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Agricultural change at the margins: adaptation and intensification in a Kenyan dryland

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ABSTRACT

Land-use and livelihood patterns among Eastern African pastoralists have undergone dramatic change in recent decades. The dynamics in East Pokot effectively illustrate these changes. We focus on the spread and intensification of honey production and crop cultivation, describing the patterns of adaptation and diffusion and the current techniques of production. These processes must be understood as dynamics of agricultural intensification, and not as forms of diversification, because current transformations in pastoral communities go beyond temporal strategies of risk avoidance. In the case of East Pokot, intensification is related to population growth, albeit not in the linear manner proposed by Boserup. Rather, this relation is mediated by variables that include markets, labour, technology and the micro-conditions of the agro-ecological environment.

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The close of the twentieth century saw major cultural and livelihood transitions in pastoral societies in East Africa. Since the 1980s, scholars have observed increasing signs of profound crisis in these societies, leading to various processes of restructuring. The 'New Pastoralism', as Hogg[1] termed it, is characterized by loss of land, resource degradation, restricted movement, encroachment of rangelands, and growing populations.[2] The pace at which the changes take place is usually described as drastic, and some authors, such as Spencer[3] and Markakis,[4] have projected a gloomy fate for pastoralism. In their view, those living in the African drylands are caught up in a dilemma, which unfolds as growing populations and decreasing rangelands pave the way for environmental destruction and destitution. Immigrant farming populations drive pastoralists away from pastures, Spencer[5] notes. They end up facing the choice of either becoming farmers themselves, or moving to urban areas in search of wage work, while 'those who do not settle are edging further into semi-desert regions, where they compete with one another and with rival pastoral groups for depleted resources'.[6] More recent approaches, pointing to declining livestock-per-capita thresholds, predict the end of pastoralism.[7]

What these voices have in common is a more or less explicit neo-Malthusian framing, which, as Moritz observes, is 'the dominant narrative about the future of African pastoralism'.[8] Although the ability of pastoralist economies and societies to change has been

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widely acknowledged,[9] these rather static Malthusian assumptions resonate well with earlier accounts of pastoralism as a conservative and change-resistant niche economy.[10]

A widely accepted critique of neo-Malthusian approaches is their ignorance of innovations and technological improvements that might be strong enough to reduce the population pressure on land and potentially also improve living conditions, even in growing populations. Alternative views, however, are often guided by a Boserupian approach that portrays intensification processes as evolutionary consequences of increasing populations and shrinking resources.[11] While intensification dynamics following such linear models have been observed, for example by Netting,[12] and models based on this approach have been adapted to capture such dynamics in the African drylands,[13] other researchers have insisted that intensification often follows much more complex and less linear pathways than suggested by Boserup's quasi-deterministic approach.[14] In his overview of African environmental history, McCann[15] notes that demographic effects on the environment are 'situational and fluid and not amenable to generalization'. This is illustrated, for example, in the contributions in Widgren and Sutton's volume on intensive agriculture in Eastern Africa.[16] By outlining the historical development of selected 'islands of intensification' in East African drylands, the authors point to 'complex interaction of ecological, social and historical factors' in the development and distribution of intensive farming.[17] As such, they refute any simple explanation for these processes, be they environmental, demographic or economic.

In this contribution, we describe the transition of Pokot livelihoods from extensive livestock husbandry to more sedentary and intensive forms of agro-pastoral land-use, particularly rainfed farming and honey production. We understand agricultural intensification as a process which involves increasing productivity per unit area of land by changing or modifying the system of land-use previously practised, as well as requiring greater inputs in terms of labour, capital and technology; more simply, it is the 'increased production of crops and agricultural commodities'.[18] As such, intensification is conventionally distinguished from livelihood diversification, which primarily refers to increased off-farm income.[19]

Certainly, since about the mid-1990s there has been a marked tendency toward livelihood diversification in the area, resulting in the spread of petty trade, illegal brewing, charcoal burning, and dealing in water and firewood, as well as cash-for work programmes.[20] Besides these activities, however, cash-income opportunities are still rare in the area, as is labour migration.[21] Although the transition from pastoralism to cultivation is sometimes also referred to as diversification,[22] and the literature on rural livelihoods suggests that intensification often goes along with processes of diversification, we suggest that honey production and rainfed crop cultivation in East Pokot are better addressed as processes of intensification. This refers particularly to those areas, where these activities are no longer carried out on an erratic or opportunistic basis, but have been integrated into the annual production cycle of local households. We furthermore argue that the dynamics of intensification in East Pokot cannot be explained as solely resulting from the temporary risk-management and income-maximizing strategies of individual households (as proposed by Mace[23]) but must be analysed as a general dynamic of agrarian transition, which involves large parts of the population.

Based on long-term ethnographic data on East Pokot, Kenya, we explore these processes of intensification, the roles played by the environment, markets and population

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patterns, and their effects on inputs, land-use change, and changing technologies. We argue that, in the case of East Pokot, intensification is related to population growth, albeit not in the direct, linear way proposed by Boserup.[24] Particularly, we see that patterns of intensification are not evenly distributed throughout the research area. Intensification has followed different trends and patterns within one community: honey production has increased in the lowland and mid-hill zones, while rainfed agriculture has increased in the highlands. As such, the intensification process has responded to the bio-geophysical conditions of the wider landscape, without, however, suggesting simple geo-deterministic conclusions. The highlands, for instance, despite providing relatively good conditions for crop cultivation, did not attract any significant population until the early 1990s.

Study site description

East Pokot is part of Baringo County, located in Kenya's Rift Valley Province, and predominantly inhabited by Southern Nilotic-speaking Pokot. As specialized, subsistence-oriented and highly mobile cattle herders, they expanded into the area during the nineteenth century.[25] East Pokot is located in the savannah plains north of Lake Baringo and in the undulating hills and escarpments that stretch towards the Laikipia Plateau in the north-east. The area consists of semi-arid to arid thorn-bush savannah, is prone to recurrent droughts, and was 'among the earliest and most regular recipients of famine relief' in Kenya.[26] Infrastructure is weak, literacy and life expectancy are low,[27] and violent conflicts with most neighbouring groups, particularly with the Turkana, have increased dramatically since the 1990s.[28] Paving of main through-roads and electrification of a few centres began only recently. While these permanent settlements serve as administrative centres and marketplaces, most households are scattered throughout the hinterlands. Land tenure is communal, and, apart from the recent implementation of community-based conservation projects[29] and the beginnings of geothermal resource exploitation, the area has until now been spared the kinds of external investments and agricultural development schemes that have led to land alienation and destitution elsewhere in the Eastern African drylands.[30]

The population in the area has increased rapidly in recent decades. Census data reflect an increase from about 40,000 in the late 1980s to 63,000 by the end of the 1990s. The most recent census figure stands at 133,189.[31] As described elsewhere, there is no solid explanation for the recent growth rates, as we are not aware of any changes in territorial boundaries or any significant in-migration dynamics.[32] While there is increasing out-migration of pastoralist Pokot toward the abandoned rangelands on the Laikipia plateau, labour migration to rural or urban areas outside East Pokot has remained an option chosen by relatively few. While the human population has increased steadily over the past three decades, the number of cattle has remained largely stable at about 100,000 animals.[33] This steady drop in the cattle/people ratio has been paralleled by the sharply increasing, market-oriented production of small ruminants: since the severe droughts of the early 1980s, the number of goats and sheep has 'increased more than fivefold to a projected all-time high of almost 700,000'.[34]

The droughts of the early 1980s also spurred rainfed crop cultivation. As in many other areas of North-eastern Africa,[35] aid agencies, like the Kenya Freedom from Hunger Council (KFFHC) established small-scale agricultural schemes and demonstration plots

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in East Pokot during that time to help destitute pastoralists to cover their drought losses and to instruct them in rainfed farming. Except in some highland areas and a few pockets elsewhere, families soon re-established themselves as pastoralists. While in the wider Baringo area cultivating pastoralists have a long history, amongst both Tugen and Il Chamus,[36] as in neighbouring West Pokot, where 'the cultivation of finger millet or sorghum has always been of some importance for most families',[37] it is in East Pokot that the partial adaption of rainfed agriculture can be safely described as a new development. In contrast to crop cultivation, however, honey production is not completely new to the Pokot. It has, however, rapidly gained importance in the past two decades, encouraged by aid organizations, which began introducing modern beehives to spur income-generation activities among local communities in the mid-1980s.[38]

The 1990s saw further episodes of short recurrent droughts, which limited recovery or expansion of livestock among many pastoralists in East Pokot. The 1999–2001 drought was more extensive and severe than the previous droughts of 1992–1993 and 1996–1997 and its effects were felt most keenly throughout Kenya. Nearly three million pastoralists and agro-pastoralists were at risk, and many lost as much as 90% of their livestock.[39] The worsening of poverty and the reduction of food security, as well as the prospect of additional sources of income, compelled many households to adopt alternative livelihoods, and today crop cultivation and beekeeping are important activities in East Pokot, though they are more predominant in some areas than in others. While in the lowland plains toward the arid north livelihoods are predominantly pastoral, the area stretching from the shores of Lake Baringo toward the highlands has witnessed a profound change from pastoralism to sedentary agro-pastoralism. This is where our study area is located: it covers a transect stretching about 50 km along a gravel road connecting Lake Baringo with the edge of the Laikipia plateau.

This transect cuts across three distinct landscape categories, which Greiner, Alvarez and Becker,[40] as part of an interdisciplinary field campaign, have classified as lowlands, mid-hills and highlands (Figure 1). This field research was undertaken to analyse the agronomic and social-ecological conditions of crop cultivation in the area, and we therefore make use of these landscape categories, which we will briefly describe. The lowlands comprise the Rift Valley bottom and shores of Lake Baringo at an average altitude of 900–1000 masl, with sparse Acacia trees and thickets. The mid-hill zone, around the small commercial centre of Tangulbei, consists of a range of undulating plateaus interspersed with steep rocky escarpments. This zone area has an elevation of 1100–1400 masl and is characterized by shallow soils and partly dense stands of *Accacia mellifera*. The highlands, around the settlement of Churo, present a transitional zone between the steep Rift Valley escarpment and the Laikipia high plateau. This area has an elevation of 1600 to more than 1800 masl, and is characterized by long hillsides and large valleys with deep, dark brown clay soils. Mean temperatures and total precipitation decline with increasing altitude, but rainfall is generally more reliable and the general conditions for crop cultivation are better in the highlands.

Methods and data

Greiner collected data for this article during a year-long stay in East Pokot, from October 2010 to September 2011, and during several shorter trips to the area. Data collection

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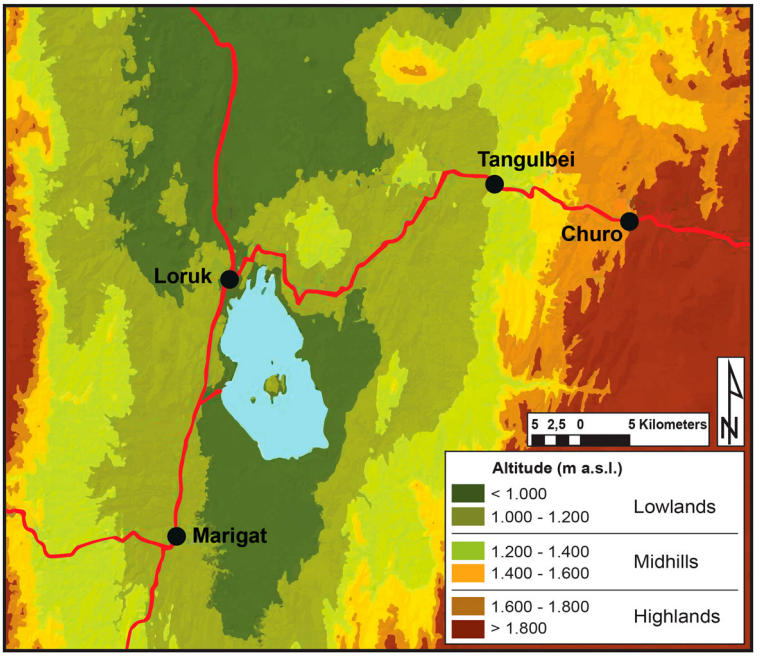

Figure 1. The research transect follows the road from Loruk to Churo, north-east of Lake Baringo.

methods included ethnographic observations, and qualitative and quantitative interviews, which he undertook with the help of a local interpreter and fieldwork assistant. To gain a broader overview of the changing situation, he conducted a questionnaire-based household survey on livelihoods and land-use patterns. This survey was based on a two-step geographical cluster-sampling approach: eight primary areas, circular in shape (radius: 3 km) were determined along the research transect, based on the assessment of satellite imagery and knowledge of the local situation gathered during a pre-excursion. These circles were subdivided into grid squares of 500×500 metres, of which a certain number were randomly selected and all households within them ($N = 271$) surveyed. Furthermore, a survey on the socio-economic attributes of local agricultural production systems and plot sizes was conducted ($N = 48$) during the interdisciplinary field campaign mentioned above.[41]

Mwaka collected data used for this article between July and September 2011,[42] using purposive sampling to identify the villages in the three regional settings: Chemolingot and Marigat in the lowlands; Chepkalacha, Tangulbei and Kokwötötö in the mid-hill area; and Churo in the highlands. This sample of locations allowed insights into the spatial patterns of the honey economy. In each village, Mwaka made a transect walk, and conducted random sampling of households to avoid the bias of choosing only households that engaged in honey production. He used interview guides for collecting data from households, traders, and district leaders ($N = 54$).

In addition to the ethnographic data, this analysis benefits from a study by Obermaier,[43] who uses recent and historical remotely sensed data to analyse long-term land-cover changes. The focus of this study, which she conducted in close collaboration with Greiner, was an investigation of the spatial and temporal dimensions of maize cultivation

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in East Pokot based on the analysis of high spatial resolution RapidEye satellite imagery and historical Landsat data.[44] Her study focused on maize cultivation, both because this is the crop predominantly cultivated by the Pokot, and also because the spectral signature of maize in remotely sensed data is relatively easy to distinguish from that of other forms of vegetation. The years covered in this study were 1986, 2000 and 2010.[45]

The intensification of honey production

Honey production and trade in East Pokot is not a novel phenomenon. While the Pokot still relied on the neighbouring Tugen and Marakwet for honey in the early twentieth century, members of the Chumo age group (born between 1900 and 1910) reportedly started to adopt honey production in the area.[46] However, there are no records of intensive or large-scale beekeeping in East Pokot before the 1980s. Rather, wild honey was occasionally harvested using fire and smoke, a process that killed many bees and forced the rest to migrate. The low-level production probably met the internal demand for the honey, which was used for medicinal purposes, food and – most importantly – to brew alcohol used in rituals.

During the droughts of the early 1980s, beekeeping increased. This was aided by outside organizations that sought to combat hunger and reduce the pastoralists' vulnerability to drought, such as the KFFHC, which launched the distribution of modern beehives in 1985. However, only at the beginning of the new millennium did East Pokot witness a massive move toward beekeeping and honey production as an alternative livelihood strategy. Before 1998 few people from East Pokot were known to harvest honey as a vocation.[47] Makali, a beekeeper in his mid-thirties, recounted the story of how he adopted beekeeping and honey production:

> I have thirty traditional log hives and twenty-six of them are occupied [colonized by bees] now as I speak. I started keeping bees in the year 2000 because all my livestock had died during the 1998/1999 drought. I had no more cows and goats, then I said to myself: what can I do to get these animals? Then I knew that bees would help because I had seen my friend prosper from keeping them and selling the honey. I started keeping bees for honey. I began with four hives, which I bought from him [the friend] at one hundred shillings [Kshs.100] each. I used the first harvest to buy goats and later I used the profits to buy more hives.[48]

While Makali's friend must have been among the few individuals who had turned to beekeeping in the 1980s and 1990s, his own way into this livelihood is representative of that of many pastoralists in East Pokot who adopted beekeeping as a form of livelihood in the early 2000s. In these years (c. 2002–2005) several organizations and programs offered support to the communities affected by the drought, among them Heifer International, under the government's Arid Lands Resource Management Program, in which a needs assessment study was carried out where the local people requested support – for beekeeping and honey production in the lowland and mid-hill zones, and for agriculture in the highlands.[49] They organized farmers, mostly women, into groups, supplied them with modern beehives, trained them in management techniques, and linked them to markets in the bigger towns and cities. Over the past decade, beekeeping has become very widespread: figures provided by the Ministry of Livestock Development, East Pokot for the period from 2009 to 2010 alone suggest that the value of honey produced

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in the 5 divisions of East Pokot increased by almost 59%.[50] This increase was partly due to the favourable climatic conditions in 2010, with above-average rainfall and good flowering. According to Greiner's survey, more than a third of all households produced honey as a means of income generation in 2010. This figure, however, hides some important regional patterns: While 41% and 45% of all households in the lowlands and the mid-hills respectively claimed to produce honey, only 29% did so in the highlands.

Methods of production

Makali's story also illustrates another important point: the relatively widespread influx of modern technologies has not replaced the traditional log hive, which remains the most common hive in the area. Locally known as *Manghen*, this hive consists of logs cut into halves, the inside gouged out and the two halves re-joined with wires in a cylindrical form. The hives are typically suspended horizontally on the trees around the homesteads. To attract bees to colonize the log, the owners smear cow dung inside the hives. The preparation of the log hive, which is made of the wood from specific trees, is labour-intensive, and processing honey from these hives is laborious since brood and honey are mixed up in the same chamber. Until recently, honey from these hives was mainly harvested using fire and smoke. Now a few beekeepers wear protective clothing while harvesting. This is common with those working in groups. Other beekeepers hire these 'harvesters' and pay them Kshs. 150 per hive (cost as of 2011). Many people harvest with smoke but without fire. This, they report, does not kill the bees but makes them dizzy and less aggressive. Yet, respondents report a high colonization rate of the traditional log hives compared to the modern hives, and this method of production is the most widespread in East Pokot (see Table 1).

The second method of production involves the use of the Kenyan top-bar hive (KTBH) first introduced in the mid-1980s. The KTBH is a modern beehive with waxed bars suspended inside the hive to provide a basis for the bees to construct their combs to hold the honey and brood. There are several variants of the KTBH, but the key principle is that of movable combs, with the bars of the frames arranged to help in maintaining a correct 'bee space', a gap of a given width allowing bees to move about in the hive between any two facing surfaces. Top bars should fit together forming a solid cover over the hive to stop bees from passing through.[51] Fitting the top, however, is always a challenge, and if this is not done well, it may limit the functioning of the hive. For instance, temperatures in the hives may rise, causing the beeswax to melt. The KTBH, described above, is the second most widespread hive in East Pokot. The Heifer International project distributed some to the community members in the initial stages of their engagement in the area. Since these hives are quite expensive, many local beekeepers continue using the traditional log hives (Table 1).

Table 1. Number of hives in production areas 2010.

Division	Log	KTBH	Langstroth	Totals
Nginyang/Mondi	5892	2184	193	8269
Tangulbei/Churo	4439	900	300	5639
Kolloa	5596	1500	143	7239
Total	15,887	4484	636	21,007

Note: GoK, *Ministry of Livestock Development, Annual Report for 2010 Bee-keeping.*

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The Langstroth hive, the third method of production, is a technical improvement of the KTBH. The difference being that the Langstroth has two boxes: the lower box or the brood box, and the upper box (or the super compartment). A queen excluder separates the boxes. This means the queen is restricted to the brood box, so the super compartment contains honey but not brood. Although this type of hive produces higher-quality honey, in comparison to log hives and KTBH, local beekeepers rarely use it. Similarly to the KTBH, colonization rates of the Langstroth hive are reported to be lower than those of traditional hives, and local producers insist that 'bees don't like these hives'.

The height of the suspended hives from the ground varies according to distance from the homestead. Those that are near the compound of the house are suspended closer to the ground to enable easy monitoring and harvesting. Those further away from the house are suspended higher on the tree to make it harder for thieves to steal the honey or the hive itself. Most of the hives however, are placed around a beekeeper's compound. Most beekeepers have expanded their production by increasing the number of hives in the same given space. Output per unit area has increased over time, and we can safely speak of a process of intensification. The increasing number of people taking up beekeeping further strengthens this trend, increasing the output per unit area through the accumulation of more beehives.

Despite the interventions of outside agents, much of the intensification dynamics in honey production can thus be attributed to local techniques. Many local producers do not remember KFFHC, and of those who do mention outside interventions, many stress that they had not personally been part of the target groups that benefited from these organizations. These organizations targeted a few individuals organized into groups, and provided them with training and KTBHs as start-up capital. The rest, like Akudu Makali, were encouraged to try beekeeping by witnessing how others had benefitted from the industry. It must be pointed out, however, that this process was supported by the presence of a market for honey. Local use of honey is minimal compared to the amount sold in external markets, and this demand has certainly boosted production. Trade in honey has been substantial, and production has grown rapidly in the past ten years. Gichora[52] points out that even in 2001, the income from the honey trade already compared favourably with other activities in the livestock-rearing sector. Both the widespread participation of many households (in those areas where conditions are suitable) and the increasing market volume sold clearly illustrate that nowadays honey production is one of the main livelihood strategies in the area. Honey is sold at three major levels: First, at the villages and local markets to middlemen. These middlemen then transport the honey to the town of Marigat, the main regional trading centre, where they sell the smaller part of it to local retail traders. The larger share, however, is sold to wholesalers from bigger cities like Nakuru and Nairobi. Most of the honey is then sold in big supermarkets, such as Uchumi and Nakumat. Based on Mwaka's study, the respondents reported that they intend to continue producing honey because of the potential profits it represents.[53]

The transition to rainfed crop cultivation

Unlike honey, the maize cultivated in East Pokot hardly has a market inside the district, let alone outside the wider Baringo area, and until the 1980s, Pokot households barely

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engaged in crop cultivation. Only in the eastern highland areas around Churo (Figure 1), had some families started small-scale, rainfed agriculture in the late 1970s, an activity which gained pace during the 1980s, as Hogg notes in a review of agriculture in semi-arid Kenya:

> In spite of their almost exclusively pastoral tradition the Pokot are clearly interested in rainfed cropping if it can be shown to be successful. In the higher altitude and more secure rainfall areas, such as Churo, to which the Pokot have only started to move in the last five or six years, crop cultivation has expanded rapidly.[54]

As noted above, droughts, livestock diseases, and the subsequent famines of the early 1980s brought large-scale development projects to East Pokot. These initiated demonstration farms all over East Pokot and sometimes distributed free agricultural tools and seedlings. In the Churo highlands, where people had already started cultivation, these efforts contributed to the rapid and long-term adoption of rainfed farming as a central component in people's livelihoods. Rich and poor alike from lower-lying areas of East Pokot were attracted and subsequently moved to the area. Ruben Cherindis, a pioneer farmer from Churo, remembers:

> When we started farming in 1979, we went to Laikipia, looked at the shambas [fields] of a white man and imitated this. The other Pokot were making fun out of us, telling us that we were playing in the mud like little children, asking us if we had no cattle at home. […] But most of the people who started cultivation by that time were poor. They had lost their cattle to a disease. During the drought of the early 1980s, those who had cultivated before had food and the others came and begged for it. This is when the other Pokot stopped making fun out of us and by the end of the drought, many of them started farming too.[55]

In the 1990s and 2000s, more and more Pokot families migrated to the highlands, became sedentary, and converted the communally owned ranch-land into individual farms. Available land near roads and settlements decreased dramatically, while the price paid for (informal) land transfers rose by more than 40% between 2007 and 2010. In the same period, conflicts over plots of land between individuals, families and clans increased dramatically and became a source of major disturbance in the affected communities. These conflicts were partially due to a lack of secure property rights and the absence of any mutually accepted authority for conflict resolution, since all land in East Pokot is strictly communal and therefore governed by traditional authorities that are increasingly losing power.[56] A closer elaboration of these dynamics, however, is beyond the scope of this contribution.

According to national census data, the population in the Churo highlands almost tripled between 1999 and 2009 (from 7510 to 21,227). Accordingly, the highlands had the highest population densities in East Pokot and most households were, and still are, actively engaged in maize cultivation.[57] In the lower-lying areas, attempts to introduce farming did not initially prove very effective, since most families resumed pastoralism after their herds recovered with the onset of the rains in the mid-1980s. During the 1990s, however, farming started to spread in these zones too, and in the mid-2000s, farming was being practised in areas 'where in the 1980s nobody even considered the option of agriculture'.[58] Today, crop cultivation is no longer associated with poverty. In 2010, almost 90% of all households in the highlands, and many in the mid-hill (ca. 60%) and lowland areas (ca. 30%) were engaged in farming. Additionally, around 40%

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of all households in the highlands cultivated a garden where they produced vegetables, which is uncommon in the mid-hill and lowland zones.[59]

Remotely sensed data confirm the ethnographic observations. Obermaier's analysis of three time periods (1986, 2000 and 2010) reveals the patterns of densification, expansion, and ultimately intensification.[60] From 1986 to 2010, the area cultivated with maize increased by 72%, from 26.1 to 45 km². While in the highlands large parts were already under cultivation in 1986, major increases have taken place since then in the mid-hill and lowland areas. Satellite imagery also reveals that cultivation starts in small clusters that emerge in biophysically more favourable areas such as highland valleys, alluvial fans, along riverbeds and along the feet of escarpments to benefit from runoff water. Proximity to settlements and roads also influences the expansion of cultivation plots.

Another feature revealed by Obermaier's work is the temporal and spatial stability or volatility of the cultivated fields. Only 18.9% of the area classified as maize fields in 1986 matches the cultivated areas of 2000, indicating a high degree of instability (Figure 2). Shifting cultivation, fallowing, failed attempts as well as trial and error are possible explanations. Additionally, a larger number of households have temporarily given up cultivation, particularly in the lowlands: most farmers claim not to have cultivated annually due to erratic rains. In contrast, the 2000–2010 imagery reveals that 49.5% of the geographical patterns remained stable, indicating that the same fields were cultivated in 2000 and in 2010. Additionally, the remotely sensed data show that in the highlands the formerly patchy distribution of maize fields has increasingly changed as fields have been merged to form a more homogeneous landscape of cultivated areas. This compaction and stabilization of land-use patterns points to the increasing scarcity of arable land as well as to the growing importance of cultivation for local livelihoods. In contrast, the spatial patterns of cultivation in the mid-hill and lowland areas remain patchy and scattered, and fields are used more infrequently. This suggests the implementation of what we have described elsewhere as opportunistic land-use strategy,[61] a strategy that resembles processes of diversification rather than being an indicator for the dynamics of intensification.

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Methods of production

The Pokot usually clear their fields of smaller trees and shrubs manually, sometimes using fire. In the lowland and mid-hill areas, the fields are mostly fenced with piled thornbushes. In the highlands, where most farmers have cultivated on an annual basis for two decades or longer, fences increasingly consist of hardwood poles, often more than two metres in height, connected by wire and dense arrays of enmeshed sticks, and sometimes even with barbed wire. Fences of either material are an important means for keeping wildlife and domestic livestock out of the maize fields, but they also serve as a way to stake claims to land, and thus are also found around large areas of uncleared bushland. About half of all farmers, in highlands and lowlands alike, employ more labour-intensive land-improvement and soil-conservation methods. Among the most common measures are the digging of walls and ditches to channel the runoff water, and the building of terraces with logs and sometimes with stones.

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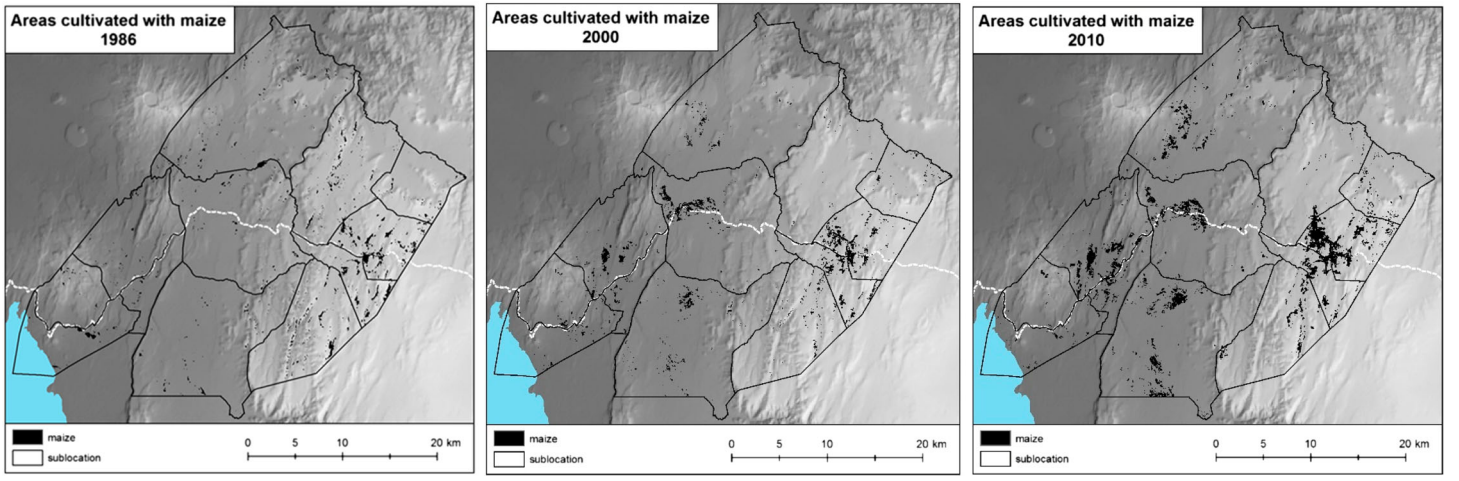

Figure 2. The spread of maize cultivation, reconstructed on the basis of high spatial resolution RapidEye satellite imagery and Landsat data.

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Fringing of the fields is usually irregular and typical field sizes rarely exceed one acre (4047 m^2), although there are notable exceptions, particularly in areas where tractor ploughing has been available for some years. This was the case in the highland areas around the market town of Churo, although more recently, tractors have occasionally been used in the mid-hill areas too. Estimates based on remote-sensing data suggest that less than 50% of the cultivated area around Churo was tractor-ploughed in 2010. Tractors are scarce, and the few that are available in the area during the ploughing season (March–April) mostly come from outside East Pokot. Their services are very much in demand by farmers in the area, and prices for ploughing have therefore been increasing, to about 2300 KSh per acre in 2011. Despite the rising costs, most farmers in the highlands prefer to have their fields ploughed mechanically, which takes no more than one hour per acre. Manual ploughing, by contrast, is extremely time-consuming, and labour is even more expensive than the hiring of a tractor, particularly in times of high demand. An experienced farm worker needs about 80 hours to plough one acre, and the cost for the ploughing of a standard plot of roughly 10×10 metres costs on average about 70 KSh. Manual ploughing of one acre therefore costs approximately 2800 KSh – about 23% more expensive than by tractor. The growing season starts between March and April and usually ends in August (mid-hill and lowland areas) and October (highlands). Maize is the single most dominant crop planted in East Pokot. Intercropping maize with beans is practised throughout all area by about 30% of all farmers, and only a few additionally cultivate green grams (mung beans), cowpeas and finger millet.

While in the highlands around Churo most farmers use certified maize seeds (mostly DH04, sometimes H614 or SC513), more than one third of all lowland and mid-hill farmers use non-certified seeds or the F2 generation of previous years' hybrid seeds harvests, which results in lower yield gaps and uneven crop stands. Like seeding, the tasks of weeding and harvesting are performed manually by hired farm workers and – in fewer cases – by family members. While mulching is practised throughout the area, in the highlands about half of the farmers additionally use animal manure to enhance fertility of their fields. This is very rare among lowland and mid-hill farmers. Weed control is practised throughout the area and, like harvesting and post-harvest processing, is predominantly performed by family members.

Not only is the risk of crop failure generally lower in the highlands, but yields are better there too. On average, farmers in the highlands harvest about 2.0 tons of maize per hectare, while the average yields of lowland and mid-hill farmers amounts to approximately 1.65 tons/ha. Although those who tractor-plough do not yield more per unit area, they manage to cultivate larger plots, and their total yields are almost double those of the farmers who do not have access to mechanical support (on average 1.8 vs. 0.9 tons/ha). Consequently, these farmers sell a good part of their harvest to local shopkeepers and invest in inputs such as hybrid seeds, solid fences and sometimes even chemical fertilizer.

Agricultural change as long-term trend among East African pastoralists

If livelihood diversification became widespread in the 1990s in East Pokot, the new millennium saw an intensification of two agricultural activities in the region: beekeeping and rainfed crop cultivation. The dynamics in East Pokot validate much of the 'Maasai Model' described by Desta and Coppock.[62] Based on the well-documented case of the

Maasai in Kenya's Kajiado District, they suggest a more general model of change among East African pastoralists, which takes the following form: (1) a decline in cattle/people ratio; (2) the need to seek for alternative sources of food (locally or through migration); (3) increased resource competition; (4) the loss of key grazing resources; (5) a sharp rise in the number of small ruminants; and – in some cases – (6) increased poverty and food insecurity. As outlined above, the changes in large-stock/small-stock ratios are manifest in East Pokot,[63] as is the increasing internal and external competition over resources and the loss of grazing grounds.[64] In the Pokot case, a tripling of population figures between 1989 and 2009 complements these trends. While the diversification of household incomes through wage labour and migration is rare in East Pokot, the intensification in the use of locally available natural resources has gained momentum. These processes of agricultural change are exemplified by increased honey production and the rapid spread of rainfed crop cultivation. While the issue of poverty is beyond the scope of this contribution, it should be noted that food insecurity in East Pokot is partially buffered by the widespread availability of drought-relief food.

Following Desta and Coppock,[65] we see the acceleration and spread of more intensive forms of land-use practices in East Pokot to be primarily driven by demographic growth and concomitant land shortage, although other variables, particularly environmental stress and the increasing adaptation of alternative values and practices, such as the attendance of Christian churches and the recognition of the growing importance of formal education, are certainly important factors too. Our appreciation of population pressure as push-factor driving the transition to more intensive land-use differs from other findings, such as those by McCabe and others, who observe that among the Maasai in northern Tanzania the majority of households adopted cultivation by choice rather than by necessity.[66] However, many approaches that explain the shift from extensive to intensive production strategies among pastoralists as individual risk aversion strategies or as temporary dynamics fall short of accounting for the dynamics observed in East Pokot and beyond. Such explanations have been developed by researchers such as Spencer, who acknowledges that cultivation can play an important role for survival in drylands, but considers it merely as a means of individual risk management with the 'overriding ideal of building up the herd'.[67] In a similar vein, Mace[68] argues that shifts between herding and farming are an individual strategy to maximize household well-being, particularly in poor families. Little et al., who consider the reasons for diversification (including cultivation) in pastoralist economies as multifaceted, and thus not necessarily linked to risk aversion, nevertheless define it as a 'cyclical rather than unilinear process'.[69] Such explanations might well suffice to describe the flexibility and diversity of pastoralist livelihoods, but ultimately tend to perpetuate the notion of pastoralists as being resistant to change. They also fail to account for situations where the transition to more intensive agrarian practices is not only a temporary strategy adopted by unfortunate individuals who eventually aspire to owning more cattle, but a general tendency among large parts of the population not only within East Pokot, but also throughout larger parts of dryland East Africa.

The relatively recent spread of crop cultivation has been noted, for example, among the Samburu,[70] Maasai,[71] and the Rendille and Ariaal,[72] to give just a few examples. Similarly, observations of increased honey production have not been confined to East Pokot alone. Kenya's *Vision 2030 Development Strategy for Northern Kenya and other Arid Lands* states, that 'bee-keeping is the fastest-growing SME activity in the region. On average 70,000 kg

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of honey are produced annually in Marakwet, West Pokot, Samburu and Baringo'.[73] We therefore see these dynamics as parts of a more general transition in East African drylands, which requires analysis within a more generalizing theoretical framework.

Concluding discussion: differentiated processes of intensification

As outlined in the introduction to this paper, we are sceptical of (Neo-)Malthusian approaches, which tend to ignore processes of adaptation and innovation and therefore often misrepresent the relationships of people with their environments.[74] The dismal and often alarmist narratives resulting from these perspectives[75] are usually countered with the more resource-optimistic Boserupian model.[76] Challenging the Malthusian assumptions of static carrying capacities, Boserup demonstrated, on the basis of historical data, that 'population increase leads to the adoption of more intensive systems of agriculture in primitive communities and an increase of total agricultural output'.[77] We see this general hypothesis validated by our data, but would qualify this. There are a number of key factors that additionally impact upon and differentiate the processes of intensification in East Pokot: specifically, the availability of labour, knowledge and technology; institutions and markets, and agro-ecological variations.

Boserup[78] clarifies that the intensification of agricultural production requires an increasing input of labour, while the efficiency of labour decreases. While a more detailed discussion of the relation between labour and agricultural change is beyond the scope of this contribution, it is important to note that despite the steep demographic growth rates, labour is scarce in East Pokot. In the highlands, for example, most families are engaged in livestock husbandry and in cultivation, while nowadays their children usually attend school and are no longer available as labour force for herding or cultivation. During the different stages in the cropping cycle, particularly during ploughing and seeding, when most farmers anxiously anticipate the first rains and rush to prepare their fields, the cost of labour consequently rises. Despite the ongoing conflicts over land ownership and the resulting processes of displacement, no landless class has yet emerged to serve as a rural proletariat.

The availability of technology, such as hybrid seeds, modern beehives and protective clothing clearly speeds up processes of intensification. In consideration of the limited availability of labour, this is particularly obvious in the case of tractors for ploughing. The organized honey production groups, whose members share knowledge and technologies, illustrate the importance of learning and knowledge transfer. In contrast to beekeeping, crop cultivation is still a highly individualized venture, as interview data reveal. Techniques for pest control, the choice of the right seeds or the timing of sowing is more often based on personal trial and error than on mutual exchange of experience. This also highlights the importance of the institutional environment on intensification processes. Although many of the transition dynamics in East Pokot result from endogenous forces, outside interventions, such as the farming demonstration plots and beehive technologies provided by the KFFHC, have clearly contributed to the spread of cultivation and honey production.

While limited assistance for farmers was available in the 1980s, there is a notable lack of agricultural extension services for crop farmers today. Because local government authorities consider East Pokot solely as a livestock production area, extension services as

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well as locally operating NGOs primarily specialize in animal husbandry. Because of this classification, land throughout East Pokot is under communal tenure, governed under customary law, which is geared toward mobile pastoralism rather than to sedentary livelihoods. Furthermore, and in contrast to livestock-related activities, farming is not regulated by rituals.[79] While land-use changes are progressing rapidly, tenure insecurity is rising due to the absence of binding legal frameworks for land ownership. This – together with the lack of work force – might well be an explanation for the relatively low investment in 'landesque capital',[80] that is, of labour-intense, long-term land improvements, such as irrigation channels and stone terraces.

As is apparent in the case of honey production, access to markets provides incentives that induce farmers to intensify their production. The same is true for the increase in small-stock production, which is encouraged by the high demand for goat meat in Kenya and beyond.[81] The distribution of drought-relief food, in contrast, might well act as a disincentive to continue along the path of intensification, as it reduces demand for locally produced maize and beans. Relief food, which usually includes beans and corn flour, is indiscriminately distributed throughout East Pokot, even in the highlands where conditions for crop cultivation are good. According to our data, 93% of all households in the research transect ($N = 271$) were entitled to drought-relief food in early 2011.

Finally, our data from East Pokot demonstrate that the process of intensification does not spread uniformly throughout the area, but is heavily differentiated by the agro-ecological features of the local environment. Beekeeping is clearly more dominant in the mid-hill and lowland zones, where the encroachment of woody shrubs increasingly constrains cattle-herding, but on the other hand provides valuable sources of nectar for honey production.[82] Crop cultivation (and vegetable gardening), in contrast, is more important in the environmentally favourable highland areas, whereas the climatic and edaphic conditions make it a rather erratic land-use strategy in much of the lowlands and mid-hill zones. Interestingly, the pastoral Pokot, who have historically preferred the environmental conditions of the warmer plains for cattle production, have long avoided the highlands due to the presence of East-Coast fever (theileriosis). This has changed in the 1980s when the Pokot started to embrace sedentary crop production as an alternative livelihood, and subsequently transformed the highlands into the most densely populated area in East Pokot. This reminds us of a study of the Mbulu Highlands in Tanzania by Börjeson,[83] who observes that landscapes of intensification are not just products of a specific sets of driving forces, but can in themselves act as drivers, by stimulating population growth. While sedentary crop cultivation certainly acts as a driver of change, our data suggest that population growth has been tremendously high throughout East Pokot in the past three decades, and the scramble for the arable areas in the highlands is rather a product of local migration dynamics.

To sum up, we have suggested that the current dynamics in East Pokot be addressed in terms of agricultural intensification, rather than diversification. While diversification points to processes of risk-spreading that can easily be discarded when these risks disappear, intensification and agricultural change imply more profound societal transformations. In this article, we argue that the dynamics of agricultural change in East Pokot, exemplified by the intensification of honey production and crop cultivation, are related to population growth. However, they do not unfold uniformly throughout the area, but are mediated by a range of important factors, such the availability of labour, technology

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and markets; the institutional embedding; and, in particular, the agro-ecological micro-conditions in the area. As such, intensification may follow several different courses within the same community. We suggest that many of the factors impacting upon these trends deserve further and more detailed elaboration. It remains to be stated however, that our observations reveal amazing capacities of adaptation and potentials for transformation among people who have often been either condemned as 'sturdy and change-resistant' or adored for their allegedly 'time-honoured traditions'. While the fate of specialized pastoralism in East Pokot may be gloomy, in our view this is not the case for the emerging new forms of agro-pastoralism.

Notes

1. Hogg, "New Pastoralism."
2. Fratkin, "East African Pastoralism;" Galvin, "Transitions."
3. Spencer, *Pastoral Continuum*.
4. Markakis, "Ethnic Conflict."
5. Spencer, *Pastoral Continuum.*
6. Ibid., 216–7.
7. Sandford, "Too Many People, Too Few Livestock."
8. Moritz, "Pastoral Intensification," 420.
9. cf. Homewood, *Ecology of African Pastoralist Societies.*
10. Schneider, "Pakot Resistance;" Evans-Pritchard, *The Nuer.*
11. Lele and Stone, *Population Pressure, the Environment and Agricultural Intensification*; Boserup, *Conditions of Agricultural Growth.*
12. Netting, *Smallholders, Householders.*
13. Mortimore, *Roots in the African Dust.*
14. Brookfield, "Intensification;" Börjeson, "Boserup Backwards?"
15. McCann, *Green Land, Brown Land, Black Land*, 22.
16. Widgren and Sutton, *Islands of Intensive Agriculture.*
17. ibid., 12.
18. Warren, *Livelihoods Diversification*, 3.
19. Scoones, "Sustainable Rural Livelihoods."
20. Österle, "Innovation und Transformation;" Bollig and Österle, "The Political Ecology."
21. Bollig, Greiner and Österle, "Inscribing Identity and Agency."
22. McCabe, Leslie, and DeLuca, "Adopting Cultivation."
23. Mace, "Transitions Between Cultivation and Pastoralism."
24. Boserup, *Conditions of Agricultural Growth.*
25. Bollig, "Adaptive cycles."
26. Spencer, *Pastoral Continuum*, 210; Anderson, "Cultivating Pastoralists;" Little, *Elusive Granary.*
27. *District Development Plan of Kenya*.
28. Greiner, "Guns, Land and Votes."
29. Greiner, "Unexpected Consequences."
30. Abbink et al., *Lands of the Future.*
31. *The 2009 Kenya Population and Housing Census*. Such growth rates are extremely high, and can only serve as a proxy here. In particular, the growth rates from 1999 to 2009 cannot reflect a natural growth rate. We thank Hartmut Lang for a critical assessment of these population figures.
32. Bollig, Greiner, and Österle, "Inscribing Identity and Agency."
33. Österle, "From Cattle to Goats," 83.
34. Ibid.
35. Anderson, "Cultivating pastoralists;" Smith, "From Milk to Maize."

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36. Anderson, "Cultivating pastoralists;" Little, *Elusive Granary*.
37. Dietz, *Pastoralists in Dire Straits*, 149.
38. Mutsotso, "The East Pokot on the Precipice."
39. Aklilu and Wekesa, *Drought, Livestock and Livelihoods.*
40. Greiner, Alvarez, and Becker, "From Cattle to Corn."
41. Ibid.
42. Mwaka, *Bee-keeping and Honey Production.*
43. Obermaier, "Spatio-temporal Assessment of Maize Cultivation."
44. RapidEye imagery was kindly provided by the German Aerospace Center (DLR).
45. Bollig, "Adaptive Cycles." The present work benefits tremendously from discussions with Michael Bollig, and from the availability of his ethnographic long-term data, dating back to the late 1980s.
46. Mutsotso, *The East Pokot on the Precipice*.
47. Ibid., 84.
48. Interview with Akudu Makali, at Kokwötötö, August 2011.
49. Interview with the Community Development Project Officer, Arid Lands, 12 August 2011. The needs assessment was undertaken during the first phase of the programme, from 1996 to 2003.
50. GoK, *Ministry of Livestock Development, Annual Report for 2009 & 2010 Bee-keeping*. The report for 2009 shows the amount of honey produced in Nginyang, Mondi, Tangulbei, Churo and Kolloa to be worth a total of Ksh 6,482,000. The report for the next year shows the amount of honey produced in the same areas to be worth Ksh 10,284,000.
51. Gichora, *Towards Realization*, 63.
52. Gichora, *Towards Realization.*
53. Mwaka, *Bee-keeping and Honey Production.*
54. Hogg, "Water Harvesting and Agricultural Production," 78.
55. Interview with Ruben Cherindis, at Churo, April 2011.
56. Bollig, Greiner, and Österle, "Inscribing Identity and Agency."
57. Greiner, Alvarez, and Becker, "From Cattle to Corn."
58. Bollig, *Risk Management in a Hazardous Environment*, 273.
59. Gardening will not be further considered in this contribution.
60. Obermaier, "Spatio-temporal Assessment of Maize Cultivation." The geographical focus of this study covers Tangulbei and Churo Divisions of the former East Pokot District (roughly the area studied by Greiner and Mwaka).
61. Greiner, Alvarez and Becker, "From Cattle to Corn."
62. Desta and Coppock, "Pastoralism under Pressure."
63. Österle, "From Cattle to Goats."
64. Greiner, "Guns, Land and Votes;" Greiner, "Unexpected Consequences."
65. Desta and Coppock, "Pastoralism under Pressure."
66. McCabe, Leslie and DeLuca, "Adopting Cultivation."
67. Spencer, *Pastoral Continuum*, 21.
68. Mace, "Transitions Between Cultivation and Pastoralism."
69. Little et al., "Avoiding Disaster," 403.
70. Lesorogol, "Land Privatization."
71. McCabe, Leslie, and DeLuca, "Adopting Cultivation."
72. Smith, "From Milk to Maize."
73. RoK, *Vision 2030 Development Strategy*, 63.
74. Leach and Fairhead, "Challenging Neo-Malthusian Deforestation Analyses."
75. Urdal, "People vs. Malthus".
76. Tiffen and Mortimore, "Malthus Controverted."
77. Boserup, *Conditions of Agricultural Growth*, 105.
78. Ibid.
79. Bollig, Greiner, and Österle, "Inscribing Identity and Agency."
80. Widgren, "Pre-Colonial Landeque Capital."
81. Österle, "From Cattle to Goats."

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82. Vehrs, "Changes in Landscape."
83. Börjeson, "Boserup Backwards?"

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