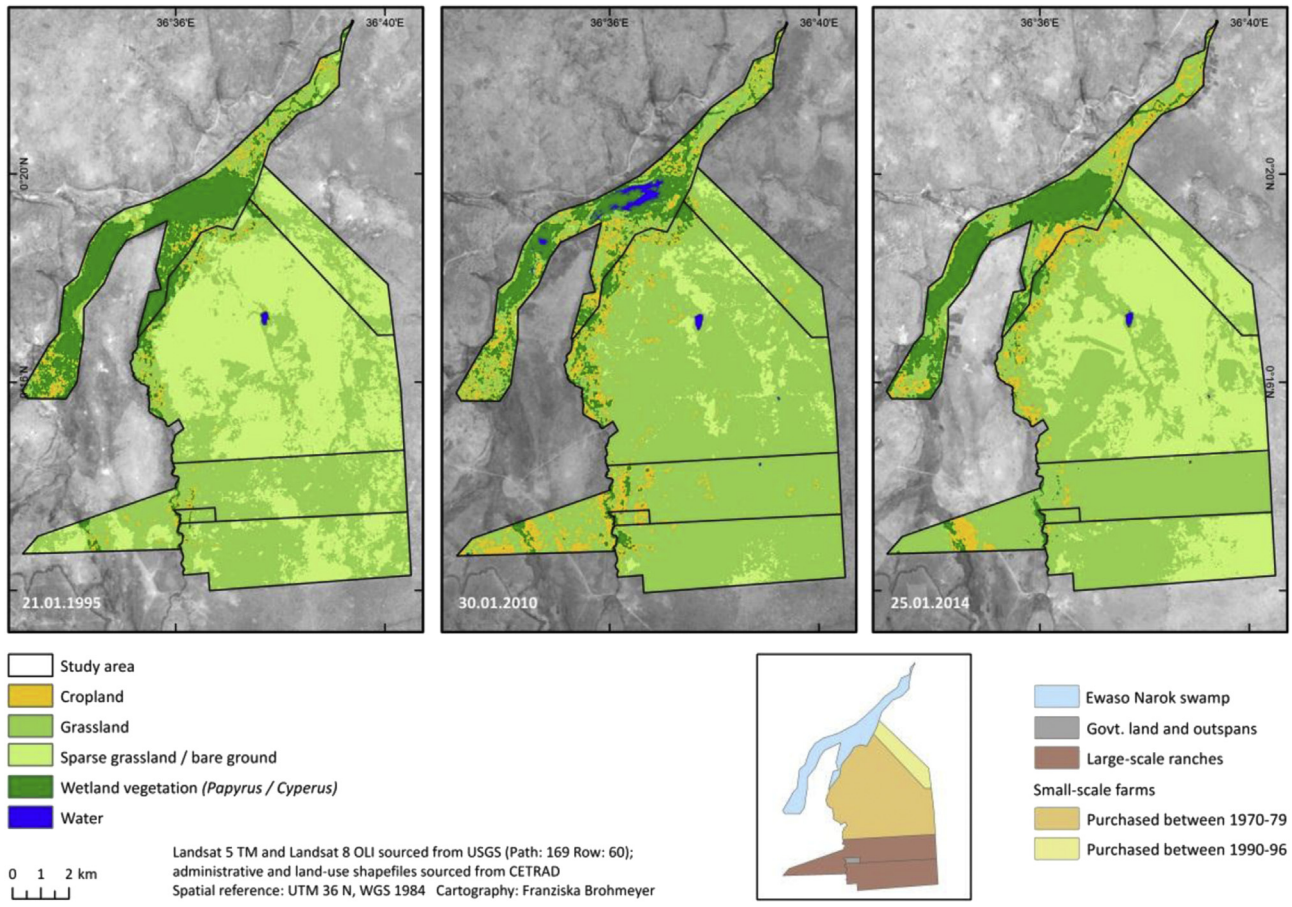

Fig. 2. Land-cover for 1995, 2010 and 2014 in Thome.

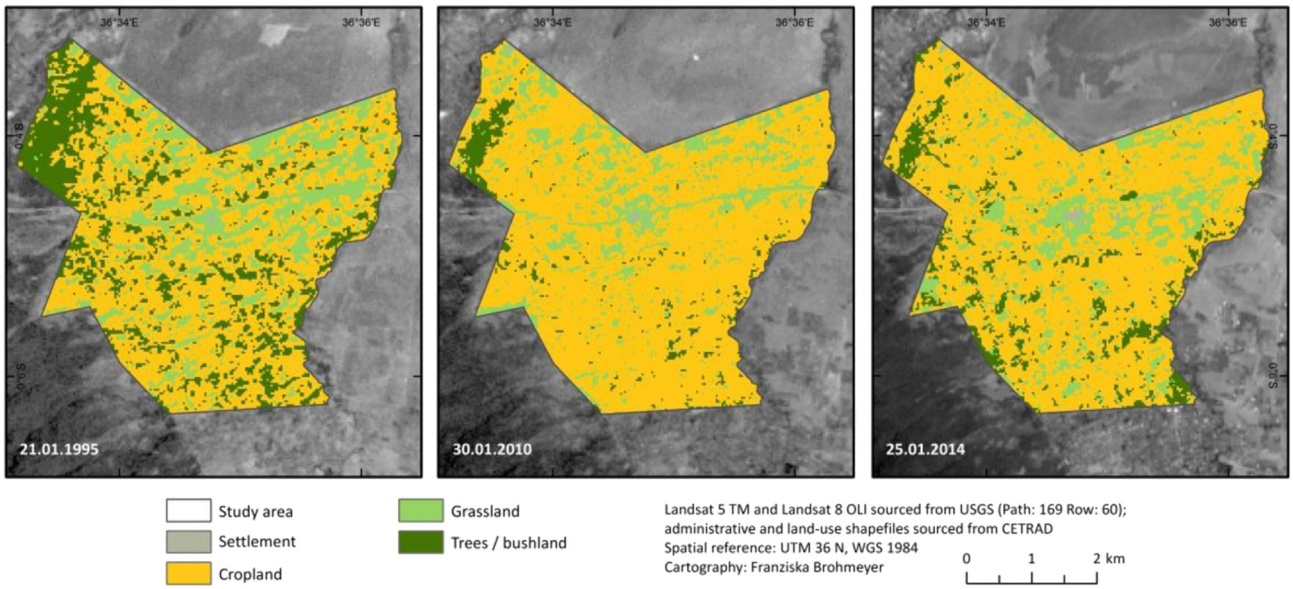

Fig. 3. Land-cover for 1995, 2010 and 2014 in Wiyumiririe.

Thome shows significant changes in four of five land-cover categories. The most noticeable change occurred in the cropland category, with a more than twofold increase in this cover between 1995 and 2010, representing an increase in its share of the total area of 3.9%. Cropland increased mainly at the expense of wetland and less through the conversion of grassland vegetation. The average overall grassland cover, i.e. the sum of denser and sparser grassland, over the study period amounts to 87.1% of the total land-area. Large

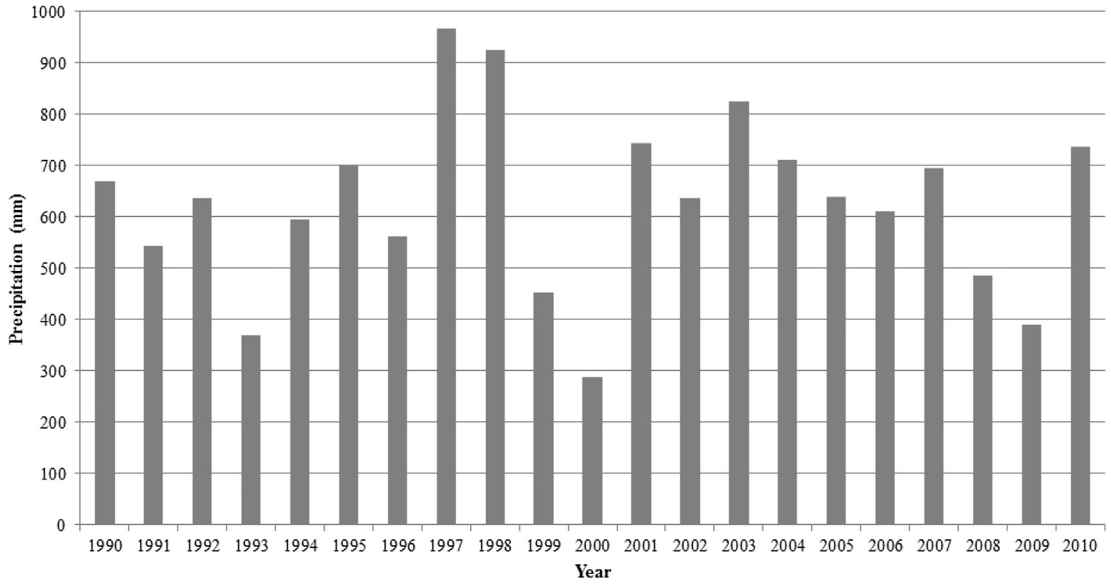

Fig. 4. Annual rainfall between 1990 and 2010.
Source: Laikipia Air Base, Nanyuki.

Table 1
Land-cover change in Thome in 1995, 2010, and 2014.

Total area: 79.42 km^2	Area (km^2)			Area (%)			Net change (%)	
Land-cover	1995	2010	2014	1995	2010	2014	1995–2010	2010–2014
Cropland	2.78	5.86	5.16	3.5	7.4	6.5	3.9	−0.9
Denser grassland	23.29	60.06	31.94	29.3	75.6	40.2	46.3	−35.4
Sparse grassland/bare ground	46.32	7.83	38.14	58.3	9.9	48.0	−48.5	38.2
Water	0.07	0.16	0.10	0.1	0.2	0.1	0.1	−0.1
Wetland vegetation	6.96	5.51	4.08	8.8	6.9	5.1	−1.8	−1.8

fluctuations occurred between denser and sparser grassland, where each gave or took cover from the other over time. The denser grass class shows an increase in coverage of 46.3% between 1995 and 2010, representing a near tripling in size over the same period, whilst sparser grassland decreased concomitantly. Wetland vegetation cover decreased at an increasing rate throughout the study period, from a share of 8.8% of the total land area in 1995, to 5.1% by 2014.

4.1.2. Wiyumiririe

In comparison to Thome, the remote sensing results in Wiyumiririe (19.84 km^2) show a more persistent mosaic-type of pattern, with the main cropland class dominating the land-cover since at least 1995. However, dotted within this class, tree and bushland cover shows a decline in the period between 1995 and 2010, followed by an increase in the period between 2010 and 2014. These dynamics between cropland and tree/bushland classes are particularly visible in the southern half of the Sub-location (Fig. 3). A Google Earth verification of changes in tree cover show increases on the edges of farm plots and along roads. In absolute terms grassland cover has remained relatively stable and concentrated in the north; however, the patterns of its distribution are quite dynamic.

The most significant changes in Wiyumiririe occur within the cropland class, whose cover increased from 58% in 1995 to 79.7% in 2010, before declining slightly to 74.1% in 2014 (Table 2). The earlier change occurred at the expense of tree/bushland cover, which in 1995 covered 4.35 km^2 (21.9%) of the study area, declining to 0.92 km^2 (4.6%) in 2010, and increasing again to 1.97% (9.9%) by 2014. Grassland cover remained relatively stable throughout the study period. Settlement cover is not detectable in the Landsat images as most farms are dispersed. However, it was possible to calculate that the main market centre in Wiyumiririe grew from 0.01 km^2 in 1995 to 0.08 km^2 in 2014.

4.2. Local explanations for the causes of change in Thome

The community meeting began with a general appraisal of the benefits of life in Thome, where the respondents immediately highlighted several major points: “we like our life, the climate is good for our livestock and farming”, “people help each other here even if we are mixed communities of Kikuyu, Samburu, Turkana, and others”, “we like our wetland, it makes us happy”, “we have plenty of grass available to our livestock”, “we have large individual plots and the community land is large”, “we are continuously active, the irrigation keeps us busy throughout the year”, and “there are business opportunities”. From these brief statements one gets the impression that local people already try to convey an appreciation of both the social and environmental conditions that form the basis of making a living in Thome.

According to the respondents the majority of people living in Thome are in-migrants who purchased plots between 1970 and 1979, with few actually having been born there. Based on the Chief’s records, the majority of plots range between 1.2 and 2 ha. The largest ethnic group are the Kikuyu, followed by the Samburu and the Turkana. All respondents reported that the mix of resource

Table 2
Land-cover change in Wiyumiririe in 1995, 2010, and 2014.

Total area: 19.84 km^2	Area (km^2)			Area (%)			Net change (%)	
Land-cover	1995	2010	2014	1995	2010	2014	1995–2010	2010–2014
Cropland	11.5	15.78	14.65	58.0	79.7	74.1	21.7	−5.6
Grassland	3.99	3.10	3.16	20.1	15.7	16.0	−4.5	0.3
Trees/bushland	4.35	0.92	1.97	21.9	4.6	9.9	−17.3	5.3

availability, including the potential to irrigate their farms, to practice rain-fed farming, and to water and herd their livestock from the wetland as well as to utilize the large grasslands for grazing, were the most important pull-factors attracting them to the area. Though all ethnic groups employ a combination of farming and livestock rearing, the Kikuyu and Turkana are largely engaged in farming, whilst the Samburu are particularly known for their large herds of cattle. The diversity of their environment and the values that different stakeholders attach to it was further discussed when respondents prepared a community sketch map of natural resources in their Sub-location.

People reported that the earliest use of furrow irrigation started with the construction of an irrigation canal in the 1920s by an Italian engineer. They also said that the wetland once belonged to a *mzungu* (referring to a colonial era European settler) owner who relied on it for grazing and water. The earliest farming in the wetland by in-migrants, after the resettlement programme, is dated back to 1984. These early pioneers made use of the irrigation canals, however, over time the canals fell into partial disrepair, and today only a few people are able to make use of them. During the discussion of the community sketch map the respondents distinguished two water use patterns of the wetland, with its deeper parts used for furrow irrigation of horticultural crops, primarily tomatoes, whilst water is pumped to the higher edges for the same purpose.

In general people highlighted that the wetland is attractive for two main reasons, namely as a refuge during the dry season and droughts, and as a key resource that affords multiple livelihood opportunities. As a result of a perceived increase in droughts, both farmers and livestock keepers stated that “in periods of drought we disappear into the swamp and live from there”. Wetlands are increasingly important for horticultural production, especially commercial tomato farming. This agricultural practice has now become the annual mainstay of most settled farmers, as it has proven to be a relatively reliable source of income. However, the respondents bemoaned the lack of an official market in Thome, stating that “the council has denied us a licence to start a market”, and, “we are forced to sell at low prices in Rumuruti”.

According to the Chief, the rights for access to water resources, including wetlands and rivers, are only provided to those who own a land-title within its vicinity, with which the land-owner can then apply for a use permit from the Water Resource Management Authority. One of the other constraints associated with horticultural farming in the wetlands was reported as the increasing frequency of flash floods. As one respondent declared, “when it floods there is so much water, it runs over the crops and sweeps them away”, and another added, “we wish that we could trap and store the water for dry periods, and to reduce the flood damage”. The respondents also expressed their concerns with regards to the health of the wetland, in particular the receding waters of the swamp, as mentioned: “the swamp used to be big, always full with water, now it's much less, we have pushed the swamp into a corner”. This situation was considered to be aggravated by an increase in upstream river flow extraction for irrigated farming, particularly by the residents of Ndaragwa and Pesi outside of Thome. Moreover, tensions exist over the use of the wetlands owing to periodic influxes of seasonal pastoralists, ‘brief case’ farmers,[2] and itinerant squatters. With the success of horticultural farming in the wetlands many once-absent landlords were also said to have begun to re-occupy their vacant plots in Thome, increasing the pressures on both the wetlands and grazing lands.

Most of the people involved in horticulture farming in the wetlands also maintain larger rain-fed agricultural plots where they grow maize and beans for subsistence. However, these plots only provide one third of their grain needs, mainly because, as was reported, rainfall was too low for higher yields. Beyond these rain-fed plots lies the open expanse of grasslands. The grazing of these pastures once constituted the most valuable land-cover unit, as livestock keeping formed the primary livelihood strategy of the first in-migrants. We were informed that in earlier times there was more grass, which was of better quality than today. But with increased incidences of cattle rustling and small-stock theft, many households opted to keep smaller numbers, or even none. However, as stated by the respondents, grazing pressure on the pastures continues to grow as livestock numbers increase owing to ongoing permanent in-migration, and seasonally by external and often armed Pokot and Samburu pastoralists who generally come when the swamp is at its lowest (January–March). Whilst farmers perceive livestock keeping as highly insecure, those who maintain large herds use their ethnic ties as an asset, as was mentioned by one Samburu respondent: “I have lots of livestock (more than one hundred cattle) and because I am Samburu I am able to maintain it. My cattle have never been raided”. These large herds provide a sufficient supply of milk for the local inhabitants and in the words of another respondent the sales of milk “pays the school fees for all my children”.

Insecurity was often mentioned as a major problem by the respondents. Even though they recently received a small contingent of Administrative Police to assist the Chief in handling the situation, the community have felt compelled to set up their own policing unit. This unit works in close collaboration with the Chief. However, the effort of this joint initiative has had limited success, which, as stated by the participants, is because “there are few administration policemen to handle the insecurity issues in the area”, “insecurity is so bad that many people have left the area”, “some farmers in the swamp are temporarily there so they don't care destroying other farmers' crops or even graze the crops”, and “squatters who have immoral behaviours like stealing from the locals”, thus suggesting that those causing the problem are largely from outside the community.

4.3. Local explanations for the causes of change in Wiyumiririe

As in the former Sub-location, the group discussion began with the question as to why people moved to Wiyumiririe and what they liked about living there. The participants were in agreement that

[2] ‘Brief case’ farmers are seasonal in-migrants who have neither land-titles nor official resident status.

the availability of cheap land and plenty of pasture were the main reasons. On the benefits of living there, they stated: "the area is semi-arid but farming still takes place depending on the rain" and "good relationship to my neighbour – there is peace in the community, people live in harmony". In the local Kikuyu language, Wiyumiririe means "to gird up" and "to be resilient", which served as the clarion call of the early setters to overcome the perceived difficulties that this new environment presented to them. They said that "this area isn't made for our traditional farming (as in the area of origin)" and "we have decided to stay here because we have nowhere else to go. We stay in the hope that the next harvest will be better".

Despite the hardship reflected in its name, nearly all the plots in Wiyumiririe were reported to have already been taken up by 1979. The land was purchased through a land-buying cooperative, subdivided into 0.8 ha plots, and sold by lottery to its members. The earliest settlers were said to have owned much more livestock, which back then was of prime importance for their livelihoods. However, this changed with the quick take-up of the vacant plots, and a transition to rain-fed farming of maize, beans and potatoes then becoming the principal mode of subsistence. This scenario existed up to 1995, when in the interim it transitioned back to livestock production. Livestock keeping is now followed by crop farming, business (market traders), and formal and informal employment (teachers, nurses, casual labour) as the most important activities for the inhabitants of Wiyumiririe. The good road was highlighted as a key asset as it facilitates access to both agricultural and labour markets.

Whilst discussing the community sketch map, the respondents emphasised that land size is the main constraint for their livelihoods. As one respondent put it, "there was a lot of grassland before, but now it's all *shambas* (farm plots)". People considered this situation as particularly problematic in view of the pressures to further sub-divide their plots for inheritance amongst sons. Due to increasingly dense settlement patterns, participants complained that there are very few areas left to graze livestock. Owing to such pressures, as it was explained, many people started to take up new farming practices. Poorer households were reported to increasingly raise small animal breeds: poultry, rabbits and dairy goats; whilst the wealthier turned to zero-grazing livestock keeping, especially of grade dairy cows. According to the respondents, this latter trend has been aided by the following factors: the availability of a local milk collection point, a cooling plant in a neighbouring centre (Ndaragwa, at 5 km distance), good milk markets, and improved fodder types. The demand for fodder is met largely through their own cultivation, especially Napier grass on cropland, and through re-investment of the income generated through milk sales for the purchase of hay, which is then silaged and stored. Fuelled by the success of dairy production, the respondents mentioned the community's aspiration for a local cooling plant that would make them more independent.

Another emergent focus in land-use is the growing adoption of low-tech greenhouses. Greenhouse technology is said to have been first introduced by an extension officer from the Ministry of Agriculture who visited the area and trained some farmers in 2008. According to the respondents, this technology reduces their dependence on increasingly insufficient and unreliable rainfall. Moreover, these greenhouses are also considered as a solution for decreasing plot sizes. As one participant asserted, "we want to save space and water, and we also want to have higher yields. The greenhouses are only 15 by 8 m and save water by drip irrigation". The cost of these structures was estimated as 100,000 ksh (~1200 USD). This relatively high price is considered as one of the main hindrances to its widespread adoption, but community members are in the process of raising funds through self-help groups. Less costly than greenhouses, but also shown to have attracted a favourable response is conservation agriculture (no-till farming). Here the participants stated that they were also taught by the Ministry of Agriculture a new soil tilling technique where they said that, "water doesn't evaporate, because you don't plough, water is conserved in the soil, water stays there, there is a machine that plants and you don't". However, part of the problem for the widespread adoption of this technique was considered to be the limited availability of the no-till drilling machine, as the Chief later informed us. The respondents were particularly encouraged by Kilimo Biashara,[3] a nationwide programme that aims at enhancing the marketization of horticultural crops, such as French beans, snow peas and tomatoes.

The planting of trees in the margins of farm plots or in small groves was considered during the community meeting as a positive development that has been taken up by most farmers, as it is evidenced in the satellite images. These trees include *Grevillia, Cyprus, Eucalyptus*, Red Cedar, Orange and Lemon, amongst others. The respondents named several reasons for planting trees, including as a wind break, as a way to attract more rainfall, as a way to fertilize their soils, as well as for timber, fuel, animal fodder, fruit and shade. Respondents further pointed out that trees are seen as long term investments from which they can sell poles and firewood, and that are more robust than either livestock or cropping to climate variability. As the Chief explained, the tree planting initiative in Wiyumiririe has been widely promoted by The International Small Group & Tree Planting Program (TIST). This Non-Governmental Organization (NGO), which receives its funding through a carbon sequestration program, pays farmers to plant trees on their farms and in collectively managed groves as part of their mission. According to TIST, up to 26,000 trees have been planted in Wiyumiririe between 2008 and 2010.

5. Discussion

Both Thome and Wiyumiririe opened up for settlement at around the same time and since then comparatively divergent livelihood pathways have evolved. In the case of Wiyumiririe most land was already settled and converted into cropland for rainfed agriculture as early as 1979, which by 2014 covered 74.1% of the Sub-location. Since at least 1995, farmers focussed on intensifying their land-use through the adoption of new technologies and innovations in farming practices, such as the rearing of high-yielding milk cow breeds, the installation of greenhouses, the practicing of conservation agriculture, and the planting of trees. Similar processes of intensification and diversification of livelihoods are taking place in other areas of Laikipia that share similar socio-ecological conditions (Ulrich et al., 2012). This pathway differs from that in Thome, where cropland (mostly irrigated) increased tremendously since 1995. Farmers expanded particularly into the wetland and its surrounding grassland areas. Whilst the combination of wetland and grassland resources attracts a wide range of users – from farmers and pastoralists to itinerant squatters – Thome's contiguity with a wider area of pastoralist access contributes to its tenuous security situation. In dealing with these adverse conditions, where little outside support is availed, local people instead rely upon highly flexible livelihood practices. In Wiyumiririe, on the other hand, the major challenge of land scarcity has been dealt with

[3] Kilimo Biashara, a financing scheme set up by the Alliance for a Green Revolution in Africa (AGRA) in collaboration with the International Fund for Agricultural Development (IFAD), aims at turning small-holder farmers' agricultural subsistence into feasible businesses through a cash guarantee fund (source: www.agra.org, last accessed: January, 2015).

through the adoption of practices and investments that aim at improving the productivity of their land. In this location a number of external development actors have played a key role in meeting residents' aspirations especially through the introduction of appropriate technologies and services.

Similar to other regions in semi-arid Africa (Scoones, 1991) the wetlands in Thome offer valuable dry season grazing and opportunities for irrigation farming. The varied usage of the wetlands is almost exclusively based on local initiative. Although several policy documents in Kenya promote wetland stewardship, there are no laws that outright regulate the use of these ecosystems outside those within national parks (GOK, 2009). Instead, the government allows for the 'sustainable' utilisation of wetland resources – on condition one acquires a permit. In practice, however, this rule is not fully adhered to in Thome and the government does little to bring this condition into force. Indeed, the drainage of the Ewaso Narok swamp for agricultural production was in the early years after independence even encouraged (Thenya, 2001). Local settlers are quite aware that the current rush to harvest wetland resources, especially for the irrigation of market-oriented horticultural produce, might in the long run "push it into a corner". A study of the Pesi swamp, 25 km upstream of the Pesi River that drains into the Ewaso Narok wetland, showed that complete degradation set in 5–7 years after the first settlers arrived (Thenya, 2001). The fact that resident groups in Thome try to enforce their perceived rights to wetland resources on the basis of title-deeds and the setting up of policing units can be considered as a strategy to prevent such a trajectory. However, equating the ownership of title-deeds with access rights to the wetland excludes a whole range of other user groups who claim a stake in it, namely 'brief case' farmers, itinerant squatters and seasonal pastoralists. This situation could therefore increase the inequity between those who can establish a registered claim to the wetland, and those who can't, an observation that has also been made in other parts of Africa (Woodhouse et al., 2000; Nüsser, 2002). The heightened insecurity that farmers associate with the usually armed Pokot and Samburu pastoralists who arrive in Thome during the dry season, has a longer history of violent incidences in the whole of Laikipia (Bond, 2014). As it has been argued, their reliance on livestock raiding is a dangerous but powerful and well-adapted practice that seeks to secure access to resources in the highly politicized landscape of northern Kenya (Greiner, 2013). One major effect of this insecurity is that the ownership of larger herds of livestock is considered less attractive to its permanent settlers, thus partially relieving the overall pressure on the grasslands.

According to Adeel and Safriel (2008), a common feature of the first livelihood pathway, where there is a high long-term risk of a downward spiral into poverty, is the combination of a low agro-ecological potential and the absence of enabling policies and effective governance. Thome generally tends towards this pathway in which resource exploitation, conflict and marginalisation reinforce each other. Whilst the residents of this Sub-location generally value both the diverse conditions of their area and their sense of community, they face three interrelated challenges: first, poor access to agricultural markets, credit facilities, and government services; second, contested resources, particularly with regards to the wetland; and third, insecurity arising from Thome's location along a corridor of pastoralist migration. The picture is rather different in Wiyumiririe. Here, as in many other parts of the County, people are faced with low and erratic rainfall including little potential to irrigate, high population densities, and small-sized household plots (Ogalleh et al., 2012). However, in Wiyumiririe population density has remained remarkably stable, as shown with the zero population growth between 1989 and 2009. Whilst this stability has reduced the pressure on already small plot sizes, it further indicates that out-migration and off-farm employment have become viable options. Moreover, Wiyumiririe exhibits important characteristics highlighting that its residents are on the second livelihood pathway, through both the technological enhancement of land-productivity and the adoption of alternative activities that leads to an increasing independence from the land. This development has been enabled through, for instance, relatively good access to agricultural, labour and financial markets, and supportive governance structures.

Community members have sought to improve their situation by intensifying their land-use through the adoption of new and expensive technologies (exotic milk cows and greenhouses), but also by diversifying into off-farm income earning activities. Capital intensive technological investments are made possible because of off-farm household incomes and the surety that an enabling governance structure provides, particularly with regards to secure land tenure rights, security, and advisory and training services. Wiyumiririe's location along a main highway and its proximity to several service centres undoubtedly facilitates the work of the government and also makes it easier for her residents to capitalise on external knowledge and technologies for their off- and on-farm activities. Local residents expressed a strong interest in investing in new technologies, particularly for more greenhouses and the installation of a milk cooling plant, yet were faced with financial constraints. In order to deal with these constraints several institutionalised self-help groups have been set up. Unlike in Thome, members of these groups have profited from government support, for instance by participating in training programmes on agricultural marketing. In general, the interest shown in conservation agriculture, the investments made in greenhouses and the planting of multi-purpose trees, indicate strong household and community level commitments to the sustainable use of resources, echoing the Kenyan study 'More People, Less Erosion' by Tiffen et al. (1994) - which challenges the view that a high population density ultimately leads to environmental degradation and a decline of wellbeing.

6. Conclusion

Our study adopted the DLP to examine livelihood pathways of two spatially proximate study sites in Laikipia County. Despite both sites being opened up at around the same time, belonging to the same County, and falling within the same national-level development policy brief, our findings show that they exhibit divergent livelihood pathways. Thome's contiguity with areas of open access and its location next to the wetland, has led to heightened insecurity and ongoing conflicts over land-use rights. Within these drylands, the wetland is a key resource for a wide range of stakeholders, but also a hotspot of contestation and exploitation. Residents have recognised that the wetland needs regulation, and have made efforts to this end. However, the absence of state support makes it difficult to enforce and sustain these attempts. Whilst it is clear that action needs to be taken to regulate forms of resource use in Thome, and also to improve security and support structures for the marketing of agrarian produce, development actors should aim at doing justice to all stakeholder claims before initiating any intervention. In contrast to those of Thome, Wiyumiririe's population benefits from a strong government presence as well as good access to several service centres. Our findings show that the community is eager to sustainably enhance land-productivity while simultaneously securing alternative off-farm incomes. In other words, Wiyumiririe represents a positive example of the second pathway, with a blend of both scenarios as described by Safriel and Adeel (2008). Further research, however, is needed to determine which sections of the community have succeeded on this pathway,

how far and why. On that basis intervention measures should then be tailored so as to ensure a socially just and equitable development for the medium to long-term. Our study shows that even within spatially proximate locations with comparable agro-ecological conditions, livelihood pathways can differ significantly. Such differentiations are all too often not considered in the planning and implementation of development interventions.

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