

Full Length Research Paper

The effects of communal land sub-division and land use changes on household waste production in the Southern rangelands of Kenya

Ekisa T. George

University of Eldoret, School of Environmental Studies (Applied Environmental Social Sciences), P.O BOX 1125-30100
Eldoret, Kenya.

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In the past few decades, the inhabitants of now Kajiado County in the southern rangelands of Kenya have experienced changes in land tenure and in land use that have impacted other aspects of their livelihoods as well as the environment. The study sought to examine these changes within the context of their potential influences on the household production and management of solid waste. Local residents from three different study areas were interviewed using questionnaires which included questions pertaining to basic demographic information, to land ownership and use, and to knowledge and behaviors regarding organic and inorganic household waste. The study revealed that while some characteristics of waste management were affected by land tenure and use, the use of waste from agricultural farms to feed livestock as a waste disposal method worked well for most households. Whereas some respondents burned their solid wastes others just left waste to litter in the compound. The majority of the results indicated that present changes in land tenure and land were key factors in influencing solid waste generation in the region. However, the study highlights several concerns about the lack of education and infrastructure for proper waste management which deserved attention. The study concluded that there was a relationship between solid waste generation and the nature of land use; agriculturalists produced more waste due to sedentarisation than pastoralists. Proper infrastructure and sensitization on solid management are keys to the negative impacts of solid waste to the inhabitants of the southern rangelands of Kenya.

Key words: Solid waste, land tenure, land use, waste management, sedenterisation.

INTRODUCTION

Kenya's south that is largely semi-arid has been undergoing extensive changes in land use and tenure, subsequently altering land use practices and the exploitation of the area's limited natural resources. Semi-

nomadic pastoralists, driven by a desire for greater economic security especially after the 2009 drought, are increasingly converting to sedentary, agricultural lifestyles. This trend is reflected in the subdivision of

E-mail: gekisa69@yahoo.com. Tel: +254711197085.

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several group ranches in the region, including the Kimana Group Ranch, because of demands from members to be allowed to convert the land to more profitable and individualistic land uses. In the Amboseli Ecosystem, increasing dependence on the rangeland and wetland areas for sedentary grazing, agriculture, and permanent residence has caused extensive environmental degradation, as well as intensified competition between humans, their domestic livestock, and wildlife. Moreover, conflicts arising from this conversion are exacerbated by a growing human population. These conflicts often negatively impact the livelihoods of community members, hindering the success and support of wildlife conservation efforts in the area. Combined with recent climatic changes, the modification of land use regimes in the area significantly alter the health of the ecosystems, as well as the livelihoods of people in the communities that depend on the land.

In Kajiado District in which Loitokitok Division is located, the main modes of solid waste disposal in the domestic setting are burning and open dumping (NEMA, 2009-2013). The practice of burning trash is problematic because of the gaseous effluents released such as carbon dioxide, nitrogen oxide, methane and smoke (Chugh et al., 1999), which contribute to climate change, can cause health problems such as acute pulmonary illnesses and Organic Dust Toxic Syndrome (Kaseva and Moirana, 2010), and overall give off heavy smoke and an acrid, unpleasant odor. Paper and plastic materials in particular can contain dangerous chemical substances that cause skin disease, carcinogenic illness, neurological disease, low birth weight, and chemical poisoning through inhalation (Nagabooshnam, 2011).

Haphazard open-dumping and informal landfills too have negative impacts on both people and the environment. For instance, several types of commonly used batteries still use heavy metals like cadmium, lead and mercury as electrodes or as means to increase their life spans, and Karnchanawong and Limpiteeprakan (2009) show that the direct disposal of spent household batteries into solid waste landfills can increase the heavy metal content in the landfill leachate. If trash pits are unlined, there is the possibility of seepage of contaminated leachate into the soil, groundwater sources and nearby surface water (Chugh et al., 1999; Karnchanawong and Limpiteeprakan, 2009). Because of the long decomposition process of many industrialized materials (e.g. plastic), landfills pose long-term environmental threats to the surrounding area that can continue even after the site is closed down (Chugh et al., 1999). Lead, for example, is relatively stable in soil, and so soil contamination from lead can persist for many years (Small et al., 1995). Additionally, the waste in landfills can harbor mosquitoes, rodents and other vermin that can act as carriers for disease transmission, such as malaria, tetanus, hookworm, cholera, tuberculosis, typhoid, and dysentery (NEMA, 2009-2013; Pearce and Turner, 1994;

Achankeng, 2003).

The shift from pastoralism to agriculture that has been taking place in southern Kenya over the last few decades represents the conversion from a nomadic lifestyle to one that is sedentary. Many researchers (DeLong, 1993; Hardy-Smith and Edwards, 2004; Berelov, 2006) have either studied or noted the archaeological relationship between sedenterisation and the subsequent need for systems of waste disposal. Indeed, Rathje and Murphy (2001) assert that the human species experienced "its first garbage crisis when humans became sedentary animals." Sedenterisation, combined with increases in the human population and with the unsanitary and environmentally detrimental waste disposal practices typical in developing countries, entails that the production and accumulation of solid waste will become increasingly concentrated and, as a result, the negative effects of this waste will be exacerbated.

This transition to agriculture is attractive to community members because of the initial monetary gain from having an additional source of income and new market opportunities with the sale of agricultural products. As household income rises, families have greater financial security with which they can alleviate many of the ailments associated with poverty: hunger, medicine, education, etc. However, with increased consumer capabilities comes the production of more household waste, especially of packaging materials that have higher contents of non-organic materials like paper and plastic (Idris et al., 2004). According to Beede and Bloom (1995), globally, a 1 percent increase in per capita income is associated with a 0.34 increase in total solid waste generation. This is an issue of concern, because awareness of and infrastructure for waste management is minimal in Kenya, especially in rural locations, and thus will not be adequate to handle the increasing production of solid waste. Furthermore, as communities develop, the composition of their household solid waste is altered to include less organic, decomposable waste and more inorganic materials such as papers, metals and plastics (Richardson and Whitney, 1995; Idris et al., 2004; Gidarakos et al., 2006). While the littering and burning of solid waste ubiquitous in rural Kenya are less problematic when the waste materials are organic, when people start dumping and burning these inorganic materials that cannot decompose and that contain toxic chemicals, these disposal techniques are ineffective in preventing the negative impacts on human health and livelihoods and on the environment.

One of the repercussions of the subdivision of the local Group Ranches in Loitokitok Division is the subsequent privatization of land. This restructuring of land tenure is another change that could influence solid waste management in the area. Garrett Hardin discusses the implications of land tenure on the environment, and in particular to pollution, in his famous "Tragedy of the Commons" (1968). He and other scholars (Cole, 2002)

argue that individuals are more likely to pollute and litter communal land than private land, because the responsibility and cost of cleaning up are diffused when the land is shared. This would indicate that solid waste management would improve in the area, after the dissolution of communal land. On the other hand, the move to privatize land previously under the ownership of community group ranches gives new land owners the freedom to use and abuse their land however they want. This could potentially lead to an increase in the amount of unmanaged solid waste, because individual land owners do not hold the responsibility to others with whom they are sharing land and subsequently experience less pressure to consider the ecological and health consequences for others with their production and management of solid waste. Thus, it is possible that the changes in land tenure to Loitokitok Division could have positive or negative impacts on solid waste management.

Both livestock and wildlife also face health risks from litter, because they mistake it for food. Moreover, in times of food scarcity, wildlife has greater incentives to forage on improperly disposed of waste, increasing the likelihood of human-wildlife encounters and conflicts. Finally, uncovered litter is an “eyesore,” and the sight and smell of litter decreases the aesthetic quality of the area for tourism. Although the issue of waste management in Kenya has begun to receive more recognition, in rural areas like the slopes of Kilimanjaro, Kimana, and Kuku, little action has been taken to implement policies aimed at presenting solutions to the problem.

This study investigated how changes in land use that is; from traditional, semi-nomadic pastoralism towards a sedentary, agricultural system—and changes in land tenure—i.e. the subdivision and privatization of communal lands contributed to solid waste and hence environmental degradation. Specifically, this study focused on how these land tenure and land use changes have influence household solid waste production and disposal methods.

Section 1 of this examines the introduction that explains the background and some literature on the study field, section 2 examines materials and methods. In section 3, the findings of the study are presented while section 4 is a discussion of the results. The conclusion and policy recommendations, including possible limitations are examined in section 5.

MATERIALS AND METHODS

The study area

This study was conducted in Southern Kenya: the slopes of Mt. Kilimanjaro (Kimana, and Kuku). It is part of the Amboseli Ecosystem. The hydrology of the region is majorly influenced by Kilimanjaro, both with respect to the amount of rainfall it receives and to the sources of ground water produced by the Kilimanjaro Aquifer. In each of these study areas, pastoralism and agriculture are the dominant land uses, with a growing trend towards agriculture. Additionally, Loitokitok Division supports large popu-

lations of seasonally migratory mammals, 70% of which live outside nearby Amboseli National Park, Tsavo West National Park and other protected areas (Okello et al., 2011). Currently in Loitokitok Division, solid waste management is a problem, because there is minimal to no infrastructure in place for the sanitary disposal of waste and little education or consciousness about the negative impacts of littering and burning (NEMA, 2009-2013).

The slopes of Kilimanjaro are located in the southeast section of Loitokitok Division, right on the border with Tanzania. Here, the main use of the land is agriculture with some agro-pastoralism. The number of individual farms reaches several hundred and range in size from 1 to over 100 hectares (Ntiati, 2002). Loitokitok sub-Division has a total area of 1,256 hectares under irrigation (Grossmann, date unknown); however, most farmers do not use irrigation and instead rely solely upon rainfall to water their crops, as the area receives over 1,000 mm annually (Okello et al., 2011). Over the past 50 years, the population of Maasai in the area, previously the dominant ethnicity, has decreased proportionally, as other ethnic groups, especially Kikuyu and Kamba, have migrated to the area seeking access to the more fertile land with higher agricultural potential (Ntiati, 2002).

Kimana is situated in the southern part of Loitokitok Division, just north of Loitokitok town. It is comprised semi-arid land with low and erratic rainfall and high temperatures. The agriculture practiced in Kimana is primarily irrigated, because the area receives about 210 mm of rain annually, with 65% during the long rains from March to early June and 35% during the short rains occurring in October and November (Okello et al., 2011). The Kimana Group Ranch is a key dispersal area for protected wildlife areas like Amboseli National Park and has a total area of 251 km² (Okello et al., 2011). In 1996, it was the first community in Kenya to set up its own wildlife conservation area, the Kimana Community Wildlife Sanctuary, which is 40 km² in size, and acts as an important dry season wildlife concentration area (Okello et al., 2011). The Group Ranch has now been completely subdivided into a private land tenure system, a move which the majority of the community supports. This support is motivated by an increasing interest in using the land for cultivation and by a desire to guarantee land ownership through the security of individual property rights as opposed to communal property rights (Okello et al., 2011).

Finally, Kuku is located in the eastern part of Loitokitok Division, next to Tsavo West National Park, directly in the path of the critical wildlife migratory route from Tsavo to Amboseli National Park (NEMA, 2009-2013). Kuku is 96,000 ha in size and receives 400-600 mm of rainfall annually (Okello, 2005). The most prevalent land use practice is pastoralism, mainly by Maasai, yet in recent years the area has undergone increases in its human population and a growing trend towards agriculture (Okello, 2005), especially after the 2009-2010 drought. However, the Kuku Group Ranch is still intact and has yet to be sub-divided.

Data collection and analysis

In order to achieve the study objectives, rural residents in Loitokitok Division were interviewed using a comprehensive questionnaire. Data were collected on the slopes of Kilimanjaro, in Kimana, and in Kuku Group Ranch in order to compare the land use practices and tenure systems in each site, as well as to obtain data for the overall region. Both open- and closed-ended questions were asked in order to gather basic demographic information and to assess the topic of waste management and its relationship to land use and tenure changes. Interviewers also recorded personal observations of each household and surrounding area. A total of 150 households and 12 key informants were included in the study. In addition to conducting interviews with rural community members, several key informants were also interviewed. These included representatives from the Ministry of Agriculture and the Ministry of Livestock. These

informants were questioned about land tenure and use changes in the region, as well as what these organizations were doing to monitor and address current human and environmental issues. Unlike the survey questions, the questions addressed to the key informants were not structured with a questionnaire.

After collection, data gathered from the questionnaires were entered and analyzed using the Statistical Program for Social Scientists (SPSS 18.0.0) to create Frequency, Cross-tabulations, and Chi-Square tests. Microsoft Excel was used to generate visual representations of the data, in the form of bar graphs and pie charts. Finally, all primary data collected was supplemented with additional secondary information, obtained from previous studies and publications and those found in the SFS library and online.

EMPIRICAL FINDINGS

Demographic, land tenure and land use profile

The demographic information was collected from respondents ($n=162$). The majority of respondents (52.5%) lived and worked on privately owned land, with 29.6% on leased land, and only 17.9% on communal land. Land tenure was significantly dependent on location ($\chi^2 = 69.929$; $df = 4$; $p < .001$), with more communal land in Kuku and more private land in Kimana and the slopes of Kilimanjaro. The most prevalent land use type practiced by respondents was agriculture (62.3%), followed by agro-pastoralism (35.2%). Pastoralism as the sole land use type was only practiced by 2 households, and correspondingly only made up 1.2% of respondents, as did "Other" land uses. On the slopes of Kilimanjaro, three-fourths of respondents practiced agriculture, whereas in Kuku and Kimana agriculture and agro-pastoralism were more evenly common land use types. Most respondents (75.6%) reported to occupy less than 5 acres, as well as to have never changed their land use practices (93.7%). Finally, land use was significantly dependent on land tenure ($\chi^2 = 32.080$; $df = 6$; $p < .001$). Figure 1 indicates that leased land supported agriculture almost exclusively as a land use type. Pastoralism was practiced the most in communal land, though by a slight margin. Private and communal land both had a combination of agriculture and agro-pastoralism, with agriculture slightly more prevalent in private land and agro-pastoralism more prevalent in communal land.

Land use and income

Annual household income of respondents was found to be statistically dependent on land use ($\chi^2 = 16.097$; $df = 6$; $p < .05$), as well as on location ($\chi^2 = 22.862$; $df = 12$; $p < .05$). Agriculturalists tended to fall on the lower end of the income spectrum compared with agro-pastoralists (Figure 2). Only one pastoralist interviewed was able to estimate annual income, which was reported to be 32,000 KSH. However, because only one value for pastoralism was collected, Figure 2 is constrained to comparing agro-pastoralism and agriculture only.

Respondents in Kuku had the highest income relative to individuals from Kimana or the slopes of Kilimanjaro. Respondents from Kimana followed, and then those from the slopes of Kilimanjaro had the relatively lowest levels of annual household income—more than half (52%) had incomes of less than 50,000 KSH per year. Dependence was not significant between income and land tenure.

Organic solid waste management

Fodder for livestock consumption was the most common use of agricultural waste (75.3%), followed by leaving it in the field and composting it. Overall, about two-thirds of respondents practiced composting. Neither use of agricultural waste nor whether or not respondents composted was found to be statistically dependent on land use or land tenure. Out of those respondents who owned livestock, the majority (85.0%) used their livestock's waste for fertilizer. 14.2% of respondents used their waste from livestock as building materials, and only one person (0.9%) used it for fuel. Use of livestock waste was statistically dependent on land use ($\chi^2 = 61.540$; $df = 6$; $p < .001$) and on annual household income ($\chi^2 = 33.225$; $df = 18$; $p < .05$). As demonstrated in Figure 3, pastoralism was the land use most commonly associated with using livestock waste as building material; agro-pastoralism and agriculture were associated with using livestock waste as fertilizer and a combination of fertilizer and building material. In terms of income, the dominant economic category of respondents who used livestock waste for fertilizer (38.5%) was those who earned less than 50,000 KSH annually.

Solid waste production based on land tenure

Figure 4 depicts each waste material in the context of different land tenure systems. Between each tenure system, solid waste composition seems relatively uniform, with the exception that more plastic is thrown out in communal land than in either private or leased land.

Overall, the main waste materials thrown away were paper (82% of respondents) and plastic (71% of respondents). Direct observations in the field support this finding. At the majority of houses visited, yard litter was mostly composed of plastic bottles, plastic bags, plastic wrappers, and paper, while cardboard, cloth, shoes, corn stalks and corn cobs, livestock waste, bones, batteries, and Styrofoam were also seen at times. Glass and metal materials, on the other hand, were rarely observed among household litter materials.

Almost all respondents (92.6%) disposed of their household waste through burning, independent of differences in land use and in land tenure. However, disposal method was statistically dependent on level of education ($\chi^2 = 17.540$; $df = 9$; $p < .05$). Individuals who

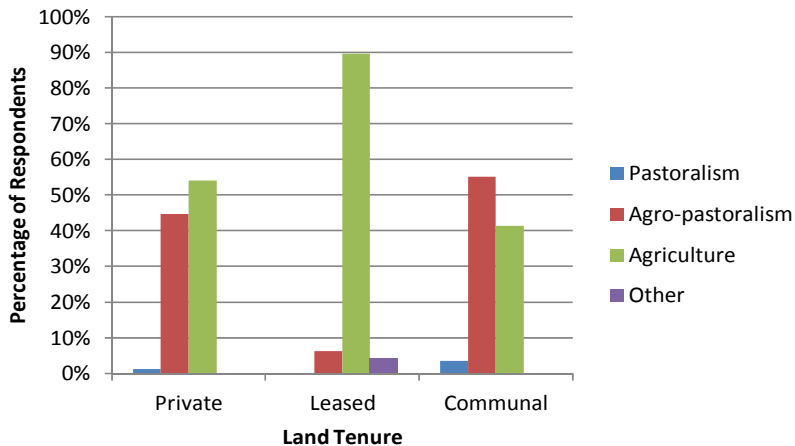


Figure 1. Land tenure and land use in Loitokitok division.

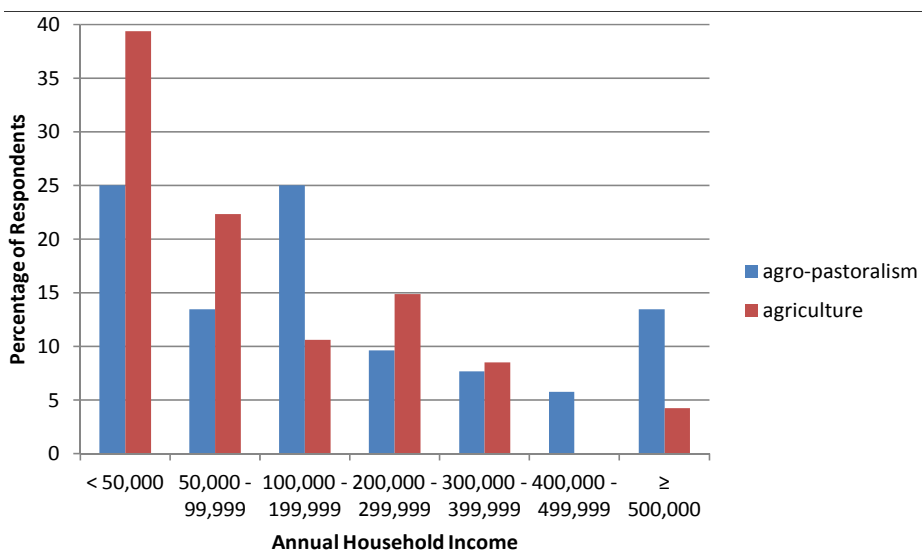


Figure 2. Land use and annual household income.

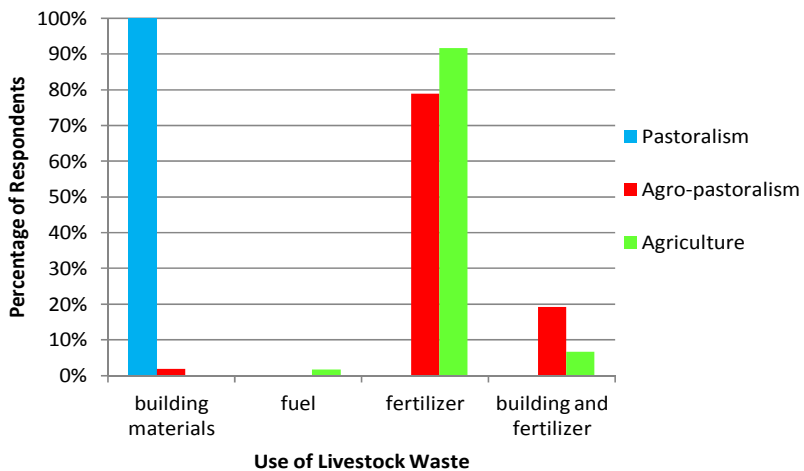


Figure 3. Land use and use of livestock waste.

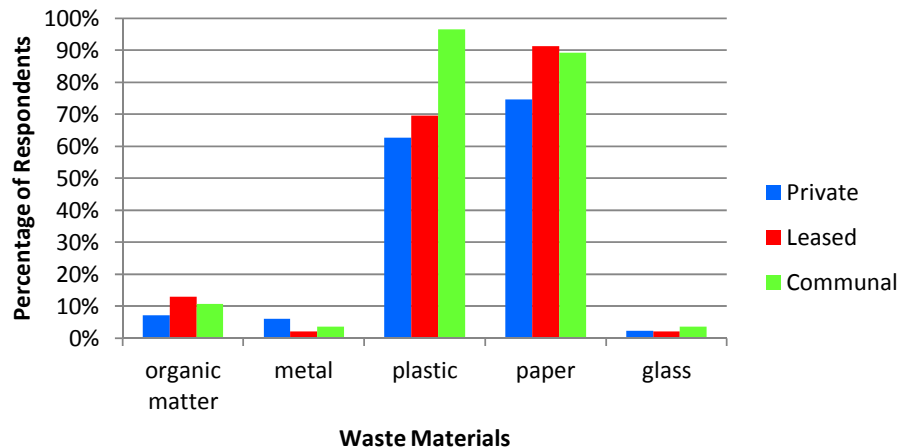


Figure 4. Waste material in the context of different land tenure systems.

had attained a university level of education were more likely to do nothing with their trash than individuals with less education. Respondents who disposed of their solid waste through burning were asked if they burned their waste in the same spot each time. 92.2% responded that their waste was burned in the same location every time. This response was statistically dependent on land use ($\chi^2 = 8.679$; $df = 3$; $p < .05$) but not on land tenure. The study found out that, agro-pastoralists were slightly more likely to burn in different locations than those who practiced pastoralism, agriculture or another land use.

Awareness on waste recycling opportunities

The majority of respondents (84.5%) interviewed were not aware of recycling options in their area. Awareness of recycling was not dependent on land use, land tenure, or location. Even in the study areas in which there was infrastructure in place for solid waste collection and management—i.e. Kimana—respondents did not have higher levels of awareness about recycling options. Other than use of livestock waste, there was no significant dependence on income for use of agricultural waste, whether respondents composted, composition of waste materials, waste disposal method, whether respondents burned their trash in the same location every time, and whether respondents were aware of recycling options.

DISCUSSION

Land use, land tenure and income

Annual household income was higher among agro-pastoralists and in the Kuku Group Ranch. One reason why agro-pastoralism was the most profitable land use practice could be that it encompasses a more diverse array of income sources, i.e. sales of crops, the leasing of land, sales of animal products like milk, and sales of

livestock animals. Also, because Kuku has historically been a pastoralist region and has recently been shifting towards agro-pastoralism, it follows that residents from Kuku would have greater levels of income, compared to residents from the slopes of Kilimanjaro and Kimana where agriculture is more prevalent. In contrast with land use and location, annual household income was not found to be dependent on land tenure. This indicates that the sub-division of the local Group Ranches and privatization of land does not necessarily lead to an increase in income and standard of living. According to a representative from the Ministry of Agriculture, one of the study's key informants, changes in locals' standards of living depended on what they decided to do with their land. Some were using it wisely, and some were not. Hence, there may have been increases in annual income after subdivision for some individuals, but not for the entire community overall.

Income and waste management

Contrary to what other literature on solid waste (Beede and Bloom, 1995; Idris et al., 2004; Gidaracos et al., 2006) has claimed, this study did not find any waste characteristics or behaviors to be dependent on income, with the exception of what respondents did with the waste from livestock. In this last case, respondents who earned less than 50,000 KSH annually were more likely to use livestock waste as fertilizer, which may be the result of being unable to afford chemical fertilizers and thus being financially incentivized to rely on livestock waste to fertilize their fields instead. However, all other responses to waste-related questions, including what materials respondents threw out, did not differ as a result of variations in income. It is possible that although income did not alter consumer behavior and, by extension, generation of solid waste with respect to the composition of waste produced, it nevertheless may have influenced the quantity of waste produced—which this study failed to

measure.

Organic waste management

The majority of respondents were found to more or less manage the organic waste that their household produced. They did this by finding ways to use the waste: for feeding livestock, for composting, for manure, and for building materials. Households that did not own any livestock often gave their post-harvest agricultural remains to the livestock of their neighbors. Furthermore, pastoralists, who did not have crops to fertilize, used the waste from their livestock as building material for houses. Thus, it appears that while there is no formal, regulated management of organic waste in Loitokitok Division, there is no need for it, because locals regularly find ways to utilize and derive benefits from the organic waste their households produce.

Production and disposal of solid waste

The main waste materials that respondents reported to throw out were paper and plastic. According to several scholars (Richardson and Whitney, 1995; Idris et al., 2004; Gidarakos et al., 2006), a decrease in organic waste materials and an increase in paper, plastic and packaging materials in household solid waste can be registered as a sign of development. Thus, the fact that paper and plastic constitute a large part of household solid waste in Kuku, Kimana and the slopes of Kilimanjaro indicates that these communities are in the process of developing. A majority of respondents said that they disposed of their solid waste by burning. This was the most common waste disposal method, regardless of land tenure. This result counters the theory that the privatization of land would produce less littering and encourage greater efforts to manage solid waste, because the responsibility of waste management would fall directly onto the individual land owner, instead of being diffused among residents living in communal land. However, from the study's results, it appears that land tenure had no influence upon waste disposal technique.

Education and waste management

The exception to burning as the preferred means of dealing with solid waste was respondents who had attained university level education. This group was found to be significantly more likely than individuals with less education to do nothing with their solid waste. It is unclear why having a high level of education would cause individuals to be less likely to attempt to manage their household waste. However, this result clearly illuminates that issues of waste management are not a part of

schools' and universities' curricula. In other words, educational institutions—at least in Loitokitok Division—are not helping to promote awareness about solid waste management or positive disposal practices. This lack of information is apparent in other ways as well. One respondent stated that he did not burn metal because it was not “biodegradable.” However, he included plastic as a material he reported to burn, thus exhibiting confusion about the recycling characteristics of different materials. Additionally, it was discovered during the course of fieldwork that there is an informal waste collection sector in Kimana town, where individuals visit houses in the area and collect recyclable materials, specifically metal and plastic. Once a certain amount has been collected, these people transport the waste materials to Nairobi and sell them to waste dealers. However, the majority of residents interviewed in Kimana and nearby Kuku were unaware of these collections and equally unaware that they could profit from the selling of their recyclable waste materials. Locals are regularly burning a resource that they could be making money with, highlighting again the lack of information available to the community about waste management.

Sedenterisation and waste disposal

Almost all respondents who burned their solid waste burned their trash in the same spot every time. Those who burned in different spots were mostly agro-pastoralists, possibly due to the more mobile nature of their lifestyle, compared with agriculture. This finding appears to support a connection between waste management and sedenterisation, a connection that has been put forth by Rathje and Murphy (2001) and multiple others (N.B. While pastoralism is also a mobile land use, only two pastoralists were interviewed, and thus the 100% who said they burned in the same spot each time may be a misrepresentation of the relationship between pastoralism and solid waste disposal).

Dangers associated with solid waste

Finally, several health hazards due to unsanitary solid waste management were observed in the field. A major part of the respondents who burned their household waste had their burn piles less than 15 meters away from their houses, putting them in close proximity with the fumes and hence at higher risk for the health problems outlined by Kaseva and Moirana (2010) and Nagabooshnam (2011). Moreover, in traditionally built bomas, cooking fires were lit inside the homes, which often possessed poor ventilation, and on more than one occasion, residents in these houses were observed placing plastic packaging materials directly into their cooking fires. Engaging in this practice not only exposes families to hazardous substances by inhalation, but also

by ingestion through their food. Solid waste that littered the yards of almost every house visited also poses health risks, especially to children. At one home, a child was seen biting a small piece of plastic; at another, a child was sucking on an old animal bone, and at yet another, a child was observed sucking on an eroding battery. These incidents represent the risks of choking, contracting diseases, and poisoning from toxic chemicals that are created by the presence of litter. Furthermore, these risks are not confined to human beings. Livestock and wildlife sometimes mistake solid waste materials for food and either get sick or die, because their bodies cannot digest them. On more than one occasion, goats were observed eating paper materials that had come from solid waste burn piles. Disease-transmission is also a danger, as exemplified by the cases of olive baboons in Lake Manyara National Park who contracted a form of syphilis after consuming used condoms from the refuse of the surrounding communities. The fact that many burn piles are neither covered nor dug into a pit means that the untreated solid waste and the risks that accompany it are even more accessible and hazardous. These examples reiterate the clear need for infrastructure for the sanitary management of solid waste and for the dissemination of information about the hazards of unmanaged waste.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study shows a dependent relationship between changes in land tenure and the composition of solid waste materials. A dependent relationship was also found between changes in land use and domestic use of waste from livestock, as well as where residents burn their solid waste. However, the majority of factors related to household solid waste which were included in the study's survey were not influenced by differences in land tenure and land use. Thus, overall, changes in land tenure and land use have not played a major role in affecting the production and management of household solid waste in Loitokitok Division. Nevertheless, this study indicates that the lack of infrastructure and education about waste management—specifically of inorganic waste materials like plastic. In Loitokitok was and is still a matter of concern, because it presents the area with health and environmental problems that transcend location, land ownership and livelihood.

Recommendations

The following were the recommendations of the study: -

1. Awareness campaigns, such as community informational sessions, workshops and the incorporation of waste and recycling topics into local schools' curricula,

that act as venues for disseminating information with the goal of effecting attitudinal and behavioral change.

2. The creation and/or improvement of current waste management infrastructure so that residents have access to public waste receptacles or collection services.
3. The organization of a day in which local residents participate in the cleaning up of litter in the towns of Loitokitok Division, which would raise awareness about the importance of proper waste disposal and also would increase these towns' aesthetic quality, making them more attractive locations for tourism.
4. Enforcement and strengthening of national and local laws concerned with solid waste management—e.g. the "Public Health Act" Akech (2006).
5. The establishment of a community initiative that pools everyone's waste materials together to be sold in Nairobi and then uses the money generated by that to finance projects that benefit the entire community.
7. The encouragement of community members to find innovative ways to reuse waste materials for their own personal use—so that they save money by eliminating the need to buy new products, e.g. plastic bags—and for commercial use for sale at community markets or to tourists, e.g. tire shoes, baskets and art.
8. Finally, a formal assessment, conducted by local authorities and sustainability specialists, that results in the creation of a long-term action plan for managing human development in the area, particularly with regard to solid waste management.
9. Further research should be done on the effects of solid generated on wildlife in the study area

Conflict of Interests

The author has not declared any conflict of interest.

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