

Environmental awareness among women who collect fuel wood from Lolldaiga Mountains in Kenya

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(Received:22 April, 2013) (Accepted:10 July, 2013)

薪採集に訪れる女性を対象とした環境意識調査：ケニア・ロルダイガの事例

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Abstract

This study aimed to describe the characteristics of villages and women's households that might induce environmental awareness among fuel wood collecting women in one location of Kenyan dry land. Two probit models were constructed to examine which parameters were associated with two dependent variables, afforestation action and thermal efficient improved cooking oven. Participation in age of respondent, family size and group-activities had a significant effect on two dependent variables. However, age and family size indicated opposite relation on two independent variables. Moreover, it could be considered that one of important factor of improved cooking oven was economically affordability because of large property (i.e. to have cows and lands). On the other hand, this study also indicated the large property had no influence on afforestation action. In addition, NPO and government support of afforestation were well provided, in the area where the proportion of afforestation action was relatively high.

Key words: dry land, environmental awareness, fuel wood, Kenya, women

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Introduction

An environmental challenge is not only important for global environment but also for agricultural production and economic activities in developing countries. The Kenyan government has also focused on dry area and put the subject of policy strengthening for the production sector including forestry (Ministry of Planning and National Development 2003). In Kenya, 80% of the land is dry area, and the forest area is 1.7% of total land. On the other hand, the three main sources of energy supply in Kenya are fuel wood, petroleum and electricity. Especially, 70% or more of domestic total energy depends on fuel wood to boil the water, to cook and so on (Energy Regulatory Commission 2010). As well as this, the deforestation has been increasing by pasturing of animal and making the forest a farmland. The government agency, U.N., and NPOs have taken various measures to solve the problem of deforestation in Kenya, and furthermore, local community is an important activity subject.

The community is often seen to be cohesive and to share social norms, networks and culture. It is well accepted that these social assets play an important role in natural resource management (Ingles *et al.* 1999; Kellert *et al.* 2000; Billgren *et al.* 2007). The social assets are seen to be a vehicle to reduce transaction costs and the problem of free riders and encourage collective action. Therefore, communities are expected to manage their natural resources sustainably. However, critics of this natural community resource management often point out that these views ignore the fact there are differences within the communities, and these differences affect resource management (Barreit *et al.* 1995; Agrawal *et al.* 1999; Leach *et al.* 1999). For instance, there often are large gaps between age, gender and wealth in the communities.

Maraga *et al.* (2010) analysed the factors to determine the community participation in afforestation projects in Kenya. It was clarified that the community participation was influenced from the benefit obtained from the afforestation and environmental

degradation. And the cultural factors and household status had no relationship with the community participation. Gebremedhin *et al.* (2003) examined the community management for collective action of woodlots in Ethiopia. They found that when the role of external organizations was more demand-driven, and promoted in intermediate population density communities more remote from markets. Moreover, the collective action might be more beneficial and more effective when managed at a more local level.

However, if a social property plays an important role in the natural resources management, it is necessary to examine the social factor to provide for it in detail.

The difference in ethnicity and community are often defused in the argument of sustainable resource management. Ethnicity is defined as a group of people who share all aspects of culture including language, traditions, songs and funerals. Ethnicity often relates to a mode of production as it ensures a way to appropriate certain resources. Ethnicity therefore is a fluid concept. If the resources change, new ethnicities might emerge. For instance, pastoral community Ariaal in northern Kenya emerged as late as the 1940s from the interrelationship between Samburu and Rendile community (Fratkin *et al.* 2005).

The relationship between natural resource management and social capital was analysed, and it was clarified that the group activity which make up social capital is important for shaping individual action to achieve positive biodiversity outcomes (Pretty *et al.* 2004). Especially, the groups where women are present were successful for collaboration in and sustainability of natural resource management in 20 countries of Latin America, Africa, and Asia (Westermann *et al.* 2005).

If the community is regarded as those of the same ethnicity, when the newly immigrated people from different parts of Kenya, there would be diversified social norm and network. Could these communities make no conservation effort? Yet the importance of natural forest management has increasingly been recognised by some components of the communities for prevention of soil erosion, preservation of water catchments,

and offsetting carbon emission as a measure tackling climate changes (Fratkin *et al.* 2005). Therefore there is a need to find what social components (origins, age, gender, and wealth) of the communities and which factors would actually trigger an environmental awareness that leads to sustainable resource management.

This paper aims to examine the economic position of fuel wood harvest behaviour from Lolldaiga Mountains. Moreover, we focus to analyse which parameters at both village and household level were related to environmental awareness among women who collect fuel wood. In this paper we hope to shed some light on social cohesion and parameters that link to sustainable rural development in Kenyan dry lands.

Methods

Study area and population

Ecological Characteristics

According to Kenya Statistic Bureau (2009), there were 16,200 people of 4,456 households in 289 km² in Umande Location, Daiga Division, Laikipia District (Figure 1). They came from all parts of Kenya about 10 to 20 years ago and settled in new villages, with different ethnicities. Umande Location lies between the Lolldaiga Mountains and Mt Kenya to the north of the Equator. It lies between 1,850 and 1,950 m above sea level on the eastern Laikipia Plateau. The distance between the two peaks is approximately 40 km. Generally the area is considered to be in the rain shadow of Mt Kenya.

It receives an annual rainfall of 550-700 mm (Mizutani *et al.* 2010). There are two rainy seasons; one in April/May, another in November/December.

Fuel wood harvesting

Since 2004, the local administrator has made this arrangement with the Lolldaiga Hills ranch that owns the Mountains, helping women with fuel wood for domestic cooking, heating, and lighting. The women are allowed to collect fallen wood, and to break branches using their own weight. They go to collect fuel wood in the Lolldaiga Mountains every fortnight and enter the farm gate between 10:30 am and exit before 2:30 pm. In September 2009, the women were mostly members of the Timau Farmers' Association established in 1982. There are 292 registered members, comprising of different ethnic groups such as Kikuyu, Meru, Kamba, Turkana, Borana, Kalenjin and Maasai. By September 2010, more women from Muramati sub-location requested the similar arrangement. Then it became two separate groups, totalling more than 600 in number.

Data collection

In order to gather baseline information of the households in the study area and analyse the factor related to environmental awareness, we conducted a rural community assessment in Umande Location, Laikipia District by using household questionnaires between August and October 2008. Using a questionnaire, the women who had come to collect fuel wood

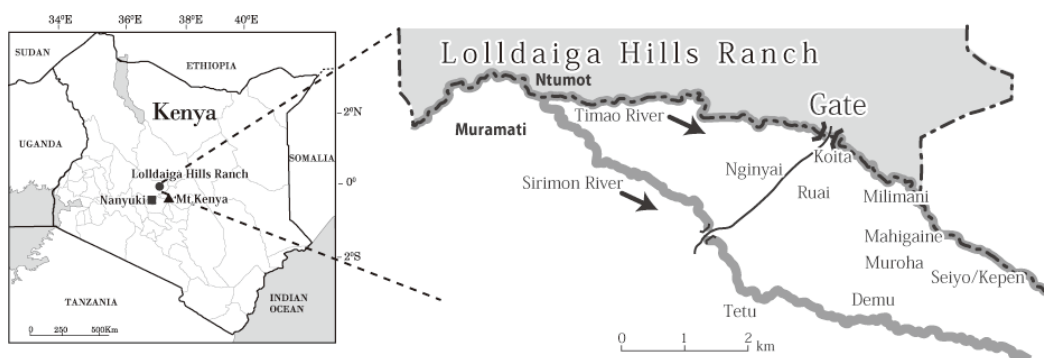


Figure 1. Map of Kenya and the study area around the Lolldaiga Mountains.

from Lolldaiga Mountains were asked about the name of their village, the time of the settlement, the age and number of household members, details of crop and livestock production including area cultivated, amount of harvest, the type and number of animals, and sale of produce. In addition, other parameters to describe the household are collected such as the time they spend collecting water from the river, type of cooking stove, the numbers of trees planted, and members of any Common Interest Group. The valid response was 278 among questionnaires of 293 collected from eight villages (Figure 1). One might assume that the group activities were initiated through numerous NGOs training courses. But we found that NGOs activity is concentrated in Demu village where the shopping centre and the primary school are located on the Umande-Nanyuki main access road. The women from Demu haven't registered in this registered group nor participated in our questionnaire survey. Therefore, our study population was not directly affected by NGOs' activity.

In order to have a timeline qualitative description of the women's activities, additional focal individual interviews were carried out in September 2009 and September 2010.

We also estimated volumes of fuel wood by measuring length and circumference of each bundle using a measuring tape. Some 54 women were randomly selected from a total of 306 who had come to the farm to collect fuel wood on the 3rd of September 2010.

Statistical analysis

Probit model was applied to carry out statistical analyses at the household level to examine which parameters related to the environmental awareness of the women regarding sustainable use of natural resources. In the probit models, the dependent variable, Y , is a discrete variable that represents a choice, or category, from a set of mutually exclusive choices or categories (Wooldridge 2008).

Dependent variables

We used two dependent variables for our analysis. One is "TREE" (whether they planted any trees or not in the past) which was chosen as an indicator of efforts of afforestation action to improve the natural resource. Another one is "COOKING STOVE", that is a variable of three types of a cooking stove, (a set of three stones=1, a soil oven=2, and the improved cooking oven=3). Improved cooking oven is usually made from lightly fired clay but thermally efficient and economical (use less fuel wood). The improved cooking oven cost 350 Kenya Shillings (KES)⁵. These two variables were not correlated to each other.

Independent variables

The hypotheses of these analyses are that the activity of environmental challenge needs some capitals, because the richer farmers have scope to pay attention to environmental challenge and they may consider economic efficiency on long-term. And, the group activities are affected by natural resource management according to the past research. Moreover, we considered that individual characteristics are related to environmental awareness.

Three individual variables were selected as commonness for statistical analyses. "AGE" is the age of the respondent, "FAMILY MEMBER" is the number of the respondent's family member, and "GROUP" is the dummy variable of the self-help group activity (participation=1 and non-participation=0). In the case of afforestation action, two variables were added. "CHICKEN" is the total number of chickens, and "CROP" is the dummy variable whether the farmer sold their crops (Yes=1 and No=0). In the case of a cooking stove, "COW" and "ACREAGE" were included in the independent variables. The former is the number of cows and the latter is the size of land holding.

⁵ The exchange rate of US\$ 1 was KES 80.

Results

Fuel wood harvest behaviour of the women

After harvesting all suitable fuel wood trees around the entrance gate by September 2009, the women went into the Lolldaiga Mountains for up to 5 km in order to access fuel wood. This distance has had to be increased to 7 km in September 2010. The women used to come back home by 2 pm; however, by 2011 they arrived home around 5pm. The average volume of fuel wood harvested by selected women was 3.14 m³ (SE 0.16) per person. The average weight of the limited samples (n=5) was 62 kg. The women who came from further away of the ranch carried a larger volume of fuel wood than those from nearer the ranch ($R^2= 0.76$, $t = 3.24$, $p=0.01$).

Household characteristics related to environmental awareness

Characteristics of fuel wood harvest women

Characteristics at the village level are summarized in Table 1. The average age of respondents is 42, and they have been living in the present village about 17 years.

Some 9% of households used the improved cooking oven:

either a portable metal column type or a heavy portable clay type. The majority of households (91%) still used the three-stone open fire that is fuel inefficient. Eighty two percent of the women from Kepen/Seiyo and 46% of the women from Koita have used improved cooking oven and their participation in group activities was highest among villages. However, those women from Kepen/Seiyo and Koita and have planted trees were fewer than those from other villages.

Forty four percent of the women participated in some group activities. In the high usage rate of improved cooking oven area such as Kepen/Seiyo and Koita, the group participation rates are also high (82% and 62%). However, in Tetu which had a high rate of afforestation action experience (88%), it was indicated that group participation rate was not so high (41%).

Table 2 showed details of the group. Nine percent of respondents participated in the group engaged on investment in farming and buying houses, and 10% respondents entered the group for buying commodity. Helping members were the major reason (66%). The activity of helping members was chiefly done in the region where the group participation ratio was high. On the other hand, in the region of low group activity ratio, the activity was not only helping members but also investing and buying commodity.

Table 1. Characteristics of respondents who collect fuel wood in the Lolldaiga Mountains, Kenya.

	Sample size	Average age of women	Dominant ethnicity	Average year of residence	Average land holding (acre/household)	Average number of cow (heads/household)	Average number of sheep (heads/household)	Average number of goats (heads/household)	Average number of chicken (number/household)	Group participation rate (%)	Afforestation action experience (%)	Usage of improved cooking oven (%)
Tetu	17	40.0	Kikuyu	11.1	1.2	1.0	1.7	1.8	7.9	41.2	88.2	5.9
Kepen/Seiyo	11	41.9	Kalenjin	21.4	1.5	2.0	3.0	4.8	4.3	81.8	36.4	81.8
Koita	13	34.1	Kalenjin	15.5	1.2	2.8	5.3	5.0	3.3	61.5	23.1	46.2
Ruai	36	46.1	Kikuyu	19.4	1.1	2.0	2.5	2.3	3.4	38.9	66.7	8.3
Nginyai	3	51.0	Kikuyu	20.7	2.0	1.5	2.0	2.0	2.0	66.7	66.7	0.0
Muroha	32	42.7	Kikuyu	17.5	1.2	1.9	3.0	6.4	4.1	21.9	62.5	3.1
Millimani	85	38.6	Meru	16.5	1.0	1.6	2.7	2.1	4.5	47.1	64.7	3.5
Mahigaini	81	40.6	Kikuyu	17.4	0.9	1.8	2.8	1.8	4.4	42.0	56.8	1.2
All	278	41.9	-	17.4	1.3	1.8	2.9	3.3	4.3	43.5	60.8	8.6

Table 2. Type of group activities in women who collect fuel wood in the Lolldaiga Mountains, Kenya.

Village	Investment	Life-goods	Helping	Unknown	Sum
Tetu	0 (0.0)	1 (14.3)	4 (57.1)	2 (28.6)	7 (100.0)
Kepen/Seiyo	0 (0.0)	0 (0.0)	8 (88.9)	1 (11.1)	9 (100.0)
Koita	0 (0.0)	0 (0.0)	7 (87.5)	1 (12.5)	8 (100.0)
Ruai	3 (21.4)	2 (14.3)	8 (57.1)	1 (7.1)	14 (100.0)
Nginyai	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	2 (100.0)
Muroha	0 (0.0)	0 (0.0)	7 (100.0)	0 (0.0)	7 (100.0)
Millimani	5 (12.5)	5 (12.5)	25 (62.5)	5 (12.5)	40 (100.0)
Mahigaini	3 (8.8)	4 (11.8)	19 (55.9)	8 (23.5)	34 (100.0)
All	11 (9.1)	12 (9.9)	80 (66.1)	18 (14.9)	121 (100.0)

Note) Parentheses indicate proportions of participation in each village.

Table 3. Factors associated with environmental awareness among women who collect fuel wood in Lolldaiga Mountains, Kenya.

Independent Variable	Dependent Variable			
	TREE		COOKING STOVE	
	Coefficient	SE	Coefficient	SE
AGE	0.02	0.01 **	-0.04	0.01 ***
FAMILY MEMBER	0.06	0.04 *	-0.13	0.07 **
GROUP	0.30	0.18 *	0.77	0.29 ***
CHICKEN	0.12	0.04 ***	-	-
CROP	0.45	0.25 *	-	-
ACREAGE	-	-	0.55	0.22 **
COW	-	-	0.29	0.12 **
n	45		49	
Log likelihood	-16.29		-9.06	
McFadden R-squared	0.45		0.44	

Note) ***significant at <0.01, **<0.05, *<0.1

In addition, the women who had never participated in group activities, 65% of them thought that lack of money was a cause to feel limitation by simple tabulation. More than 80% of the women showed willingness to participate in any group activities in the future. They had shown interest in trainings. Popular subjects were; small-business management (50%), agriculture (45%), and animal husbandry (27%). Forestry came in fourth being only 6%.

Factor associated with environmental awareness

The result is shown in Table 3. The variables "AGE" and "FAMILY MEMBER" had negative effects for willingness to improved cooking oven. Group-activities (GROUP) had a positive effect on both willingness for improved cooking

oven and afforestation action. In the case of willingness for improved cooking oven, a positive association was found with the cultivated acreage (ACREAGE) and the number of cows (COW). On the other hand, the number of chickens (CHICKEN) and the presence of crop sales (CROP) had positive effect on afforestation action.

Discussion and Conclusion

Approximately ninety per cent of households immigrated to this location after 1980. The community itself cleared the woodlands when they had settled. When other people began cutting the viverrine forests along the rivers after 1993-1995, this community could not prevent others from cutting trees. Those

people only thought about making charcoal for sale in order to live. People did not know each other as they came from different parts of Kenya. After all the trees had gone, they found that the rivers stopped flowing, and the area became less productive than before; there was less rainfall, less grass, and there were fewer wild and domestic animals. The newly settled communities do not have much in common in a way of ethnicity, previous location, culture, language, song and tradition. However, some social cohesiveness was found in fuel wood harvesting.

We started gathering data in 2008. The first one was a rural community assessment conducted by a questionnaire survey. In addition, to have a timeline qualitative description of the women's activities, focal individual interviews were carried out in September 2009 and September 2010. Then, the quantity of fuel wood women carried out from Lolldaiga Mountain was estimated in 2011.

Since data were collected between years, we understand that women's awareness toward environment might have altered as time went by. According to the Lolldaiga Hill farm workers, every year the numbers of women who participated in fuel wood collection increased and they tended to spend longer time on the mountains.

According to the result of fuel wood harvest behaviour research, total annual harvest of fuel wood was estimated at more than 40,000 m³, assuming that 600 women collected 3.14 m³ for 26 days, individually. The women estimated a lower price for the fuel wood they collect averaging KES 193 ranging 150 and 250 (n=20). The women indicated that they use a load of fuel wood within a week. Two loads may be converted to a sack of charcoal that can be sold at KES 600 in local villages, but if taken to Nanyuki, District capital it could be sold at KES 1,000. An estimate of 19 tons of fuel wood was harvested in one day. The annual harvest per household would then be 3,200 kg and 1,300 kg per capita. Uganda study (Tabuti *et al.* 2003) reported a range of 228 and 341 kg per capita. Others ranged between 400 and 1,500 kg depending on the altitude (cited in Christensen *et al.* 2009). This study falls within the larger range of published

data, and it implies that the fuel wood may be generating income for this community.

Using the above mentioned volume and the local price of fuel wood in the results, we calculated villagers' benefit and it was found out to be five million shillings annually. This is equivalent to US\$144 per household per year. According to a similar survey of randomly selected 100 households of Muramati in 2004 before the fuel wood collection of women started (unpublished data), 15% of household income came from the sale of fuel wood in Muramati, Daiga Divison. When we asked 15 selected farmers in 2012 on price of charcoal, the sale of charcoal increased 21%. Fuel wood and charcoal is the only commodity that the poor could actually sell. Therefore, collecting free fuel wood from the forests of the Lolldaiga Mountains is obviously profitable for the poor. It is paramount that other livelihood sources that are more profitable than fuel wood harvest should be found. Funds raised from the sale of fuel wood should be reinvested in other income generation activities.

Some people have done the activity of environmental protection, and we clarified it by using questionnaire survey data. The characteristics of women were examined at both village level and household level to find the parameters leading to their environmental awareness. At the village level, the ethnicity appeared to have effects in both positive and negative ways for sustainable resource management. When we looked at diversity in the origins of the locations, the women who came from less diverse origins were more likely to use the improved cooking oven. Subsequent field visit confirmed that many indigenous trees were left intact in their villages. It appeared that the dominant ethnicities are Kalenjin in both villages. People of Kalenjin have a lot of people who have migrated from the West of Kenya according to an investigator. As for Eldoret whose Kalenjin people are main residents, it is the fourth big town in Kenya, and an improved cooking oven has already been used. It is thought that it is spread to the Lolldaiga region, and there are a lot of people who used that type of oven before.

At the household level, "AGE" and "FAMILY MEMBER"

had negative but significant effect on the usage of improved cooking oven. The younger women between 20 and 40 years old settled recently, who have smaller family size, are likely to use the improved cooking oven. The households which had immigrated recently were usually a small household, often with an infant. The differences between such characteristics of the family were not confirmed for the afforestation action. There were many indigenous trees in Kepen/Seiyo and Koita on which the young generation lives comparatively as mentioned above.

Other differences between improved cooking oven and afforestation action are capitals of the person who have willingness for each natural resource action. In the case of willingness for improved cooking oven, a positive relation was shown in the cultivated acreage (ACREAGE) and the number of cows (COW). These factors clearly reflect the revenue of households. On the other hand, the number of chickens (CHICKEN) and the presence of crop sales (CROP) had a positive effect to afforestation action. It was thought that the ability of investment is needed for investment to improved cooking oven. However, afforestation action might not need so much money, because a lot of support from NPOs and governments were provided for protecting of the forest.

Group-activities (GROUP) had a positive effect on both afforestation action and usage of improved cooking stove. This indicates that the group activities would assist in increasing environmental awareness in women. However, we do not know whether these group activities did encourage them to participate together in the management of natural resources.

In conclusion, we have found that there is a different aspiration on environmental issues amongst different social components in the Daiga community in the dry land of Kenya. The majority of women would wish to earn the maximum they could obtain from the natural resources available for their family. Those women walking so deeply into the forest may face a higher risk of encountering dangerous wild animals such as buffalo and elephants. Group activities also play an important role in both information and financial assistance.

Therefore, group activities are to be strengthened to ensure better information flow for inducing environmental awareness between the different social components (origins, age, gender, and wealth) of the newly settled community.

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摘要

本研究は、ケニアの乾燥地帯の一地域において、薪収集を行う女性の環境意識の誘因となる村及び世帯の特徴について明らかにすることを目的としている。植林経験と熱伝導率のよい改良オープンという二つの被説明変数に関するパラメーターを算出するために、二つのプロビットモデルを用いた。回答者の年齢、世帯員数、およびサークル活動への参加は2つの従属変数に有意な効果を持っていた。ただし、回答者の年齢と世帯員数は改良オープンと植林経験に逆の関係性を示している。さらに、改良オープンでは、牛や土地などの資産を有し、経済的に余力があることが導入の要因として示された。植林経験ではこのような大きな資産は要因として示されず、むしろ経験者の割合の多い地域ではNPOや政府によるサポートが充実していた。

キーワード：乾燥地帯，環境意識，薪，ケニア，女性