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Kampung Naga, Garut photo by Barry Kusuma

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Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in book:

Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds) Tropical Forest Community Ecology. Wiley-Blackwell, New York.

Abstract:

Assaeed AM. 2007. Seed production and dispersal of *Rhazya stricta***.** 50th Annual Symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:

Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.) Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:

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Local knowledge on rice variations (landraces) of the Naga Community, West Java, Indonesia

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Abstract. *Permana S, Iskandar J, Parikesit. 2018. Local knowledge on rice variations* (*landraces*) *of the Naga Community, West Java, Indonesia. Asian J Ethnobiol 1: 1-8.* Ethnobotanical studies have indicated that diversity of local varieties of crop plants and associated local knowledge has seriously eroded in many developing countries across cultures, including West Java, Indonesia, due to many factors such as agricultural modernization, development of market economy, government policies, and human population increase. This paper gives an account of the local knowledge or the traditional ecological knowledge (TEK) about the rice varieties (landraces) of the wet rice fields, management of wet rice farming, and also factors influencing local knowledge of rice landraces of the wet rice fields of the Naga community, West Java, using a combination of qualitative and quantitative ethnobotanical methods. The study results show that the Naga community has still maintained a rich TEK on local rice landraces. About 15 landraces of wet rice have been recorded, distinguished by the Naga community based on traditional knowledge. They also manage various local rice landraces and wet rice farming activities, including seed selection, preparing nursery and land, planting, crop and pest management, and harvesting and storing harvested rice based on the TEK embedded in their culture.

Keywords: Ethnobotany, local knowledge, Naga community, rice landraces, wet rice field, West Java

INTRODUCTION

The local village communities of West Java owned local knowledge, also called local ecological knowledge or traditional ecological knowledge (TEK), on local crop varieties (landraces) and local ecosystems, which are deeply embedded in their culture. These traditional ecological knowledge models have been inherited from their ancestors and orally transmitted intergenerational using the local language or mother tongue (Iskandar 2012). Further, traditional ecological knowledge is not static but dynamic due to continuous and intense interactions between local communities and the environment. This knowledge may be embedded in Western scientific knowledge by selecting and introducing external information (cf. Iskandar and Ellen 2007).

One of the traditional ecological knowledge models is regarding the rice varieties. The Naga community usually cultivates various rice varieties or *landraces*, adapted to local ecosystems based on TEK. Initially, mainly the local rice varieties were farmed in the *sawah* agroecosystem of West Java (Iskandar and Ellen 1999; Iskandar 2012). The word *landrace* is used for rice varieties or categories (following Siegeta 1996; Brush 1991, see also Iskandar and Ellen 1999) used by the local people of West Java to distinguish them from 'varieties' in the conventional Western taxonomic sense. Thus, in this context, a landrace is a local rice category according to characteristics reflected in the specific vernacular names.

The local knowledge or the traditional ecological knowledge on the local rice varieties of the wet rice fields is a dynamic system to adapt to the various ecological, socio-economic, and cultural changes. The traditional ecological knowledge has changed due to many factors, including human population increase, government policy, market, economic development, and the erosion of local languages (cf. Maffi 1999; Lizarralde 2004; Iskandar and Iskandar 2011). The local rice varieties of West Java have dramatically eroded due to modernization of the rice farming systems, such as introducing modern high yielding rice varieties, the introduction of pesticides, and inorganic fertilizers through the Green Revolution program since the 1960s, etc. Consequently, some germplasm of local rice varieties of the wet rice field systems has wholly disappeared. Though the people of the Naga community have adopted Green Revolution in general, they have culturally maintained the various local rice varieties (landraces). The local rice varieties have been integrated with the modern rice varieties. As a result, both the local rice varieties and the contemporary rice varieties are cultivated in the wet rice field system of the Naga community. Some research on the local rice varieties has been carried out by scholars, such as Iskandar and Ellen (1999), Warsiti (2009), and Tarigan (2013). Those researches have not focused on integrating the local rice varieties and modern rice varieties farmed in the rice field system. This paper provides an account of the local knowledge or the traditional ecological knowledge (TEK) on the management of rice varieties (landraces) and factors

influencing the local expertise on rice landraces of the wet rice field of the Naga community, West Java. The worldview of the Naga community on rice will be elucidated in this paper.

MATERIALS AND METHODS

Location and people

This research was conducted in Naga Hamlet in Neglasari Village, Salawu sub-district, Tasikmalaya District, West Java, Indonesia. Geographically, the Naga hamlet is located in the hilly upland area, between Garut and Tasikmalaya districts (Figure 1).

The distance from the town of Tasikmalaya to Naga village is approximately 30 km, while the distance from the city of Garut is about 26 km. To reach the Naga hamlet from the parking area of vehicles, people must walk using a footpath down the valley for approximately 20 minutes.

The altitude of Naga hamlet is 690 m above sea level. It has an air temperature between 21.5^0 and 23^0 Celsius. The Naga has a total area of about 10.5 hectares.

The land use of Naga hamlet can be divided into five types, namely hamlet area, wet rice field, garden and mixed garden, river, and protected forest. The hamlet area consists of traditional houses made of bamboo and wood with roofing of Arenga leaf and fiber and the home garden. The home garden consists of sheep cages and the mortar for pounding rice, along with the fish ponds (Figure 2. A). The wet rice fields are located outside the hamlet area, while the gardens and mixed gardens are located in the hilly area. The traditional protected forest is situated outside the hamlet's riverbank (Figure 2. B).

According to the ecological history, the recorded initial population of the Naga community in 1921 was only 35 individuals. In 1984 and 1985, the people of the Naga community were 351 individuals and 353 individuals, respectively. Recently, the population of the Naga community was registered in 2013, which includes a total of 325 individuals representing 108 households (Table 1).

It can be seen from Table 1 that the population of the Naga community has increased between 1921 and 2013. However, the population has registered a decrease between 1985 and 1994 due to migration to neighboring areas or urban areas, particularly the Naga people who do not like to keep their original culture. In other words, the people who are presently residing in the Naga hamlet have still maintained their traditional culture as a community.

The main subsistence activity of the Naga community is farming that involves cultivating the wet rice fields, gardens, and mixed-gardens. They also traditionally keep some livestock, namely local chicken, sheep, and fish, in the fish ponds. In addition, they have off-farm activities such as making bamboo artifacts, peddling, and running a small business in shops (*warung*).

Table 1. The population of the Naga community, Neglasari, Tasikmalaya, West Java, Indonesia, from 1921 to 2013.

Year	Population	Households
1921	35	-
1984	351	-
1985	353	-
1994	314	97
2001	326	-
2011	305	103
2013	325	108

Note: (-) data not available. Source: Suganda (2006), and the hamlet statistical data of Naga (2013)

Figure 1. Location map of the Naga Hamlet, Neglasari Village, Salawu Subdistrict, Tasikmalaya District, West Java, Indonesia

Figure 2. A. The hamlet of Naga community, West Java, Indonesia, consists of the traditional houses, the sheep cage, and fishpond. B. The conventional protected forest located on the riverbank outside the settlement area

Method

The method used in this study was a combination of the qualitative and quantitative techniques with the ethnobotanical approach (Martin 1995; Iskandar 2012). Several techniques, namely observation, semi-structured interview or in-depth interview, and structured interview, were applied. Observation was used to obtain general information on the settlement conditions, wet rice field, garden and mixed-garden, and the protected forest. The semi-structured interview with the informants was purposively selected based on completeness and categorization (Bernard 1994; Iskandar 2012). The informants were selected by the snowball technique based on the initial referrals given by the informal leaders. The informants consisted of aged men and women farmers, circumcisers (*dukun* or *paraji sunat*), healers (*dukun jampe*), a guardian of the grave or sacred place (*kuncen*), a hamlet leader (*tua kampung*), and the village staff (*perangkat desa*). Meanwhile, the structured interviews were undertaken with the randomly selected household. The number of respondents was decided using the statistical formula of Lynch et al. (1974 cited by Iskandar 2012) given below:

$$n = \frac{N.\ Z^2.P.(1-P)}{N.\ d^2.+\ Z^2(1-P)}$$

Where:
n = Number of Respondents
N = Total number the households
Z = value of normal variable (1.96)
P = proportion of maximum probability (0.50)
D = error (0.10)

The total registered households of the Naga community were 108, and the number of respondents calculated by the statistical formula was 34, as shown below:

$$n = \frac{108.\ (1{,}96)^2.0{,}50.(1-0{,}50)}{108.(0{,}10)^2.+\ (1{,}96)^2(1-0{,}50)}$$

n = 34

Data analyses

The qualitative data were analyzed during and after the field research. The data collected in the field and obtained from different sources, such as interviews, were continuously cross-checked. Moreover, the data were categorized and reduced based on relevance to the study's objectives (Moleong 2004; Iskandar 2012). The o data was interpreted regarding its consistency based on two perspectives, namely the informant perceptions (*emic view*) and scientific analysis by researchers (*etic theory*) (Iskandar 2012). Then the data was narrated with descriptive and evaluative research (cf. Newing et al. 2011). Meanwhile, the quantitative data were also statistically analyzed by calculating the percentage of the respondents answering each question of the questionnaire, presented in tables and charts, and narrated with descriptive and evaluative analysis.

RESULTS AND DISCUSSION

Source of the TEK on the rice landraces

The Naga people of West Java have obtained their traditional ecological knowledge (TEK) on the landraces of the local rice by intergenerational inheritance from their ancestors, and it's the result of a long process of cultural adaptations with the local environmental conditions. Of the 34 respondents of the Naga community who participated in the study, 28 respondents or 82.35% have obtained their TEK on the landraces of local rice from their parents and 3 (8.82%) from their neighbors or other people, and 1 (2.94%) from friends/relatives (Table 2). 2 respondents do not know the actual source of their TEK.

As shown in Table 2, there is no doubt that the parents have an essential role in transmitting the TEK. Therefore, we agree with Boyd and Richerson (1985) and Hewlett and Cavalli-Sforza (1986 quoted by Puri (1997) that village people learn the TEK by three general processes, which can be labeled as *parental*, *peer*, and *individual* learning. Parental learning involves fathers, uncles and aunts, and other elders teaching young boys and girls. Learning at this stage is equivalent to 'vertical cultural transmission' because socially transmitted knowledge is passed from generation to generation or inter-generational. Peer learning occurs in a group of young farmers, from roughly fourteen to seventeen. Afterward, boys or girls start to learn alone. Learning at this stage is equivalent to 'horizontal cultural transmission' because it occurs between members of the same generations or intra-generational. Meanwhile, individual learning takes place as adults, who often prefer to learn alone, before they have children to teach, and the children join rice farming activities with their peers and parents (cf. Puri 1997).

Traditionally, although the community of Naga has a low formal education, people have deep traditional ecological knowledge on landraces of rice and the practice of rice farming, which is originated from these three stages of learning, namely parental, peer, and individual learning.

The TEK on rice landraces

Based on the intensive field research, TEK on 15 landraces of local rice (*Oryza sativa L*) commonly cultivated by the Naga community in the wet rice fields (*sawah*) has been recorded. These rice landraces are generally named as the *pare ageung/ranggeuyan* consisting of *pare cere hideung, pare cere bodas, pare gantang, pare jamblang kuas, pare jamblang rancung, pare lokcan, pare jengkol, pare jidah nangka, pare peuteuy, pare regol, pare sarikuning, pare srek-srek bodas, pare srek-srek beureum, pare ketan bodas* and *pare ketan hideung*. The 15 recorded landraces of local rice are locally categorized (the folk taxonomy) or distinguished based on 11 criteria, namely seed shape, seed color, hairy (*buntutan*) and non-hairy (*teu buntutan*) nature of the seed, presence of long hair and ordinary hair, the color of seed hair, the hulled rice color (*warna beas*), culinary character, nature of stem branching (*cangcian*), rice stalk color (*barungbung*), leaf shape, grain color (*ranggeuyan pare*), easily fall out and not easily fall out feature, and the ecological characteristics needed for proper growth in the fields (Table 3).

Table 2. The sources of the TEK of Naga people, West Java, Indonesia on landraces of local rice

Sources of the TEK	Respondent number	Percentage of the total
Parents	28	82.35
Relatives and friends	1	2.94
Neighbors/other people	3	8.82
Do not know/do not answer	2	5,88
Total	34	100,00

On the basis of ecological characteristics, the wet rice field (*sawah*) can be divided into 5 categories, namely *sawah hieum, sawah ledok, sawah negrak, sawah angar*, and *sawah bebedahan*. *Sawah hieum* is related to the wet rice field in the hillsides and shaded tree canopies and getting shine. *Sawah ledok* deals with the wet rice field with fertile soil, with enough water and sunlight. *Sawah negrak* is concerned with the wet rice field that has fertile soil and enough sunlight. *Sawah angar* may be defined as a damp rice field with dry soil and is less productive. Meanwhile, *sawah bebedahan* may be defined as the wet rice field that is newly established, low fertile soil, to be fertile soil, so it must be fallowed between 1 and 1.5 years. Among 5 categories, the best *sawah* that is considered ideal for farming the rice is *sawah ledok*.

Meanwhile, the *sawah hieum* category is only suitable for planting rice of *rek-srek. This* rice landrace is perceived as resistant to the lack of sunlight caused by the vegetation shading. Nowadays, the Naga community introduces new rice varieties called pare segon, including Ciherang, Sarinah, and IR-64. Those rice varieties are predominantly cropped in the wet rice fields of a lack of water (sawah anggar), high sunlight, and a high air temperature. The age of new rice varieties (*pare sengon*) is relatively short of the average between 3 and 4 months.

Based on the Western scientific knowledge (etic view), the rice crop (*Oryza sativa L*) can be divided into two significant varieties, namely *indica* and *japonica* (Fox 1991). In addition, another variety of rice named *javanica* is also known (Table 4).

It can be seen from Table 4, based on the TEK of the Naga community, the rice can be divided into two major types, namely, *pare ageung* or *pare ranggeuyan* (local varieties) and *pare unggul*, *pare pendek* or *pare segon*. The first type of rice, *pare ageung*, is predominantly grown by the Naga community in the wet rice fields of the upland area with low sunlight (*hieum*) and relatively cool air temperature. Meanwhile, the second type of rice, *pare unggul* or *pare pendek*, is commonly planted by the Naga community in the wet rice fields of the flat and open areas (*sawah datar/sawah negrak*) (cf. Siregar 1981; Iskandar 2001 cited by Warsiti 2009, Iskandar 2012). The *pare unggul* type needs high sunlight, warmer air temperature, and has a short harvesting time of about 100 days (Iskandar 2012). In general, planting pare segon/pare pendek varieties is commonly done in the wet rice fields of non-shaded (sawah negrak) areas, which is in line with the botanical knowledge (Western Scientific) knowledge that these rice varieties need high sunlight. In other words, though the traditional ecological knowledge of the Naga community and the Western Scientific knowledge has a different origin (the Naga community knowledge is based on empirical experiences of trial and error and the Western Scientific knowledge is theoretical), the understanding about the appropriate places needed for proper growth of various rice varieties is generally the same (cf. Berkes and Gadzil 1995).

Table 3. Characteristics of landraces of local rice in the TEK of the Naga community, West Java, Indonesia

Local name	Hairy/non-hairy	Seed color	Hulled rice color	Ecological characteristics*)	Culinary Feature
Cere bodas	Non-hairy	Yellow	White	SL, SA, SN, SB	Sticky
Cere hideung	Non-hairy	Black	White	SL, SA, SN, SB	Sticky
Gantang	Hairy	Yellow	Red	SL, SA, SN, SB	Tasty
Jamblang kuas	Hairy	Yellow	White	SL, SA, SN, SB	Ordinary
Jamblang rancung	Hairy	Yellow	White	SL, SA, SN, SB	Ordinary
Loccan	Hairy	Yellow	White	SL, SA, SN, SB	Ordinary
Jengkol	Hairy	Yellow	White	SL, SASN, SB	Ordinary
Jidah nangka	Hairy	Yellow	White	SL, SA, SN, SB	Ordinary
Peuteuy	Non-hairy	Yellow	White	SL, SA, SN, SB	Ordinary
Regol	Hairy	Yellow	White	SL, SA, SN, SB	Ordinary
Sarikuning	Hairy	Yellow	White	SL, SA, SN, SB	Ordinary
Srek-srek bodas	Hairy	White	White	SH	Ordinary
Srek-srek beureum	Hairy	Red	White	SH	Ordinary
Ketan bodas	Non-hairy	Yellow	White	SL, SA, SN, SB	Tasty, Sticky
Ketan hideung	Non-hairy	Black	Black	SL, SA, SN, SB	Tasty, Sticky

*) Note: SL=*Sawah Ledok* (wet fertile soiled rice field); SA= *Sawah Anggar* (dry non-fertile soiled wet rice field); SN=*Sawah Negrak* (non-shaded wet rice field); SH=*Sawah hieum* (shaded wet rice field); and SB= *Sawah Bebedahan* (new non-fertile soiled wet rice field).

Table 4. Two wide rice varieties of the Naga community, West Java, Indonesia

Rice varieties based on the Naga community classification (emic view)	Characteristics	Rice varieties based on Botanical classification (etic view)
Local varieties (*pare ageung, ranggeuyan*)	Relatively long-maturing, sturdy, wide-leaved rice with long panicles, large and bold grains, and low photoperiod sensitivity	*Javanica*
The superior varieties (*pare unggul, pare pendek*)	Narrow leaves, shorter culms and panicles, and slender grains, and often photoperiod sensitive	*Indica*

Source: Fox (1991), Irawan and Purbayanti (2008)

About the diversity of rice varieties (landraces), the 7 landraces (ala) have been recorded from the Alune community of Pulau Seram (Suharno 213), which is lower than that of the Naga community, which has 15 landraces of rice. The diversity of rice landraces of Naga community, however, is lower than that of the Rancakalong community of Sumedang, from which 22 landraces (Warsiti 2009 and Baduy community of Banten from which 89 *huasan pare* (landraces of rice) have been reported (Iskandar and Ellen 1999). According to ecological history, the Naga had a high diversity of landraces in the past. However, some landraces of local rice disappeared (Table 5) because of many factors, including the introduction of new rice varieties and the selection process undertaken by the Naga people. The Government-sponsored Green Revolution Program has predominantly carried out the intensive introduction of new rice varieties in the Naga area since the late 1960s.

Initially, the Naga community rejected the modernization and introduction of new rice varieties due to the fear of disturbance to the environment. However, after the local government of Tasikmalaya, in cooperation with village staff, provided motivation and subsidized the seeds of new rice varieties, pesticides, and inorganic fertilizers to the Naga people, they accepted the modernization of the rice farming (Tarigan 2013). Due to this, some local rice varieties, including *salak*, *goyot*, and *geulis* (Table 4), disappeared from the Naga area. The introduction of the high-yielding rice varieties through the Green Revolution has caused the erosion of the local rice varieties that were adapted adequately to both local ecosystems and socio-cultural conditions of the local people. In other words, various local rice varieties had been cultivated by local people of the Naga hamlet based on the traditional ecological knowledge in robust embedded with local culture in different local environments of the rice fields, including local soil conditions for a long time (cf. Brush 2004). Since the local community has adopted those local rice varieties to local ecosystems for a long time, the local people's capital infestation, knowledge, and ability are given for a long time (cf. Brush 2004). The consequence of the disappearance of the local rice varieties being replaced by the high-yielding rice varieties is the disappearance of associated traditional ecological knowledge of the local community farming those local varieties.

Table 5. Some introduced new rice varieties, and some disappeared, local rice varieties of the Naga community of West Java, Indonesia

Introduced rice varieties	Disappeared local rice varieties
IR-64	Salak
Ciherang	Goyot
Septinah	Geulis
Bepak	Torondol
Royal	Jambu
Warneng	Nemol
Sinatnur	Kalapa
Jalur	Gadog
OR	Tamiang
Cisadane	
Bengawan	
Deris	

Management of the rice farming

The Naga community in the wet rice field (sawah) agroecosystem has culturally farmed both the local and the high-yielding rice varieties. Culturally, the management of rice farming in the *sawah* agroecosystem consists of various stages like seed selection, nursery preparation, land preparation, planting, looking after planted rice, preventing pests, harvesting, and storage of harvested rice.

The annual farming activities of the Naga community have been culturally based on the agricultural calendar (*pranata mangsa*). The *pranata mangsa* is used as the leading guide by the Naga community for determining the timing of each rice cultivation activity adapted to two main seasons, namely the wet and dry seasons (Figure 3).

The agricultural calendar of the Naga community is similar to that of Sundanese (cf. Iskandar 2012). This calendar is divided into twelve months, namely *Kasa* (June-July), *Karo* (August), *Katiga* (August-September), *Kapat* (September), *Kalima* (October-November), *Kanem* (November-December), *Kapitu* (December-February), *Kawolu* (February-March), *Kasanga* (March), *Kasadasa* (March-April), *Desta* (April-May), and *Sada* (May-June). Although currently, the weather, the climate, and the wet and dry seasons can hardly be predicted due to global warming, the Naga community has tried to apply the agricultural calendar with adaptations to dynamics of climatic changes. In addition, the predominance of the sounds of insects, namely turaes (*Cryptotympana acuta*) and tonggeret (*Dundubia manifera*), are used as indicators of the end of the rainy season and start of the dry season. The appearance of a constellation of the star of *Kidang Kencana* (the belt of Orion) is also commonly used as an indicator of the starting of the dry season.

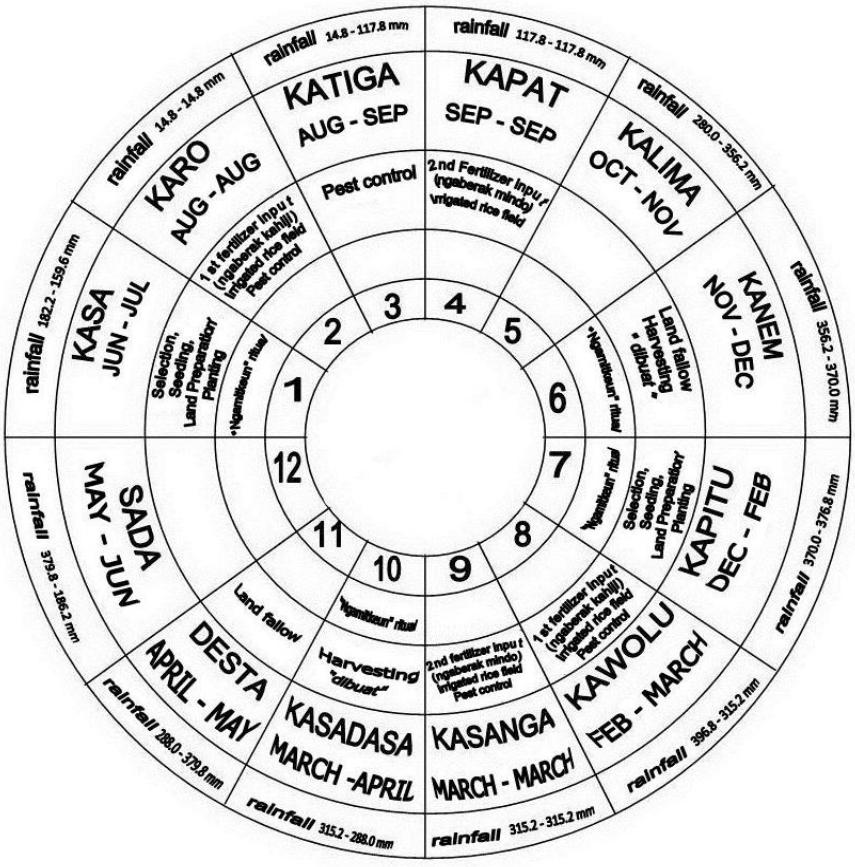

Figure 3. The agricultural calendar (*pranata mangsa*) of the Naga community, West Java, Indonesia

Figure 4. Several rice varieties are nearly harvested in the wet rice fields of the Naga community, West Java, Indonesia

On the basis of the rice farming practice, it can be noticed that though the Naga people are also growing high-yielding rice varieties, they still practice rice farming based on their traditional ecological knowledge traditional agricultural calendar (Figure 3).

Before the 1980s, the Naga people cultivated only local rice varieties (landraces), which were planted in March-April (*Mangsa Kasadasa*) and September-October (*Mangsa Kapat/Kalima*) (Tarigan 2013). However, after adopting the Green Revolution in 1984, the local rice varieties are called padi lokal or pare ageung. The Naga community commonly cultivates the modern varieties or the high-yielding rice varieties. They produce local rice varieties (*pare ageung*) in the primary season called the *tahun besar* (*taun ageung*) and then cultivate the modern rice varieties called the *tahun kecil* (*tahun alit*). The use of the *tahun besar* and the *tahun kecil* is not concerning the low and high rainfall intensity, but by referring to the nature of rice varieties (local rice or modern rice) planted at that time. In the primary season or *tahun besar* (*tahun ageung*), the local rice varieties or *padi lokal* (*pare ageung*) are predominantly planted in June, July, August, September, and November. In January, February, and March, the modern rice varieties (*pare pendek*) are mainly planted and are called *tahun kecil* (*tahun alit*) (Figure 4). During April, May, and December, the wet rice fields are fallowed during the remaining months. This custom of the Naga community practicing rice farming by allowing a fallow time between has been considered a measure to maintain soil fertility. In addition, the new modern rice varieties are predominantly planted in the rainy season are intended to maximize rice production because these varieties require more water. On the contrary, the local rice varieties are mainly grown in the dry season, considering these varieties are adapted to a shortage of water in the wet rice fields (cf. Altieri 1990). According to Clawson (1985 cited by Altieri 1990), planting and managing different crop varieties and applying the fallow time can maintain these crop varieties by preventing pests and increasing crop harvest.

Worldview of the Naga community on rice

Like Sundanese village people in the past, the Naga community believes that rice has a goddess called *Nyai Pohaci* (cf. Prawirasuganda 1964; Wessing 1978). *Nyai Pohaci* is perceived as the fertility goddess who owns and protects rice. In addition, the Naga community believes that rice has its origin from parts of the eye and the heart of *Nyai Pohaci*. Each watch consists of a grain of rice consisting of a different color. The white grain of rice has originated from the white eyelids and the hairy black grain of rice from the eyelashes of *Nyi Pohaci*. In addition, the varieties of sticky rice (*padi ketan*) are believed to have come from the heart, and each array is composed of five grains of rice (Suganda 2006). As a result, the Naga community highly respects and appreciates the traditional rituals, such as planting and harvesting rice.

Based on this study, it can be concluded that the Naga community has a rich traditional ecological knowledge about rice varieties (landraces) and the *sawah* rice farming practice. This research also confirms the hypothesis that the ecosystems which have experienced the significant human presence and human resource use over time are biocultural systems—systems that have been shaped jointly by biological and cultural dynamics. This is not only in terms of causing environmental degradation and resource depletion but also in terms of human contributions, directly or indirectly, to the maintenance and even to the creation of biodiversity, including the local varieties of crops like rice, as presented in this study of Naga community (cf. Maffi 2004).

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REFERENCES

Altieri MA. 1990. Why Study Traditional Agriculture?. In Carrol CR, Vandermeer JH, Rosset PM (eds.). Agroecology. McGraw Hill Book, New York.

Abdoellah OS, Hadikusumah HY, Takeuchi K, Okubo S, Parikesit. 2006. Commercialization of homegardens in an Indonesian village vegetation compositions and functional changes. In: Kumar BM, Nair PKR (eds.). Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Springer, Berlin. DOI: 10.1007/978-1-4020-4948-4_13.

AIPI. 2014. Panel Discussion: Development of ethnobotany in Indonesia. Jakarta 01 January 2014, 10: 53. [Indonesian]

Bernard HR.1994. Research method in anthropology: qualitative and quantitative approach. Sage Publications, London.

Berkes F, Folke C, Gadgil M. 1995. Traditional ecological knowledge, biodiversity, resilience, and sustainability. In: Perrings CA, Maler KG, Folke C, Holling CS, Jansson BO (eds.) Biodiversity Conservation. Kluwer Academic Publishers, Dordrecht, Nederland. DOI: 10.1007/978-94-011-0277-3_15.

Boyd R, Richerson PJ. 1985. Culture and Evolutionary Process. University of Chicago Press, Chicago.

Brush SB. 1991. A farmer-based approach to conserving crop germplasm. Econ Bot 45 (2): 153-165. DOI: 10.1007/BF02862044.

Brush SB. 2004. Farmers bounty: locating crops diversity in the contemporary world. Yale University Press, USA. DOI: 10.12987/yale/9780300100495.001.0001.

Creswell JW. 2012. Research design: qualitative, quantitative, and mixed approaches. Pustaka Pelajar, Yogyakarta. [Indonesian]

Fox JJ. 1991. Managing the ecology of rice production in Indonesia. In: Hardjono J (ed). Indonesia: resources, ecology. and environment, Oxford University Press, Singapore.

Hehakaya MA.2010. Study on Local knowledge of the people on varieties, usability, processing, and cultivation of banana plants (*Musa* spp) in the Sukajaya Village, South Sumedang Sub-district, Sumedang District. [Thesis]. Department of Biology, Padjadjaran University, Sumedang. [Indonesian]

Hewlet BS, Cavalli-Sforza LL. 1986. Cultural transmission among Aka Pygmies. Amer Anthropol 88: 922-934. DOI: 10.1525/aa.1986.88.4.02a00100.

Irawan B, Rahmayani E, Iskandar J. 2009. Study on variations, utilization, and management of Aren in Rancakalong village, Rancakalong Sub-district, Sumedang District, West Java. Seminar on Ethnobotany IV, 18 May 2009, Cibinong. [Indonesian]

Iskandar J. 2012. Ethnobiology and sustainable development. Puslitbang LPPM Unpad Bandung. [Indonesian]

Iskandar J, Ellen R. 1999. In situ Conservation of Rice Landrace among The Baduy of West Java. J Ethnobiol 19 (1): 97-125.

Iskandar J, Ellen RF. 2007. Innovation, 'hybrid' knowledge and conservation of relict rainforest in Upland Banten. In: Ellen R (ed), Modern crises and traditional strategies: local knowledge in Island Southeast Asia. Berhahn Books, New York.

Iskandar J, Iskandar BS. 2011.,Agroecosystem of Sundanese People. Penerbit Kiblat, Bandung. [Indonesian]

Lizarralde M. 2004. Indigenous knowledge and conservation of the rainforest: ethnobotany of the Bari of Venezuela. In: Carlson TJS, Maffi L (eds), Ethnobotany and conservation of biocultural diversity. The New York Botanical Garden Press, New York.

Lynch SJF, Hoelnsteiner RM, Cover CL. 1974. Data gathering by social survey. Philippines Social Science Council, Quezon City.

Maffi L. 1999. Linguistic diversity. In Posey D. (ed), Cultural and spiritual values of biodiversity. Intermediate Technology Publication, London. DOI: 10.3362/9781780445434.002.

Maffi L. 2004. Maintaining and restoring biocultural diversity: The evolution of a role for ethnobiology. In: Carlson TJS, Maffi L (eds), Ethnobotany and Conservation of Biocultural Diversity. The New York Botanical Garden Press, New York.

Martin GJ. 1995. Ethnobotany: A Methods Manual & Chapman & Hall, London. DOI: 10.1007/978-1-4615-2496-0.

Matanubun H, Rochani A, Sumule. 1995. A. Some aspect of the indigenous knowledge of selected sweet potato farming system in Irian Jaya. In: Schneider J. (ed.). Indigenous Knowledge in Conservation of Crop Genetic Resources. International Potato Center and Central Research Institutes for Food Crops, Bogor.

Moleong LJ. 2004. Qualitative Research Method. Remaja Rosda Karya, Bandung. [Indonesian]

Newing H, Eagle CM, Puri RK, Watson CW. 2011. Conducting research in conservation: a social science perspective. Routledge, London. DOI: 10.4324/9780203846452.

Okubo S, Parikesit, Harashina K, Muhammad D, Abdoellah OS, Takeuchi K. 2010. Traditional Perennial Crop-based Agroforestry in West Java: The tradeoff between on-farm biodiversity. Agroforest Sys 80(1):17-31. DOI 10.1007/s10457-010-9341-8.

Prawirasuganda A. 1964. Traditional ritual of Pasundan. Penerbit Sumur Bandung, Bandung. [Indonesian]

Puri RK. 1997. Hunting knowledge of the Penan Benalui of East Kalimantan, Indonesia. [Dissertation]. Department of Anthropology, University of Hawai'i, Hawai'i.

Rahayu M, Susiarti S, Sihotang VBL. 2012. A preliminary ethnobotanical study of useful plants by Local Communities Bodogol Lowland Forest, Sukabumi West Java. J Trop Biol Conserv 9 (1): 115-125.

Siegeta M. 1996. Creating landrace diversity: the case of the Ari people and ensete (*Ensete ventricosum*) in Ethiopia. In Ellen R, Fukui (eds). Redefining nature: ecology, culture, and domestication. Berg, Oxford.

Suharno, Wirawati DM. 2013. Seram island: imaging of its natural environment and the agricultural behavior of Alune people. Kepustakaan Populer Gramedia, Jakarta. [Indonesian]

Suganda H. 2006. Naga hamlet maintains the tradition. Penerbit Kiblat, Bandung. [Indonesian]

Fatriati T. 2008. Study on taxonomy of bamboo in Sumedang Sub-district based on morphological character and reed epidermal anatomy. [Hon. Thesis]. Department of Biology, Padjadjaran University, Sumedang. [Indonesian]

Tarigan, G.H. 2013. The changes in agricultural system of the Naga community, Neglasari village, Salawu Sub-district, Tasikmalaya District. [Thesis] Environmental Program Study, Padjadjaran University, Sumedang. [Indonesian]

Warsiti I. 2009. Management and Utilization of the local rice and factors affecting of conservation of the local rice varieties. [Thesis] Environmental Program Study, Padjadjaran University, Sumedang. [Indonesian]

Wessing R. 1978. Cosmology and social behavior in a West Javanese settlement. Ohio University Center for International Studies, Ohio.

Wirahman B. 2005. Study on taxonomy of Durian varieties in Subang District, West Java. [Thesis]. Department of Biology, Padjadjaran University, Sumedang. [Indonesian]

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Local knowledge of Karangwangi People of Cianjur District, West Java, Indonesia on water pollution of the Cikawung River

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Abstract. *Primadiani D, Iskandar J, Sunardi. 2018. Local knowledge of Karangwangi People of Cianjur District, West Java, Indonesia on water pollution of the Cikawung River. Asian J Ethnobiol 1: 9-14.* In the past, village people of Karangwangi, Cianjur District, West Java Province did not face any water supply problem, including supply from the Cikawung River. Of late, however, they are experiencing problems with water sources, particularly water supply from the Cikawung River. Since pesticides have been intensively used in the local agroecosystems, such as irrigated rice fields and monoculture vegetable gardens, the Cikawung river water is polluted. In addition, the consequences of an increase in the conversion of forests and traditional mixed-gardens into agricultural and settlement areas have dramatically affected hydrological balances. On this background, this research was carried out to elucidate the local knowledge of the Karangwangi people on the status of pollution of water of the Cikwaung river. This research used a mix of qualitative and quantitative methods with descriptive qualitative analysis. The qualitative data collection technique used was in-depth interviews with informants chosen purposely with snowball sampling. The quantitative data collection technique was interviews with respondents using questionnaires and measurement of physical, chemical and biology parameters of Cikawung River water. Results of this research confirm that village people of Karangwangi have considerable local knowledge on water categorization, pollution, and pollution indicators of the Cikawung River

Keywords: Local Knowledge, Cikawung River, Karangwangi Village, Pesticides, Water Pollution

INTRODUCTION

In the past, most village people of Java, including those of West Java, were getting an appropriate supply of water from various sources, such as wells, springs, showers, and rivers. The water supply was adequate and proper because the village environment was adequately maintained, and the population was limited. The village people used water based on the local knowledge and cosmos or beliefs (cf. Iskandar 2012). The term local knowledge, in this case, is synonymous with various terms, including rural people's ability, indigenous technical knowledge, insider knowledge, traditional environmental knowledge, peoples' science, and folk knowledge. It may relate to any knowledge held more or less collectively by a population, informing understanding of the world, embedded in and conditioned by local tradition (Sillitoe 2002). The village people's knowledge of water ranges from their ability to categorize water to maintain water resources based on the traditional conservation practices. Some water resource areas, such as upstream forests and springs, have been considered sacred places and prohibited from disturbances.

Both local knowledge and cosmos or belief systems have played essential roles in utilizing and maintaining the water resources in the village ecosystem. Such local knowledge of village people is inherited from their ancestors and transmitted orally from generation to generation through the mother language. In addition, local knowledge has been obtained by trial and error of the village people during their interaction with the local environment for a long time (Iskandar 2009). Indeed, a long process of interaction between the village people and their environment has resulted in the local wisdom of the village about the climate (cf. Aulia and Arya 2010).

However, due to human population increase, intensive penetration of market economy to village areas, and rapid development of new technologies, some local knowledge of the village people has eroded. As a result, the environment and natural resources, including water, have not been widely exploited. Moreover, some environmental destruction has not been avoided (Iskandar 2014). Unlike in the past, water availability has been changed due to the destruction of the watershed area. Therefore, there has been a water shortage during the dry season in many villages. Conversely, during the wet season, there has been flooding. The water supply is very high in the wet season, but its quality is terrible because it predominantly contains high sediment content. It has been caused due to the destruction of watersheds. For example, the forests and traditional agroforestry systems have been converted to other land uses, such as settlements and other human facilities. Consequently, rainwater rarely penetrates deep soil during the rainy season but directly flows into the river and causes flooding. Conversely, there is a lack of water supply during the dry season due to minimal water stock in the deep soil. In addition, the quality of water in the river

has decreased due to many factors, including pollution from pesticides. This is because many pesticides have been intensively used in the wet rice fields and commercial gardens, the leaching of which come into the rivers. As a result, the water resources in many villages are no longer sufficient, and water has become an economically high-value commodity (cf. Susilo et al. 2016).

In general, the availability of water supply in the village ecosystem is dependent on the condition of the watershed environment. Therefore, any change in the watershed environment may change the water supply of the rivers (cf. Wahid 2009; Halim 2014; Sri et al. 2014). The lowland and riverbank are known as fertile soil due to sediment carried along by the river, and this area is predominantly used for agricultural purposes (cf. Rochgiyanti 2011). In many cases, some conflicts between conservation, agriculture, and settlement areas have occurred caused by socio-economic changes of the community. Moreover, they have changed human behavior about the environment (cf. Hakim et al. 2016).

The Cikawung river of Karangwangi village, Cianjur District, West Java, has a vital role for village people. For example, it has been used to irrigate the wet rice, wash, and take baths by village people. However, due to intensive use of pesticides in the wet rice field and commercial gardens, this river has been polluted, and its water organisms have been killed (cf. Collins 1975) cited by Tilak et al. (2007). In addition, the intensive use of synthetic pesticides has caused erosion of local knowledge about biopesticides (Iskandar 2014).

This paper aims to elucidate the local knowledge of the Karangwangi village on the water pollution of the Cikawung River. Three different aspects are studied in this paper: local understanding of village people of Karangwangi on river water, water pollution, and indicators of water pollution using macro-zoobenthos diversity.

MATERIALS AND METHODS

Location

This research was conducted from February to May 2017 in Karangwangi Village, Cianjur District, West Java. The Karangwangi Village is located directly adjacent to the Indonesian Ocean on the South. This village is situated approximately 200-275 m above sea level. Karangwangi Village has about 2,300 hectares, consisting of 1,115 hectares of rice fields and gardens. Jayanti Nature Reserve also borders Karangwangi Village. Cikawung River is one of the rivers that pass Karangwangi Village.

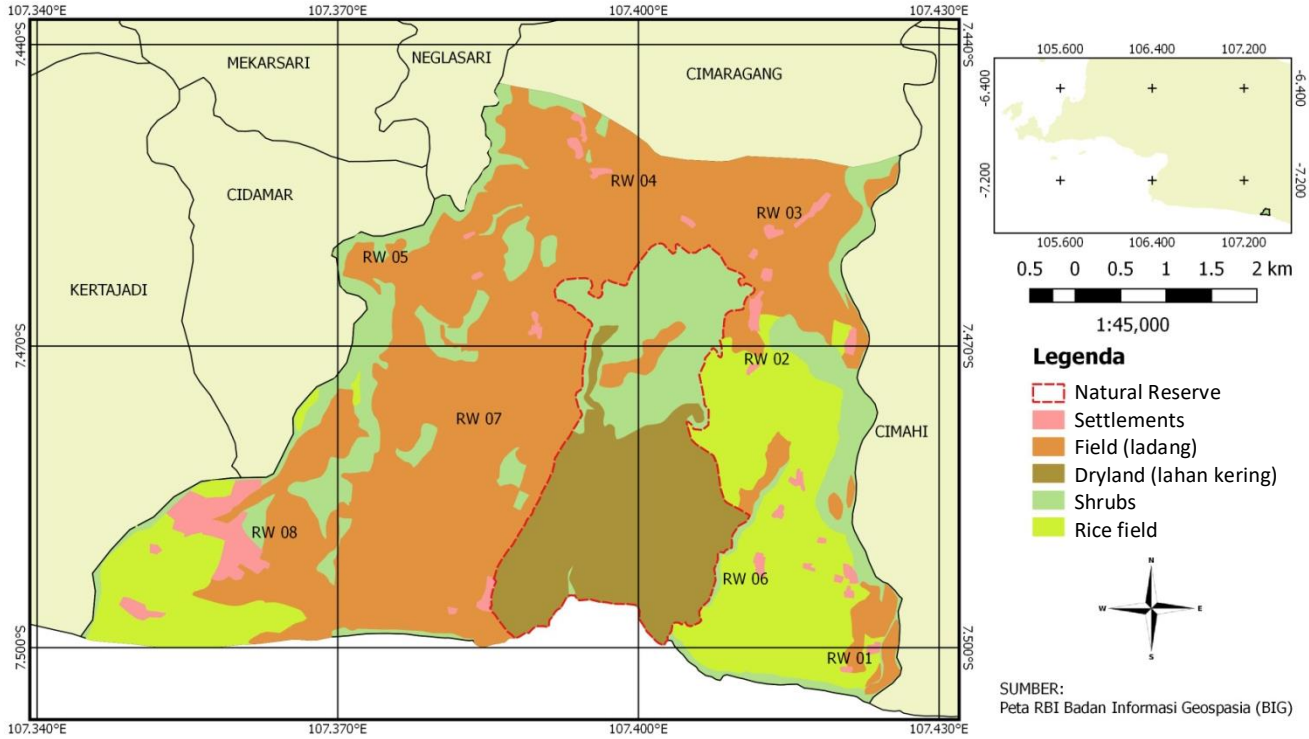

Figure 1. Research location in Cikawung River, Karangwangi Village, Cianjur Subdistrict, West Java, Indonesia

Data collection

Qualitative and quantitative mixed-method with ethnoecology and ethnobiological approach was applied for data collection (Iskandar 2012; Alburque et al. 2014). Several field research techniques such as observations, in-depth interviews, semi-structured interviews, and biological samplings were undertaken to collect the primary data in the field. The observation was carried out to record the general condition of the Cikawung River, agroecosystem types, and settlement environment. The Deep interview was applied to understand the village people's knowledge of the Cikawung river of Karangwangi. It was carried out with informants, such as informal leaders, the village staff, farmers, fishers, etc. The structured interview was undertaken with randomly selected respondents. The total number of respondents was calculated by the Lynch formula (Lynch et al. 1974).

$$n = \frac{N . Z^2 . p(1-p)}{N . d^2 + Z^2 . p(1-p)}$$

Where:
n = sample number (respondents)
N = population number
Z = normal variable value for level of confidence 95% (1.96)
P = highest proportion (0.5)
D = *sampling error* (0.10) (Lynch 1974).

Based on the statistical formula, it has been determined that the total number of household respondents is 92. Each of them was interviewed using the questionnaire. In addition, biological sampling was also carried out by collecting water samples of the Cikawung River, and some variables, including COD, BOD, PH, and macro-zoobenthos diversity, were analyzed in the laboratory.

Data analysis

The qualitative data was analyzed through several stages (Iskandar 2012). Firstly, data obtained by observation and in-depth interviews were cross-checked. Secondly, the data were summarized and synthesized. The quantitative data obtained by the questionnaire were analyzed by simple statistical methods like calculating the percentage of respondents answering the questionnaires, as shown below:

$$P = \frac{f}{N} \times 100\%$$

Where:
P = Percentage of the total
f = Data Frequency
N = Total number of processed samples (Warsito, 1992).

The data of macro-zoobenthos diversity was analyzed using Shanon-Wiener Diversity Index (Odum 1981; Yuliana et al. 2012).

Shanon-Wiener Diversity Index(H') = $- \Sigma$ (ni/N) ln (ni/N)

Where:
ni = number of individual genus -i
N = total number individual all species
ln = number of species

RESULTS AND DISCUSSION

The water of the Cikawung river

In general, all informants of village Karangwangi village opined that the quantity and quality of water in the Cikawung River has changed. The amount of water in the Cikawung River was more stable in the past. Even during the dry seasons, the water of Cikawung never decreased too much. Nowadays, however, during the dry season, particularly during the drought periods caused by the climatic anomaly, the water level in the river of Cikawung decreases drastically. As a result, many people of Karangwangi village face problems obtaining sufficient water for their daily needs, such as washing and taking a bath.

According to some informants, the water shortage has been caused by many factors, both natural and manufactured or anthropogenic—the main natural factors long-dry seasons caused by the climatic anomaly. In addition, different anthropogenic factors are predominant causes for the decrease of water in the Cikawung River and other water sources. On the one hand, the water demand has increased due to population increase, and water in the various water resources has been intensively exploited; on the other hand's water supply has decreased due to the destruction of vegetation of the watershed, and the forests and traditional agroforestry systems have been converted to settlements and agricultural areas. The lack of water in the Cikawung River, particularly during the dry season, has affected the village people of Karangwangi village. Cikawung River was traditionally used for taking baths and washing. In addition, it was predominantly used for agricultural purposes, such as irrigation of the rice fields and monoculture gardens. Based on the monoculture garden, some farmers of the Karangwangi village have been intensively cultivating chili crops for two years. Since chili production has been high, some people are interested in planting chili pepper.

About the environmental history, in the past, the Karangwangi people cultivated rice both in the wet-rice field (*sawah*) and the swidden farming system (*huma* or *ladang*) (cf. Iskandar and Budiawati 2011). They grew rice based on the local knowledge, cosmos, and applied LEISA (Low external inputs and Sustainable Agriculture) system (cf. Reijntjes et al. 1992). For example, various inputs such as rice seeds, organic fertilizer, and biopesticides were obtained from the village. Moreover, the Cikawung River was less polluted. Nowadays, the practice of swidden cultivation by farmers has decreased. In addition, the cultivation of rice in sawah and planting commercial crops, such as chili pepper in the gardens, has intensified the use of chemical fertilizers and pesticides. As a result, the

Cikawung River has been polluted by pesticides. The farmers have adopted the changes in rice and chili pepper cultivation to increase population density and intensive penetration of the market economy to villages. The hydrological system of the Cikwung river has changed due to disturbances in the vegetation of forests and mixed-gardens in the watershed. Therefore, according to some informants, for rehabilitation of the Cikawung watershed, some plant species, including Picung (*Pangium edule*) and Kiara (*Filicium decipiens*), have been planted in areas of 100 m from upstream area. This program has not been optimally undertaken due to a lack of human resources. According to informants, some species, such as changkring (*Erythrina fusca),* kiray *(Metroxylon sagu),* Benda or teureup (*Artocarpus elastica*), and *Ficus racemosa,* have been considered for planting in the riverbank area. These plants can be appropriately grown in the lowland area (Ulfah et al., 2015). Two plant species, namely *Ficus racemosa* and *Artocarpus elastica,* of the Moraceae family have predominantly been grown in particular areas close to water sources. In general, plants of the Moraceae family have the ability of hydrological conductance, which can absorb water in large quantities at night. That is because the plants of the Moraceae family have a deep root system (Sofiah and Fiqa 2014).

Water Pollution of Cikawung River

Based on the results of in-depth interviews with informants, it can be inferred that the quality of water of the Cikawung River has also decreased. According to the perception of 92 respondents, the water of the Cikawung River can be divided into two categories, namely dirty water and clean water. The dirty water is polluted by waste and has become turbid and developed bad smells (Table 1).

As mentioned by informants, the water of the Cikawung river has become turbid due to *cileucang* (runoff) containing a lot of mud or sediment. That is why the people of village Karangwangi have traditionally used the water of the Cikawung river for bathing and washing only. Water for cooking and drinking has been predominantly obtained from wells and rainwater harvesting collected and stored in gallons. Unlike the wet season, in the dry season, the water of the Cikawung River becomes clear. Therefore, during the dry season, the people of Karangwangi have used water of the Cikawung River for drinking, cooking, washing, and bathing.

Table 1. Category of polluted water based on the respondents' perception

Indicator of polluted water	Number of respondents	Percentage of respondents
Color	82	89.13
Waste	20	21.73
Smell	36	39.13
Taste	8	8.69

Unlike the Karangwangi people, the water of the Cikawung river is categorized by urban people of Jakarta based on sources (the local water company/PAM, private drink, washing, latrine/MCK; river, rainwater), color (colored including chocolate and black and colorless), smell (odorless and smell including the smell of soil, rust, stench), motion (flowing profusely/flooding, regular, and not flowing), use (drinking and cooking, bathing and washing, not suitable for anything), and how to obtain (without cost and labor, and vice versa) (Ahimsa-Putra 1997).

According to informants, the deteriorating quality of water of the Cikawung River is also indicated by changes in the diversity of fish. A wide variety of fish has been recorded in the Cikawung river due to support by good quality of water. Today, however, the population of fish species, such as eel or belut (*Monopterus albus*), catfish (*Clarias sp*.), lubang (*Anguilla marmorata*), and beunteur (*Puntius binotatus*), has decreased. It has been estimated that about 30 % of the fish population has decreased compared to 40 years ago. The decrease in fish population has been caused mainly by the intensive use of synthetic pesticides. Synthetic pesticides are chemical materials that can poison fishes because fishes are good accumulators of several kinds of pesticides, especially lipophilic pesticides (pesticide which easily attaches to fat tissues) (Taufik 2011).

In addition to pesticides of agricultural origin, the river Cikawung has also been polluted by pesticides used by people to catch fish. In the past, village people of Karangwangi used to catch fish by fishing nets (*heurap*) or natural poisons made of plants roots. Presently, some people use chemical pesticides to catch fish and enhance the size of fish catches.

Supriyono et al. (2015) explained that synthetic pesticides are toxic chemical materials that can disturb ecosystem balance and disturb aquatic organisms. Catching fish using synthetic pesticides for a particular purpose needs selective permission to minimize its negative impact on the ecosystem. The kinds of pesticides used by farmers in the study area are starban, aripo, puradan, TSP, Culakron, etc.

Traditionally, the villagers of Karangwangi knew various plants that could be used as natural pesticides to kill pests. For example, fruits of Picung (*Pangium edule*) have been popularly used as an herbal pesticide by rural people. The preparation method involves dissolving pounded fruits in water which is then sprayed on pests. Picung can be used to kill insect pests, such as walang sangit (*Leptocorisa acuta*). Most village people were also aware that coconut (*Cocos nucifera*) mixed with cassava (*Manihot esculenta*) could be used as a natural agent for poisoning wild boar (*Sus scrofa*). Nowadays, however, natural pesticides are not used longer by villagers. It is because people assume that synthetic pesticides can kill pests more effectively and faster when compared to natural pesticides. In addition, various synthetic pesticides are readily available in markets, whereas the plants used as herbal pesticides are rarely found in the ecosystem. As a result, the natural pesticides are less predominantly used by

farmers, and later on, they will be abandoned entirely or forgotten (Kardinan 2011).

Pesticides can cause a negative impact on the environment and the people who are directly or indirectly exposed to them. Pesticides that have been sprayed can get into the human body through skin absorption (Chaturverdi et al., 2013). Informants of this study also explain that presently several people in Karangwangi have experienced skin diseases; one such person lives in Situwangi. This fact also indicates that pesticides have polluted the water of the Cikawung River. However, this has not influenced the villagers to stop using synthetic pesticides.

As presented in Table 1, people of the Karangwangi village categorize the polluted water of the Cikawung river not only based on change of color but also by rotten smell developing due to contamination. Informants explain that although the water smelled and contained waste, the people in Karangwangi still used it as long as the water did not smell soap or pesticides. If river water doesn't smell, people can still use it for wash and bath.

The results of the semi-structured interview indicated that 35 % of respondents mentioned that the Cikawung River at Garedog area has a high level of pollution, 24 % of respondents said that the Geredog area has a moderate level of pollution, and 37 % of respondents mentioned that the Situwangi area has the lowest level of pollution. The area is located upstream and is expected to have a high level of pollution because this area is close to the wet rice fields where the use of pesticides is intensive. On the contrary, the Situwangi location is expected to have the lowest pollution level because the discharge of water is higher when compared to the other areas. In other words, the pollution level in the Cikawung River is expected to decrease in the downstream area due to water dilution, caused by increasing water volume due to discharge from the creeks originating from the forests of the nature reserve Jayanti.

Macro-zoobenthos diversity

Analysis of the macro-zoobenthos diversity in different river locations shows that Situwangi, located downstream, has relatively lower diversity than that of the Geredog and Nempel areas located in the upper stream (Table 2).

It may be assumed that the lower index of a diversity of macro-zoobenthos in the Situwangi area is caused by high water pollution. This biological analysis result is somewhat different from the respondents' perception that the pollution level in Situwangi is lower than that of Geredog and Nempel due to the dilution of water. However, it must be considered that the diversity of macro-zoobenthos in the different areas of the Cikawung river is influenced by water pollution and other factors, including temperature, sediments, and organic materials, etc. (cf. Putro 2014; Pamudji et al. 2015).

In general, however, the biological and chemical parameters (COD, BOD, and pH based on the government regulation 82, the year 2001) support the perception of village people of Karangwangi that the water of the Cikawung is in relatively good condition.

Table 2. Value of diversity index of macro-zoobenthos based on the Shannon-Wiener of Cikawung River,

Location	Diversity index of macro-zoobenthos
Geredog	1.05
Nempel	1.04
Situwangi	0.87

Based on this study, it can be concluded that the village people of Karangwangi have exceptional local knowledge on aspects such as water categorization, pollution level, and pollution indicators of the Cikawung river. In addition, they are also aware that the quantity and quality of Cikawung river water have changed due to natural and anthropogenic factors.

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REFERENCES

Ahims-Putra HS. 1997. Water and Ciliwung water: a study on ethnoecology. Prisma 1 (26): 51-72, Jakarta. [Indonesian]

Aulia TOS, Arya HD.2010.Local Wisdom in Water Sources Management in Kuta Village. Sodality J Socio, Com Human Ecol 4 (3): 345-355.

Chaturvedi M, Sharma C, Chaturvedi M. Effects of Pesticides on Human Beings and Farm Animals: A Case Study. Res J Chem Environ Sci 1 (3): 14-19.

Hakim N, Murtilaksono K, Rusdiana. O. 2016. Land Utilization Conflict in Halimun Mountain National Forest. Sodality J Village Socio 4 (2): 128-138. DOI: 10.22500/sodality.v4i2.13377.

Halim F. 2014. Effect of Relationship Between Flood and Land Utilization Management in Manglayang Watershed. J Sci Eng 4 (1): 45-54. [Indonesian]

Indonesia Government Law No. 82 (2001). Management of Water Quality and Management of Water Pollution. Indonesian Ministry of Environment, Jakarta

Iskandar J, Budiawati SI. 2011. Sundanese Agroecosystem. PT Kiblat Buku Utama, Bandung. [Indonesian]

Iskandar J. 2009. Human Ecology and Sustainable Development. Magister of Environment Program, Padjadjaran University. Bandung. [Indonesian]

Iskandar J. 2012. Ethnobiology and Sustainable Development. AIPI, Bandung. [Indonesian]

Iskandar J. 2014. Human and Environment with All Alteration. Graha Ilmu. Yogyakarta. [Indonesian]

Juliana R. 2014. Differences in Plankton Comunity Structure in Segara Anak Swamp Structure Area, Cilacap [Hon. Thesis]. Jendral Soedirman University. Purwokerto. [Indonesian]

Kutanegara PM. 2014. Human, Environment, and River: Transformation of Social Life of Community of Code River Bank. Ombak Publisher, Yogyakarta. [Indonesian]

Lynch F, Hoelnsteiner RM, Cover CL. 1974. Data Gathering by Social Survey. Philippine Social Science Council. Quezon City.

Odum EP. 1971. Fundamental Ecology: Third Edition. UGM Press. Yogyakarta. [Indonesian]

Pamuji A, Muskananfola MR, A'in C. 2015. Effect of Sediment Toward Macrozoobenthos Abundant in Bethawalang River Estuary. J Fish Sci Tech 10 (2): 129-135 [Indonesian]

Permana A. 2016. Number of Population, Geography, and Household of each Village in Cidaun. Local Government of Cianjur, Cianjur.

Putro SP. 2014. Macrozoobenthos Research Sampling Method and Application. Graha Ilmu. Yogyakarta

Reijntjes C, Haverkort B, Waters-Bayer A. 1992. Farming for the future: An introduction to Low-External-Input and Sustainable Agriculture. The MacMillan Press Ltd., London.

Rochgiyanti. 2011. River Function for People in Kuin Riverside, Banjarmasin City. Com J 5 (2): 229-237. [Indonesian]

Sari SW, Ruslan W, Bambang RW. 2014. Identification of Land of Sumbergunung Riverside Utilization in Batu City. Nat Source Environ J 1 (2): 25-30. [Indonesian]

Sillitoe P. 2002. Participant Observation to Participatory Development: Making Anthropology Work. In Sillitoe P, Bicker A, Pottier J (eds), Participating in Development: Approaches to Indigenous Knowledge. Routledge, London.

Sofia S, Fiqa AP. 2014. Kind of Plants Around Highland and Lowland Spring (Study Case in Malang City). LIPI. Pasuruan

Supriyono, E, Pong-Masak PR, Naiborhu PE. 2005. Study of Triclorofom Insecticide Toxicity Toward *Oreochromis* sp. Indonesian Aqua J 4 (2: 163-170. [Indonesian]. DOI: 10.19027/jai.4.163-171.

Susilo DA, Sarwoprasodjo S, Hubeis M, Ginting B. 2016. Discussion of Water Resources Management in Indonesia (Study Case 2002-2015). Sodality: Sodality J Village Socio 4 (3): 217-223.

Taufik I. 2011. Pesticide Pollution to Fishery in Sukabumi-West Java. Aquaculture Media 6 (1): 69-75. [Indonesian]. DOI: 10.15578/ma.6.1.2011.69-75.

Tilak KS, Veeraiah K, Raju JMP. 2007. Effects of Ammonia, Nitrite, and Nitrate on Hemoglobin Content and Oxygen Consumption of Freshwater Fish, *Cyprinus carpio* (Linnaeus). J Environ Biol 28 (1): 45-47.

Ulfah M, Rahayu P, Dewi LR. 2015. Local Plants' Morphology as A Potential Water Storage: Water conservation in Karangmanggis, Boja, Kendal, Central Java. Proceeding of National Conference of People Indonesian Biodiversitas 1 (3): 418-422. [Indonesian]

Wahid A. 2009. Analyzing Factors Influence Mamasa River Debit. SMARTek J 7 (3): 204-218.

Yuliana E, Adiwilaga M, Harris E, Pratiwi NTM. 2012. Relationship Between Phytoplankton Abundance and Physical-Chemical Parameters in Jakarta Bay. Akuatika 3 (2): 169-179. [Indonesian].

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The contribution of modified taungya system to forest cover and livelihoods of forest-fringe communities: A case study of Worobong South Forest Reserve in Ghana

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Abstract. *Ebenezer A, Ameka GK, Annang TY. 2018. The contribution of modified taunga system to forest cover and livelihoods of forest-fringe communities: a case study of Worobong South Forest Reserve in Ghana. Asian J Ethnobiol 1: 15-30.* The purpose of this study was to consider the function of the MTS in assisting forest recovery and in ameliorating the subsistence of peasants within the Worobong South Forest Reserve (WSFR, Akim portion). Geographic Information System (GIS) and Remote Sensing (RS) were utilized to examine the expanse of forest canopy decrease from 1990-2010. The analysis of the involvement of the MTS strategy on forest canopy recovery was also performed by analogizing the natural forest to the MTS plantation by utilizing the 100 m x 100 m square transect techniques and using the Simpson's Index of Diversity. A socio-economic survey including semi-structured interviews was performed to find out the thinking of the MTS peasants in the Akwansrem, Feyiase, and Miaso communities and forestry officials on forest recovery and the contribution of the MTS to livelihoods of peasants in the study area. The study results showed that the forest canopy in the WSFR had experienced various alterations and/or enhancements, particularly in the closed forest canopy. The jungle canopy declined by 0.41% and 0.17% in 1990-2000 and 2000-2010, respectively. Nevertheless, a principal alteration was examined within the closed canopy in terms of forest vegetation categories. Between 1990-2000, the closed canopy underwent a decline of 45.55%, but it had an increase of 1.25% (41.4 ha) in 2000-2010. It was expected that there would be a further enhancement in the closed canopy in 2010-2020 if the current recovery rate continues to grow. The Simpson's Index of Diversity showed that the natural forest transect was more diverse (1-D = 0.93) in terms of variety and distribution than the MTS transect (1-D = 0.41). And, stem number was nearly 50% higher than that of the MTS plantation. The research results showed that around 600 to 800 trees were planted by individual peasants annually on 0.8 ha of downgraded lands. The enhancement of closed forest canopy within WSFR was ascribed to the success of the MTS strategy. The results also signified that the subsistence of MTS peasants (concerning their access to livelihoods and farm products and their ability to bear the expense of their children's education and to construct buildings) had raised. Still, fear of future expectations and continuity of the MTS, unbalanced distribution of MTS farms, wildfires, and illegal logging were several affairs considered impending to the strategy. As a result, several suggestions have emerged. Some of these were: routine evaluation of the contexture and spatial degree of the forest cover to keep track of alterations with the application of GIS and RS; The requirement to explain the directives and advantages of the MTS strategy to farming societies and; the implementation of laws to fulfill the policies that will guarantee continuous management of the forest.

Keywords: Forest cover, Ghana, livelihoods, taungya system

INTRODUCTION

Forests are avowed to have several roles at international, regional, and local stages. They serve as a source of wood and non-wood products with economic value such as industrial wood, wood fuel, fiber, food, medicines, soil generation, soil and water conservation. Other services set up by woods are refining air and water, nutrient recycling, keeping biological diversity (habitats, species, and genetic resources), alleviation of climate alteration and carbon isolation, and protection for the vast majority of terrestrial biodiversity. The jungle accommodates occupation, livelihood, enjoyment, conservation, and natural and cultural heritage (World Bank 2005). Furthermore, the Food and Agriculture Organization (FAO 2001) approximates that 60 million local people live within forests and depend on them entirely. With some extent of dependency, much larger numbers live on the fringes of forests; thus, people's reliance on trees and jungle is infinite. The World Bank also informed that around 1.6 billion people in the world depend on forest founts for their living (World Bank 2001), and 86% of rural people (2.6 billion) are taking part in agriculture (including forestry) to bring about food and cash (Crowley 2010).

Nevertheless, the denudation rate is rising globally caused by the alteration of forests by farming labors involving commercial farms and swidden agriculture, logging, fuelwood collection, grazing, and increasing urbanization and industrialization. About 80% of the world's forest regions declined intensely over the past three decades leading to the decrease of the earth's capability to absorb carbon dioxide (UNEP 2000). According to the United Nations Food and Agricultural Organization, about 30% of the forest region vanished in 1990 and 2005 alone

(FAO 2006). This situation has contributed to the deliverance of high levels of greenhouse gases into the atmosphere because trees are cut down (World Bank 2010).

Forest founts in Ghana's forest regions have vanished at a worrying number. Ghana lost roughly 80% (8 m ha - 1.6 m ha) of its forest canopy in 1900 and 1990, influencing the biodiversity and essential sources of subsistence for the bucolic populations (Ghana Forestry Commission 2002; Opoku 2006). The Ghana Forestry Commission (2002) further informed that some forest conservations such as Pamu Berekum in the Brong Ahafo Region had lost over 98% of its forested cover within the same period.

According to Opoku (2006), the role of forest-fringe societies in the vast devastation of the forest has brought to visualizing the forest as an "economic, social and human rights‟ decomposition." Therefore, reforestation and plantation arrangements are becoming more and more significant to replenish the disafforested and downgraded natural forests. The Forest and Wildlife Policy, set up in Ghana in 1994, underlines the significance of collaborative forestry management (CFM) and community-based natural resource management (CBNRM). These have acted as a catalyst in familiarizing numerous arrangements to rectify people's entryway to forest and tree founts. Additionally, attempts have been built to preserve the remaining forests by establishing forest sanctuaries, resulting in two management arrangements for Ghana's forests: forest reserves and off reserves (IUCN 1996).

Reforestation and plantation arrangements in the downgraded areas of the forest reserves comprise the Modified Taungya System (MTS), while private timber tree plantations are remarkable in the off-reserve regions. All these arrangements are under the National Forest Plantation Development Programme (NFPDP) umbrella, launched in 2001. The 1994 forest and wildlife policy aim at "conservation and sustainable development of the nation‟ forest and wildlife founts for the conservation of environmental quality and the perpetual flow of optimum benefits to all segments of society" (MLF 1996). This was followed by the re-launch of the NFPDP in 2001. To stimulate the participation of peasants in the program to restore lost forest (FPDC 2002), enhance food security, and ultimately reduce poverty become the aims of the NFPDP (Ghana Forestry Commission 2004). The Traditional Taungya System (TTS) is modified to be MTS adopted for implementing the NFPDP.

Producing commercial timber and food crops and inter-planting crops and trees become the aim of the TTS. 35,000 ha of forest plantations were developed in 2000 through the TTS (Agyeman et al., 2003). Yet, records at the Forest Service Division (FSD) showed the confirmation of mixed successes. The problems of species-site-matching, inadequate expertise, and supervision were the significant challenges faced by the TTS arrangement. The farming in unauthorized forestlands and the devastation of tree seedlings were abuses of the TTS arrangement. In 1984, the TTS was adjourned (IUCN 1996). Despite the challenges and abuses, forest communities requested its re-introduction with changes because Taungya is viewed as a beneficial forest tenure system for restoring forest cover and improving peasants' wellbeing (FAO 2003). Therefore, the TTS was modified under the 1994 Forest and Wildlife Policy ratified by the Ministry of Lands and Forestry (MLF) and became the MTS (MLF,1996). To help achieve the NFPDP goals becomes the expectation of this. The NFPDP aims to encourage the development of a sustainable forest fount base that will satisfy future demand for industrial timber and enhance environmental quality. Also, the program is intended to create jobs and significantly raise food production in the country, thereby increasing wealth creation and lowering rural poverty (NFPDP 2008).

The study's objectives were: (i) To study the spatiotemporal alterations in forest cover and the contribution of the MTS scheme in forest cover recovery reestablishment within the WSFR over the last two decades (1990-2010). (ii) To discover the benefits of the MTS scheme to local peasants.

MATERIALS AND METHODS

Study area

Location, extent, and ownership

Worobong South Forest Reserve (WSFR, Akim Portion) is located in latitudes 6˚30'N and 6˚24' N and longitudes 0˚33' W and 0˚21' W. The Forest Reserve lies in the Eastern Region of Ghana within the Fanteakwa District Assembly with the headquarters at Begoro. The Forest Reserve forms part of the Forest Management Unit (FMU) 44. WSFR (Akim Portion) shares common boundaries with Southern Scarp Forest Reserve (Akim Portion) in the southwest and the WSFR (Kwahu portion) in the northeast. The WSFR (Akim Portion) covers an entire region of 10,935.00 ha (109.35) with a total perimeter of 71.72 km. The external boundaries are fixed with concrete pillars at approximately 800 m intervals. There are fifteen admitted farms in reserve covering a region of 233.14 ha (575.85 acres), with an internal perimeter of 30.69 km. The internal farm boundaries are marked by cut lines with wooden beacons at the corners except for the first corners where concrete pillars bearing the number of the farm have been erected. The Akwansrem village is wholly within the Reserve with an admitted village-land region of 91.31 ha (225.53 acres). The land cover map of WSFR (Akim Portion) is presented in Figure 1 (Forest Management Plan 2013).

Ownership of WSFR (Akim Portion) is vested in the Begoro stool, which owes its allegiance to the Omanhene of Akim Abuakwa. The Reserve was then publicized by the Forestry Department in 1928 and gazetted by Gold Coast Governor Order Number 17 of 1936 (Forest Order Sec 15 of Cap 63 of 1936) (Forest Management Plan 2013).

Physical environment

According to the Forest Management Plan (2013), the WSFR falls within the Moist Semi-Deciduous South East (MSSE) Sub Type vegetation region and the Tropical humid Climatic region. The average annual rainfall ranges between 1,250 mm and 1,500 mm. The mean maximum

temperature ranges between 27˚C and 35˚C while the minimum lies between 19˚C and 23˚C. The three-storied structure is in certain parts, though most forest conservation is two-storied, and the emergent trees are relatively close together. Hilly and rocky at most parts with 50% of the slope greater than 15˚ are the contours of the conservation area, but the rest of the region is relatively flat. The hilly regions have some steep slopes with contours varying between 1,840 m and 2,330 m above sea level, and these are laid in the central and southwestern part of the Conservation. The west end of the Forest Conservation overlies the upper and lower Birimian series rocks. The Voltaian Sandstones cover most parts of the remaining region. The soil color is reddish to brown, and the ground is mostly sandy loam with patches of clay. The Conservation is dissected by perennial streams such as Mia (at the western portion), Sutwum and Nubeso (at the southern portion), and the Worobong (at the northern part). The forest-fringe communities are Feyiase, Mianya, Ayigbetown, Miaso, Pillar 10, Asarekwao, Akwamu, Kotoku, Kumfere, Ankensu, Owusukrom, Esaase, Ahomahomasu, Kronkronso, Bisibuom, Pesiator, Akoradarko, Amokrom, Apaa, Opare, and Begoro. Akwansrem community is the only community situated in the conservation (Forest Management Plan 2013).

Stands diagnostic of the conservation

The total volume of timber in the WSFR is estimated at 3,359,888 $m^{3,}$ of which 1,158,235 m^3 (34.5%) is greater than 70 cm dbh and 2,201,653 m^3 (65.5%) is between 10-69.9 cm dbh. The total volume of economic timber species is estimated at 2,061,466 $m^{3,}$ of which 870,863 m^3 are greater than 70 cm dbh. Timber species average 188.5 (approximately 42.2%) consists of trees greater than 70 cm dbh, and 37.1 (approximately 19.7%) consists of trees greater than 110 cm dbh. The mean basal region for the Conservation is m^2/ha. Timber species account for 99 (58.9%) stems per ha, while all other species apart from timber constitute 69 (41.1%) stems per ha (Forest Management Plan 2013).

Stocking of species

A total of 210 species have been recorded in the Conservation, of which 59 are timber species (Forest Management Plan 2013). Timber species such as *Chrysophyllum subnudum, Triplochiton scleroxylon, Cylicodiscus gabunensis, Entandrophragma candollei, Piptadeniastrum africanus, and Turraenthus africanus* are well represented above 70 cm dbh (more than 40 stems per 100 ha) in the Conservation. Others such as *Albizia zygia, Celtis milbraedii, Celtis adolfi-friderici, Nesogordonia papaveriferii, Piptadeniastrum africanum, Chrysophyllum subnudum, Hannoa klaineana, Parkia, Sterculia rhinopetala, Guregion cedrata, Parkia bicolor, Petersianthus macrocarpus, Piptadeniastrum africanus, Turraenthus africanus, and Strombosia glaucescens* also have a satisfactory level of stocking. However, timber species such as *Anopyxis klaineana, Ceiba pentandra, Daniellia ogea, Dailium aubrevellei, Entandrophragma candollei, Holoptelea grandis, Morus mesozygia, Okoubaka aubrevillei, and Terminalia Superba* appear to have low stem distribution in the Conservation (Forest Management Plan 2013).

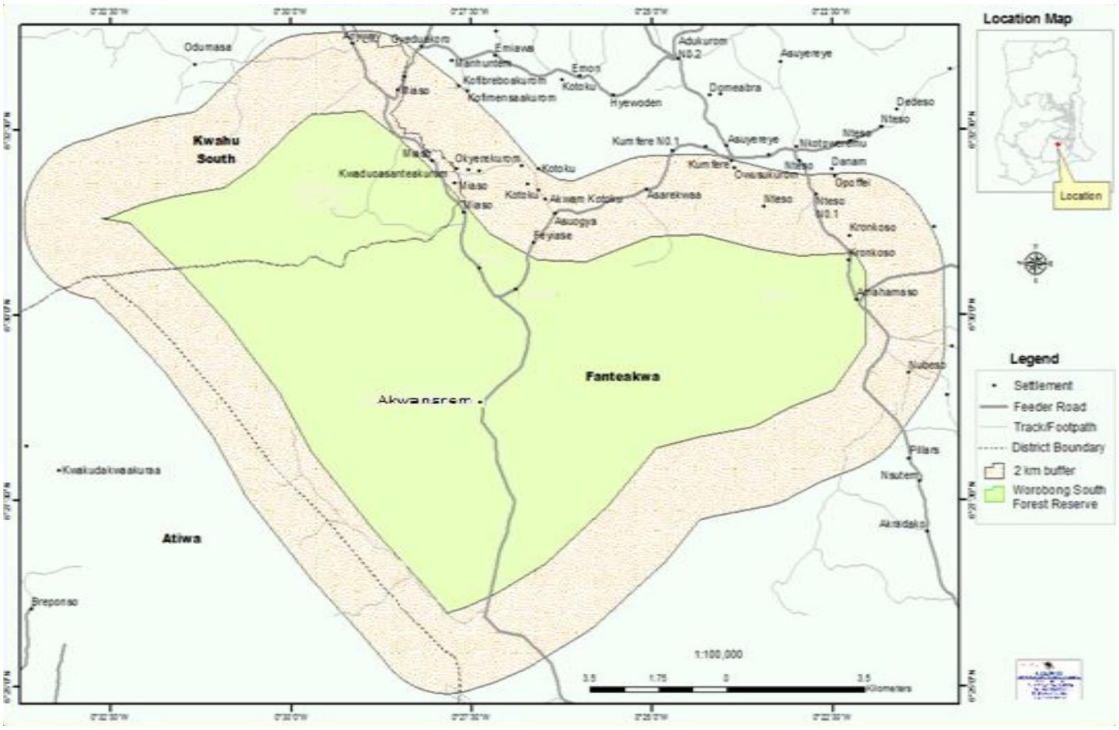


Figure 1. Map of Worobong South Forest Reserve (Akim Portion) with a 2 km buffer (CERSGIS 2013)

Socio-economic activities

The economy of the fringe-forest societies around the Forest Conservation is mainly agriculturally based. The populations are primarily peasants who mainly cultivate plantain, maize, cocoyam, yam, cocoa, oil palm, and vegetables like cabbage, tomato, garden eggs, okra, and pepper. The main non-agricultural activity is petty trading, and basket weaving is the cottage industry in the region. Wednesdays are observed as "*taboo days"* for visiting the conservation. There is an exclusion region in the Forest Conservation which serves as a sacred grove believed to be the abode of the wife of the fetish, Bosompra (Forest Management Plan 2013).

Methods

Desk study of literature

To understand legal access rights to forest founts, regulations on benefits in conservations and off conservations in Ghana, and the Benefit-sharing Agreement of MTS, a desk-study of relevant literature was performed. This information was gathered from a review of pertinent forest policies and acted, and the 2013 Worobong Forest Conservation Management Plan.

Forest cover change analysis

To ascertain temporal and spatial alterations in forest cover, at least two time-periods data sets are needed (Jenson 1986). This study utilized three-time interval data sets for 1990, 2000, and 2010 calendar years. The analysis was performed using optical satellite imagery to create a time series of images. A set of high-resolution multi-sensorial and multi-temporal satellites images from the Landsat (TM and ETM+) family of satellites were examined. Cloud-free scenes were acquired for 1990 (Landsat TM), 2000 (ETM+), and 2010 (Landsat ETM+) during the dry season. The Landsat TM and ETM+ images were geo-referenced using 1:50,000 topographic data sets from the Ghana Survey Department. The images were acquired from the Centre for Remote Sensing and Geographic Information Services (CERSGIS 2013) at the University of Ghana (Table 1).

Satellite imagery, processing, and classification

A particular method in establishing forest cover maps with satellite imagery requires explaining spectral classes by clustering the image data and assigning pixels into classes (CERSGIS 2013). The Interactive Self-Organizing Data Analysis Technique Approach (ISODATA) algorithm performed unsupervised classification with maximum iteration set at 99, convergence threshold at 0.9, and several classes set at 30. The threshold value of 0.9 and maximum iteration values of 99 were utilized to ascertain the exactness of the categories. Noise in the images was eliminated by passing a 3x3 majority filter over the resulting vegetation cover and land-use images. Ground truthing of the images was performed in the study region to ascertain the positional exactness of the images using a Global Position System. In relatively flat regions, correction for terrain displacement is not necessary (Boakye et al. 2008), but in the mountainous areas such as the WSFR, orthorectification was utilized to avoid overlapping images. The image processing software ERDAS IMAGINE 8.4 was used for the analysis.

A post-classification method was utilized to classify the images into forest cover/land-use types (Mas 1999). The most apparent method used in alteration detection studies is the post-classification method based on a comparative analysis of images acquired at different moments after independent classification. This method has the advantage of minimizing the problem of normalization for atmospheric and sensor differences between different dates (Singh 1989) since the images were from different sensors, taken on different dates by CERSGIS, and had been independently classified and labeled, the post-classification method to change detection was considered suitable for this study.

The classification image referencing was carried out to maintain the original Digital Number (DN) grayscale value during classification. All categories generated during the unsupervised classification process were converted into a binary image because the primary purpose was to detect temporal and spatial alteration in vegetation cover. Since 1960, the rasterized image of the WSFR of Ghana has not been regenerated. Thus, this image marked the forest boundary to remove misclassified pixels outside the forest boundaries. The alterations in recorded forest cover included the alteration from forest to non-forest for logging, bushfires, and tree crop plantation using ArcView 3.3 GIS software.

Specifically, the following processes were carried out:

Acquisition of raw satellite image. This is the first step in this procedure (Figure 2. A).

Rectification or geo-referencing the raw image to Ghana Projection System. That is assigning Ghana Coordinates to the image using 1:50000 Ghana Topographic data. Example: Roads and Settlements from Survey Department. Rectification means the method of protruding the data onto a plane and creating it cohere to a map projection system. To assign map coordinates to the data is geo-referencing. As all map projection systems are related to map coordinates, rectification involves geo-referencing (Figure 2. B).

Classification of images. Classification means the method of classifying pixels into a finite number of individual categories, or classes, of information based on their record values. If a pixel meets a particular set of criteria, the pixel is allotted to the category corresponding to the standards. There are two ways to classify pixels into different categories, namely:

Table 1. Characteristic of remote sensing imagery data

Image type	Sensor	Bands	Date of acquisition	Spatial resolution
Landsat	TM	453 (RGB)	08/02/1990	30 m
Landsat	ETM+	453 (RGB)	14/02/2000	30 m
Landsat	ETM+	453 (RGB)	01/02/2010	30 m

They are supervised and unsupervised. Supervised classification is more closely controlled by the user than unsupervised classification. During this method, we decide on pixels that represent patterns recognized or will ascertain with facilitating from different sources. Information on the data, the desired categories, and the formula to be utilized are needed before start choosing training samples. By determining patterns within the imagery, it'll be able to "train" the computer systems to spot pixels with similar characteristics. By setting priorities to those categories, it supervises the classification of pixels as they are appointed to a category value. At the same time, unsupervised classification is more computer-automated. It permits the specification of the computer's parameters as guidelines to expose statistical patterns within the knowledge. Initially, the Unsupervised Classification choice was chosen, and so the classified pictures were verified using Global Positioning System (GPS) for the aim of orientation within the field.

Recoding. The next step is recoding, namely, to assign a new category value number to all categories, making a new thematic raster layer utilizing the new category numbers. Some of the classes were combined through this method. After recording, the raster attribute table was exported as .dat. The exported file was processed in excel, and statistics for all the varied categories were generated. Once the scale of a pixel was found out (e.g., the Landsat 30mx30m = 900m), then the pixels per category were multiplied by 900 to gain the entire region in meters per category, and this was divided by 10,000 to acquire hectares, then finally was divided by 100 to achieve sq. kilometer (Figure 2. C).

Map composition. Several maps were finally drawn up exhibiting the alterations in the cover types, with statistics showing the alterations from 1990, 2000, and 2010.

Exactness assessment. Randomly chosen points per category were made at the Centre for Remote Sensing and Geographic Information Services (CERSGIS) office. Category sampling to verify exactness was as follows: closed forest fluvial vegetation (15), Open-forest fluvial vegetation (20), Dense shrub/herbaceous (20), etc. Within the closed forest, 13 was impenetrable forest fluvial while 2 was Open fluvial vegetation, and hence to calculate the exactness of the impenetrable forest fluvial vegetation, the formula was 13/15x100. This formula was applied to all the categories to acquire the matrix in Table 5.

Analysis of forest diversity of the natural forest and the Modified Taungya System (MTS) plantation

It is impossible to calculate each living and non-living thing in an ecosystem. Therefore, an excellent technique for locating what things exist in an ecosystem is by developing transects (NMSU 2013). A transect is an ecological tool helping to calculate the relative abundance of organisms in a region. Additionally, the NMSU (2013) depicts transect as an accounted region where sample population counts of plants and animals may be acquired. The accounted region needs to be wide enough to characterize the ecosystem's biotic and abiotic factors. To trace alterations from time to time, it is significant for the researchers to measure alterations in abundance (Philippoff and Cox 2013). Further, a line transect with a certain interval is used, which is simple to utilize in the field. Transect lines might be created from measuring tape or rope with a mark at periodic intervals. The dimension of the transect (whether a one-meter sq. or a 10-meter or perhaps a 100-meter square) is decided by the biotic factors within the region to be examined (NMSU 2013).

So, this study applied the 100 m x 100 m sq. transect method to form a comparative analysis of the natural forest and, therefore, the MTS plantation inside the WSFR. A preliminary survey was performed to pick the transect sites and applicable methods (Figure 3).

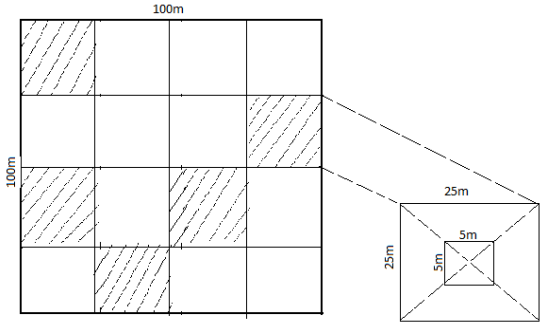
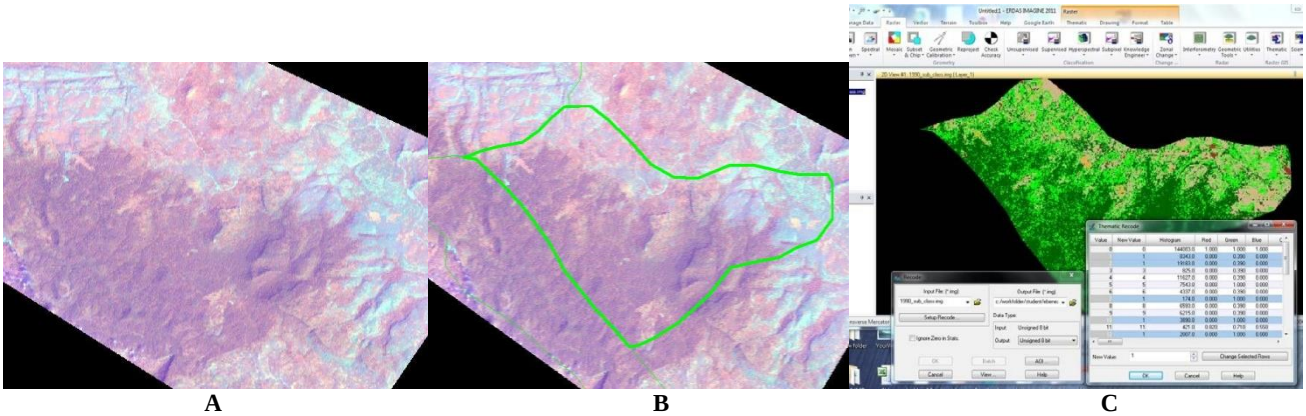


Figure 3. 100 m x100 m square transect



A **B** **C**

Figure 2. A. Acquisition of raw satellite image; B. Rectification or Geo-referencing the primary image to Ghana Projection System; C. Recoding

The 100 m x100 m square was calculated for both sites. Each site was split into 16 plots of 25 m x 25 m square. The calculations were performed with a measuring tape, tagged with a cutlass, and fixed with pegs. 5 plots were sampled separately and randomly for both sites. All trees ≥10 cm diameter at breast height (dbh) were calculated and recorded, registering unusual species. Then, within each sample (25 m x 25 m), a quadrant of 5 m x 5 m was measured with a tape measure and fixed with pegs and all tress species ≥1cm dbh was also calculated and recorded. The circumference of the tress was measured with a tape measure, and the dbh of tress was calculated by dividing the circumference of individual trees by = 3.14. Further, identifying all tree species was performed in the field. In contrast, those that could not be identified immediately were taken to the Herbarium at the Department of Botany, University of Ghana, for identification.

This method supplies the researcher with the tools required to answer his own ecological questions and develop comparisons among sites (Philippoff and Cox 2013). This experience led the researcher to a proper understanding of what made the WSFR what it was.

Simpson's Index of Diversity

The nature of this research needed that the stem numbers of trees in each transect should be counted. This was performed by calculating the number of trees. Meanwhile, species diversity (species richness, evenness, and relative abundance) was examined with Simpson's diversity index. In line with Powell (1982) and Brower and Zar (1984), Simpson's Diversity Index measures diversity. In ecology, it is often utilized to calculate the biodiversity of a habitat. It calculates the number of species present and the abundance of each species. Simpson's Index (D) measures the chance that two individuals randomly picked out from a sample may belong to the same species (or the same category other than species).

The formula for calculating D is

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

Where :

n = the total number of organisms of a particular species

N = the total number of organisms of all species

The grade of D ranges between 0 and 1. 0 describes the unlimited variety with this indicant, and 1 represents no diversity. It means that a higher grade of D indicates lower diversity. This is neither intuitive nor logical, so to fix this problem, D is often deducted from 1 to give: Simpson's Index number of Diversity (1-D) (Philippoff and Cox 2013).

The value of this index also ranges from 0 to 1, but now, a greater grade shows a greater diversity of the sample distribution. This makes more sense. In this case, the index shows the potential that two individuals randomly selected from a sample may belong to different species (Philippoff and Cox 2013).

Socio-economic interviews

Data on the MTS method, woodland cover alterations, and socio-economic parameters were assigned via examination and interviews with Authorities of the District Forestry Department in charge of the WSFR (Akim Portion), MTS farmers, as well as key informants. Three forest-fringed societies out of 7 were picked out. The societies were Akwansrem (the only community within the conservation), Feyiase (situated in the north-eastern fringe), and Miaso (positioned in the North-western boundary). These selected societies were purposively picked out so that they will match in with the scope and region of the bigger studies. These societies had additionally been actively engaged in the Modified Taungya System since its establishment in Ghana in 2002.

This study utilized purposive sampling and simple random sampling strategies. The purposive sampling was used to pick out a class of peasants, i.e., MTS peasants. Then, within the purposive selection of only MTS peasants, respondents were selected randomly, relying on availability as properly as the willingness to participate. A total sample of 85 respondents was obtained within the limitations of time and different sources. This consisted of 31 MTS peasants in Akwansrem, 25 MTS peasants in Miaso, and 24 MTS peasants in Feyiase. Therefore, 80 MTS peasants that represented 42.5% of the goal population were interviewed. Additionally, semi-structured interview questionnaires were directed to 3 MTS heads (one from every community sampled), the forest officer in charge of the MTS, and the woodland supervisor of the WSFR (Akim component). Information from these sources served as a perfect tool for balancing the collected data and also the base for the study so that it was no longer entirely on MTS peasants' perceptions. Again, it supplied a reasonable opportunity for the researcher to explain components of the MTS, which are neither usually explicitly defined nor understood.

In each society, a pilot survey including a meeting with the community's chiefs was performed, and the studies' goal was defined. The age, gender, and educational degree of respondents, and other factors probable to steer the scope of data to be acquired were contemplated in the management of the questionnaire. Before administering the questionnaires, the study's goal was thoroughly defined to the respondents with the intention to inspire participation.

RESULTS AND DISCUSSION

Demographic characteristics of respondents

A sum of 80 questionnaires was managed to MTS agriculturists. 69 males constituting 86.25% and 11 females constituting to 13.75% were interviewed. The academic level of respondents demonstrated a high rate of semi-literates. Approximately 8.8% of the respondents had no past formal education, whereas 59 constituting about 73.8% of them have had primary/Junior High School/middle school education. About 65% of the respondents were married, 5% were widowed, 6.3% were divorced/separated, and 21.3% were single. Table 2 shows other subtle elements. In the meantime, the age groups and occupations of respondents are displayed in Table 3 and Figure 4.

Table 3 presents the age groups of respondents. The majority (42.5%) of the respondents were within the 40-54 age group. This was followed by the 25-39 age group while only about 6.3% of respondents were below 25 years. Figure 4 shows Respondents' employment (or Alternative Livelihood) other than the MTS. Most of the respondents were peasants engaged in various activities such as cocoa farming, foodstuff farming, fruits and vegetable farming, Poultry farming, and goat raising. Moreover, some few respondents engaged in trading while a few others were into Carpentry, chainsaw operation, and masonry.

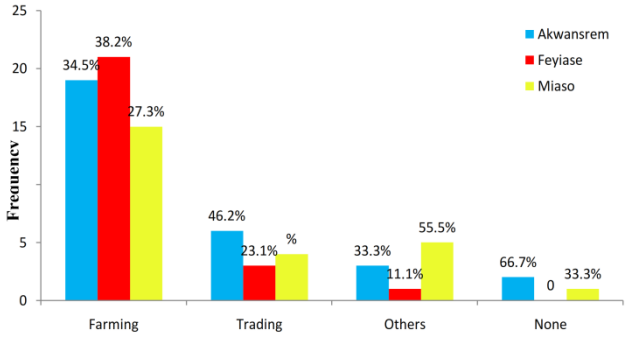


Figure 4. Employment (or alternative livelihood) of respondents other than the MTS

Forest cover change analysis

The provisional analysis in woodland cover alterations exposes two different trends in the WSFR: the period of serious woodland cover loss between 1990 and 2000 followed by the period of decreased woodland cover loss between 2000 and 2010. The region rough calculations showed that during the first period (1990-2000) a total loss of 46.17 ha (0.46 km^2) constituting 0.41% of woodland cover loss while a total of 20.34 ha (0.20) constituting 0.17% of woodland cover loss in 2000 and 2010 (Table 4).

In addition to the above analysis, the forest cover alteration with regard to the various vegetation cover types was also examined. The exactness evaluation shown in Table 5 exposes an overall exactness of 82.93%.

The forest cover alteration with respect to the different vegetation cover types was useful in noticing specific regions of denudation, regeneration and the contribution of plantation development. Table 6 reveals the region in km^2 occupied by a class.

The region evaluation exposed that vast denudation happened during the first decade (1990-2000). Table 6 expressed that a total region of 2764.89 ha (27.65 km^2) of closed-canopy forest was lost during the period 1990-2000. Figure 5 also expresses that there was some form of vegetation cover type alteration from closed canopy forest to open canopy forest from 1900 to 2000. For example, while the region of closed canopy forest declined from 60.70 km^2 to 33.06 km^2, the open canopy forest rose during the same period from 30.31 km^2 to 42.17 km^2. The most remarkable alteration in forest cover during the first decade was examined within the closed canopy forest, which underwent a percentage decline of as much as 45.547%.

Table 2. Demographic characteristics of respondents

		Akwansrem (N=31)	Feyiase (N=24)	Miaso (N=25)	Total
Gender	Male	25	23	21	69
	Female	6	1	4	11
Educational level	Primary	24	15	20	59
	Secondary	3	5	2	10
	Tertiary	0	3	1	4
	None	4	1	2	7
Marital status	Married	20	15	19	52
	Single	5	8	4	17
	Widowed	2	0	2	4
	Divorced/ Separated	4	1	0	5

Table 3. Age of respondents

Age group	Akwansrem (n=31)	Feyiase (n=24)	Miaso (n=25)	Total
Below 25	2	0	3	5
25-39	9	6	10	25
40-54	15	11	8	34
55 and above	5	7	4	16

Table 4. Provisional alterations in forest cover within the WSFR

Period	Forest cover change (ha)	% change in forest cover	% average annual rates of forest cover change
1990-2000	-46.17	-0.41	-0.03
2000-2010	-20.34	-0.17	-0.01

Table 5. Exactness Evaluation Table based on Error Matrix of the pixel-based method

Class	Closed riverine vegetation	Open riverine vegetation	Dense shrub/ herbaceous	Grass/ herbaceous	Bult up/ bare regions	Sum
Closed forest/ riverine vegetation	13	2	0	0	0	15
Open forest riverine vegetation	2	16	1	1	0	20
Dense shrub/herbaceous	0	1	17	2	0	20
Grass/herbaceous	0	1	1	15	3	20
Bare/built-up region	0	0	1	2	22	25
Sum	15	20	20	20	25	100
Exactness	86.67%	80.00%	85.00%	75.00%	88.00%	

Note: Overall Exactness = 82.93%

Table 6. Matrix of land cover by class values for the years 1990, 2000 and 2010

Class value	1990 (km^2)	%	2000 (km^2)	%	2010 (km^2)	%
Closed forest riverine vegetation	60.70	53.09	33.06	28.91	33.47	29.27
Open forest riverine vegetation	30.31	26.51	42.17	36.878	42.56	37.22
Dense shrub/ herbaceous	22.28	19.48	33.87	29.62	32.97	28.83
Grass/ herbaceous	0.65	0.57	4.39	3.84	4.28	3.74
Bare surface/ built up region	0.41	0.35	0.87	0.76	1.07	0.94
Total	114.35	100	114.35	100	114.35	100

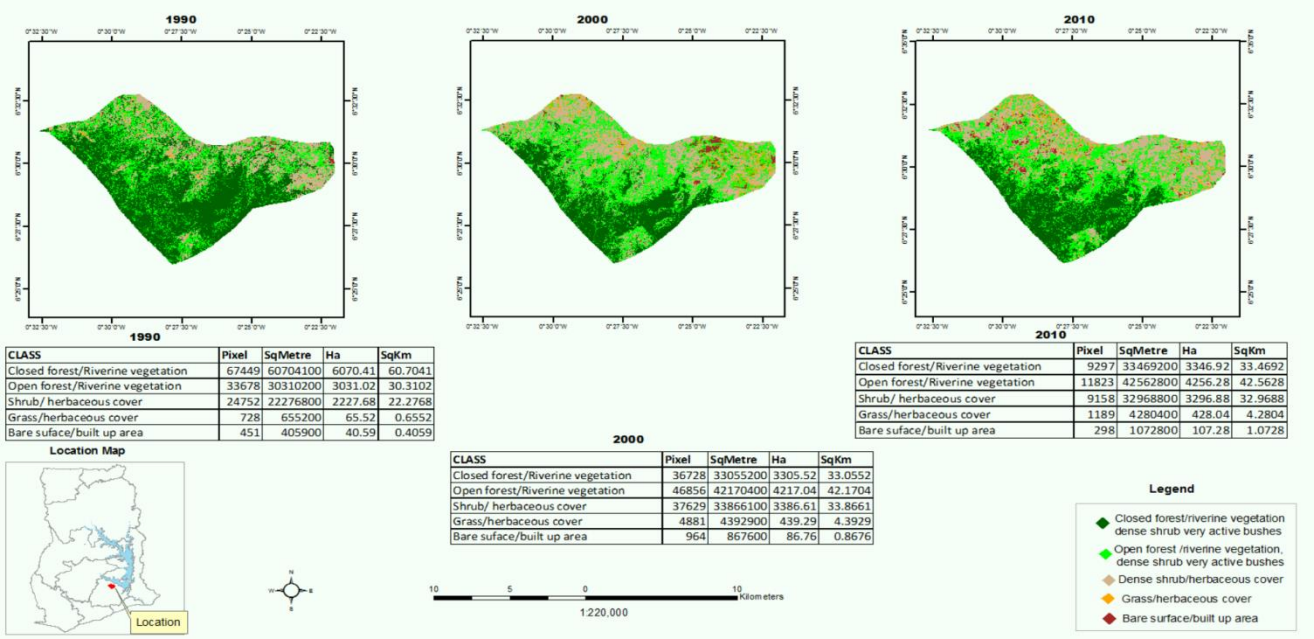


Figure 5. Classified Satellite Image Maps of Worobong South Forest Reserve (1990, 2000 and 2010) (CERSGIS, 2013)

The second decade (2000-2010) recorded a remarkable alteration in provisional patterns of alteration in the regions of both closed and open-canopy forests. Analysis of forest cover for the 2000-2010 period disclosed that the closed forest canopy underwent a region raise of 41.4 ha representing 1.252% of region regenerated. There was also a raise in the region of open canopy from 42.17- 42.56 km^2 between 1990-2000 and 2000-2010 respectively. Nevertheless, the raise during the second period was far smaller (0.93% alteration) than within the first period (39.13% alteration) and the most remarkable forest cover type alteration from the 1900-2000 levels was evaluated in the closed canopy cover.

Visual analysis of the scheme of forest cover alteration among the various time intervals was also performed by looking at the spatial variation in forest cover. Figure 5 expresses three different forest vegetation cover maps and their variation in spatial distribution that was produced. From 1990 to 2000, much of the denudation happened from the northern fringes/portions expanding into the center of the conservation. The intensity of denudation was based in the north-eastern corner near the border of the Worobong South Forest Conservations (Kwahu portion) within the Kwahu South District. There was alteration of the thick closed forest canopy mostly into open forest canopy and to some extent herbaceous cover of grass or shrub. There were also huge patches of bare/built-up regions mustered in the north-eastern portions and fringes of the conservation.

During the period 2000-2010, forest cover loss still mustered within the northern portions of the conservation but with decreased patches of herbaceous cover of grass or shrub. There was a raise in the bare/built-up regions now with smaller patches but mustered within the northwestern portions and fringes of the conservation. However, there was a remarkable development of closed forest canopy especially within the center of the conservation. It could also be noticed that some of the open forest canopies have altered into closed canopy forests. It is projected that between 2010-2020, there will be further development in the closed-canopy forest raising forest cover in the conservation.

The Modified Taungya System (MTS) and forest cover recovery reestablishment

This section expresses the outcomes from the 100 m x 100 m square transect and people's perception of the

contribution of the MTS on forest cover development/ recovery.

Results from the 100 m x 100 m square transect

Table 7-10 indicate diversity of plants in the sampling plots.

Simpson's Index of Diversity

Results after the estimation of the Simpson's Index (D) and the Simpson's Index of Diversity (1-D) are as Table 11.

Table 7. Natural Forest Samples (25 m x 25 m) ≥10 cm dbh

Species	Sample					
	1	2	3	4	5	Total
Albizia zygia	3	0	2	0	3	8
Triplochiton scleroxylon	2	0	0	3	3	8
Pitherdeniastrum africanus	4	1	3	5	0	13
Nesogordonia paparifera	5	4	5	4	7	25
Maesobotrya barteri	2	0	0	0	0	2
Oxyanthus speciosus	1	0	0	0	0	1
Cola gigantea	1	0	0	0	0	1
Bathia nitida	3	0	0	0	0	3
Rothmannia longiflora	2	0	0	0	0	2
Terminalia superba	1	0	0	2	2	5
Milicia excelsa	1	0	0	0	0	1
Monodora ternifolia	1	0	0	0	0	1
Carapa procera	2	3	0	0	2	7
Turraenthus africanus	2	2	1	0	3	8
Celtis adolfi-fridericii	3	4	0	4	0	11
Parkia sterculia	1	4	1	0	2	8
Bridelia microphylla	0	2	0	0	0	2
Terminalia ivorensis	0	2	1	0	0	3
Ficus exasperata	0	1	0	0	4	5
Rauvolfia vomitoria	0	1	0	0	0	1
Celtis milbraedii	0	2	4	5	0	11
Entandrophragma angolense	0	0	1	0	0	1
Strombosia glaucescens	0	0	3	0	2	5
Clanitha sp.	0	0	1	0	0	1
Erythrina senegalensis	0	0	2	0	0	2
Ceiba pentandra	0	0	0	2	0	2
Entandrophragma candollei	0	0	0	3	0	3
Total	34	26	24	28	28	140

Table 8. MTS Plantation Samples (25 m x 25 m) ≥10 cm dbh

Species	Sample					
	1	2	3	4	5	Total
Cedrella sp.	39	48	38	33	35	193
Albizia zygia	3	3	1	2	0	9
Nesogordonia paparifera	4	3	0	2	2	11
Celtis milbraedii	2	0	1	1	2	6
Ficus exasperata	2	1	0	0	0	3
Triplochiton scleroxylon	2	0	0	1	1	4
Ceiba pentandra	0	3	0	0	0	3
Ficus sur	0	1	0	0	0	1
Terminalia superba	0	2	3	1	0	6
Piptadeniastrum africanum	0	0	3	4	2	9
Ricimodendrum sp.	0	0	1	0	0	1
Bombax blancoanum	0	0	1	0	0	1
Terminalia ivorensis	0	0	0	2	0	2
Albizia adianthifolia	0	0	0	0	1	1
Bathia nitida	0	0	0	0	1	1
Total	52	61	48	46	44	251

Table 9. Natural Forest Samples (5 m x 5 m) ≥ 1 cm dbh

Species	Sample					
	1	2	3	4	5	Total
Uapaca togoensis	2	0	0	0	0	2
Bathia nitida	6	15	13	6	8	48
Pentaclethra macrophylla	15	10	0	0	7	32
Turraenthus africanus	2	2	0	3	0	7
Xanthoxylum gilletii	1	0	0	0	4	5
Pitherdeniastrum africanus	2	0	0	0	0	2
Nesogordonia paparifera	1	0	0	0	3	4
Cedrella sp.	0	1	0	3	0	4
Oxyanthus speciosus	0	2	1	0	0	3
Microdesmis puberula	0	3	5	0	0	8
Tabernaemontana crassa	0	1	0	0	0	1
Maesobotrya barteri	0	2	0	0	0	2
Napoleonaea vogelii	0	1	0	0	0	1
Carapa procera	0	2	0	0	0	2
Heisteria sp.	0	0	4	3	0	7
Connaraceae sp.	0	0	3	0	0	3
Albizia zygia	0	0	1	7	0	8
Celtis milbraedii	0	0	4	5	0	9
Ficus exasperata	0	0	0	0	3	3
Cola milleni	0	0	0	4	4	8
Parkia bicolor	0	0	0	4	0	4
Total	29	39	31	35	29	163

Table 10. MTS plantation samples (5 m x 5 m) ≥ 1 cm dbh

	Sample					
Species	**1**	**2**	**3**	**4**	**5**	**Total**
Cedrella sp.	5	5	6	4	5	25
Cola millenii	11	4	0	18	15	48
Bathia nitida	5	6	0	0	7	18
Triplochiton scleroxylon	3	0	3	6	0	12
Terminalia superba	3	0	1	1	0	5
Terminalia ivorensis	0	4	3	0	0	7
Pentaclethra macrophylla	0	5	0	0	4	9
Ficus exasperata	0	1	0	0	0	1
Microdesmis puberula	0	0	2	0	0	2
Celtis milbraedii	0	0	0	1	0	1
Petersianthus macrocarpus	0	0	0	0	5	5
Total	27	25	15	30	36	133

Table 11. Results of the Simpson's Index of diversity

Transect	D	1-D
Natural Forest (25 m x 25 m)	0.068	0.93
MTS Plantation (25 m x 25 m)	0.595	0.41
Natural Forest (5 m x 5 m)	0.138	0.86
MTS Plantation (5 m x 5 m)	0.196	0.80

Table 12. Respondents' view on the contribution of the MTS to forest cover recovery reestablishment

Response	Akwansrem	Feyiase	Miaso	Total
Yes	22	19	20	61
No	5	4	4	13
N/A	4	1	1	6

The result from Simpson's Index of diversity (Table 11) showed that the natural forest is more varied in terms of species copiousness and evenness/relative richness than the MTS plantation. For the 25 m x25 m samples, Diversity values (1-D) of 0.93 and 0.41 were recorded for the natural forest transect and the MTS plot respectively. Although, stem calculation for the later was higher than the former, copiousness (number of individual tree species) and evenness (relative richness) was relatively higher for the former. This is evidenced by comparing Tables 7, 8, 9 and 10. For instance, by comparing the number of species in Table 7 with that in Table 8, the result shows that the natural forest recorded 8 tree species which was higher than the MTS plantation. Examples of tree species lacking in the MTS plantation comprise *Monodora ternifolia, Carapa procera, Turraenthus africanus, Celtis adolfi-friderici, and Parkia sterculia.* The most abundant tree species in the natural forest sample was *Pitherdeniastrum africanus* (13).

Equivalently, by comparing the 5 m x 5 m samples (Tables 9 and 10), it showed that the natural forest recorded more tree species (24) which was higher than the MTS plantation (14). Yet, the most abundant tree species for the natural forest was *Bathia nitida* followed by *Pentaclethra macrophylla*, while for the MTS plantation it was *Cola millenii* followed by *Cedrella sp.* and *Bathia nitida.* Furthermore, the average number of trees per sampled plot was counted by dividing the total number of stems for each community by the number of samples. Tables 7 and 8 show the number of stems per plot sampled within the 25 m x 25 m transect squares, the average number of trees per sampled MTS plot was 50 while that of the natural forest was 28.

Views from peasants concerning the Modified Taungya System and forest cover recovery reestablishment

To calculate if the MTS has had contribution to forest cover recovery reestablishment, respondents were asked to answer yes or no. Table 12 shows their responses.

Most of the respondents (76.3%) noted that the MTS has had contribution to forest cover recovery reestablishment while a few others have responded otherwise, and the others were not sure. However, interview with the MTS heads confirmed that the MTS has really contributed to forest cover recovery reestablishment in the WSFR. Both respondents and MTS leaders in all communities agreed that about 600-800 trees were grown every year.

Plot allocation and responsibilities of farmers under the Modified Taungya System

Farmers were questioned if they took part in MTS as individuals or as a group. If the peasants were a member of a group, they were questioned if they had routine interactions with supporting institutions, in order to try and to get an idea of the involvement of the peasants in the implementation process and to find out the manner in which information was communicated to them and by them. The result signified that there was a Community MTS Committee in all three communities who relay information to the peasants. The setting up of these committees is part of the plans put in place in order to give the community a voice and an arena of discussion and to make sure the compliance of all actors engaged in the MTS scheme. The committee is set up of those members of the society who are picked out after putting themselves forward and is headed by representatives from the Forest Services Division (FSD). It is the committees that allocate the downgraded lands to peasants. They also monitor the performance of peasants and FSD as well as resolve frictions and help implementation of sanctions if necessary.

Most peasants had been engaged in the MTS since its inception in 2002. Plots had been allocated annually, except for 2009 in Akwansrem and 2012 in Feyiase. Most peasants reported having being allocated plots roughly equivalent to half to an acre, each year that land was allocated. For some peasants, the precise measurement was quite difficult to tell, since different local peasants utilized different means of measuring. What became clear however was that the chiefs of the Modified Taungya Committee in all villages had been allocated substantially more land (about two or three acres, each year of allocation) than other members of the committee.

Farmers were also questioned about roles in the MTS with the view that knowledge and full understanding of their roles is remarkable in order for all the peasants to effectively contribute to the scheme's success. From the study, all respondents were keen to state that they needed to plant and then take care of the tree species and the crops. Some mentioned the need to weed and the need to maintain the trees and to replace seedlings if there is mortality, others mentioned the responsibility in the dry season is to protect the trees from fire. There was an overwhelming feeling of the importance of generally keeping an eye on the trees, be it in the instance of fire, chainsaw operation, theft or encroachment.

Tree species and agricultural crops cultivated under the Modified Taungya System

Information gathered from respondents including MTS heads and Forest Authorities signified that the tree species peasants planted depended on what seedlings were available to them. According to the MTS peasants, this somewhat restricted their choices. This is because peasants were interested in planting fast-growing species like Teak, *Cedrella,* and Ofram (*Terminalia superba). Cedrella sp*. was the most commonly grown species by peasants (87%). However, 12% of peasants in Feyiase reported planting indigenous Wawa *(Triplochiton scleroxylon),* while 15% of peasants in Miaso planted slow-growing mahogany (*Khaya grandifoliola).*

Furthermore, the products harvested from the land in-between the tree seedlings were taken into consideration. It was identified that almost all of the staples of the Ghanaian diet were grown. All MTS peasants planted plantain. Other crops included maize (47.5%), cocoyam (41.3%) and vegetables (55%). The vegetables included garden eggs, onions, tomatoes, peppers, okra, etc. However, cassava was not allowed at the initial stages of planting and was only allowed when the tree seedlings had rooted sufficiently (Table 13).

Motivation for participating in the MTS

Table 14 shows the reason given by peasants for participating in the MTS program. Out of the reasons listed, access to farmlands, increased access to food crops and improved livelihoods were identified from all three communities as the main interests for participating in the MTS. However, apprehension for the environment and livelihoods seem to be of less interest to the respondents.

Standard of living and livelihood benefits from the MTS

The Farmers were questioned about how the MTS is contributing to their livelihoods. Of the respondents in Akwansrem, 63.3% saw the MTS plot as a reliable source of livelihoods, hence a major livelihoods option, whereas 36.6% saw it as a safety net. In Feyiase, 54% saw it as a reliable source of livelihoods while 44% saw it as a safety net. In Miaso 60.0% and 36% saw it as a reliable source of livelihoods and a safety net respectively (Table 15).

Farmers who sold their farm products were questioned to state the average livelihoods they have been livelihood from their MTS farm plots. The average livelihoods per season were as follows (Table 16). This table showed that most peasants who sold their farm produce earn between GH¢ 500- GH¢ 1,000 every season. However, some peasants earned above GH¢ 1,000. In order to try to establish any alterations in their standard of living, peasants were questioned to describe their ease of getting the following: farm produce, children's education, putting up a building, household's daily care and access to land for farming since the introduction of MTS. In all three communities, majority of peasants reported that it was now easier to access farm produce and land for farming. The percentage of peasants in Akwansrem reporting on their ability to afford children's education was much lower than that of Feyiase and Miaso. Approximately a third of peasants in Akwansrem and Feyiase reported putting up a building was easier. It was reported that the provision of the household's daily care was easier for the majority of the peasants. The peasants, who had not seen an improvement, reported that the level of ease to access the various options remained the same (Table 17).

At the current stage of MTS, it is clear that the MTS is affecting positively people's lives; the livelihoods generated from the agricultural crops are enabling peasants to achieve an increased standard of living.

The interview with the MTS chiefs showed that small-scale subsistence farming with crops like maize, cassava, cocoyam, and plantain is the main provider of livelihoods, along with NTFPs that can be harvested from the forest. They confirmed that they and the peasants can make a reasonable livelihood from the agricultural crops acquired from the MTS, since the crops belong to them and they gather all the revenue from their sale. On the occasions when they may have a surplus, they can sell products in the local markets. At other stages, the crops are utilized for livelihood, and hence form a non-cash component of their livelihoods. However, apprehensions were raised at the deficiency of diversity in the livelihood portfolios of the community, in that it is mainly dependent on crops and with the threats of land degradation and wildfire, it means that it is not a very secure option. The objective of the MTS scheme is not only to increase the livelihoods of the autochthonous rural population within the surroundings of the plantation sites but also to broaden the plantation sites in an economically and ecologically sound manner. By further interaction with peasants and MTS heads, it appeared to be difficult to achieve factual data on the extent to which the MTS contributed to people's livelihoods. Not just because of a deficiency of proper records, but moreover because so little is ever transformed into a physical monetary value (*i.e.*, much is pettily traded, or non-cash livelihoods).

Table 13. Crops cultivated under the MTS

Agricultural crop	Number of respondents			
	Akwansrem	Feyiase	Miaso	Total
Plantain	31	24	25	80
Maize	16	9	13	38
Cocoyam	10	13	10	33
Vegetables	17	12	15	44
Cassava	14	13	16	43

Table 14. Reasons for participating in the MTS

Reason	Number of respondents		
	Akwansrem (N=31)	Feyiase (N=24)	Miaso (N=25)
Access to farm land	24 (80%)	20 (80%)	21 (84%)
Access to food crops	21 (70%)	22 (88%)	18 (72%)
Income	3 (10%)	5 (20%)	2 (8%)
Apprehension for the environment	13 (43.3%)	5 (20%)	8 (32%)
Improved livelihood	23 (76.6%)	19 (76%)	20 (80%)

Table 15. The MTS as an alternative source of livelihoods

Contribution to income	Frequency		
	Akwansrem	Feyiase	Miaso
Reliable source of livelihoods	19	13	15
Safety net	11	11	9

Table 16. Average livelihoods from the sale of farm produce

Income (Cash in GHC)	Frequency		
	Akwansrem	Feyiase	Miaso
Below 500	6	5	2
500-1,000	5	8	6
1,000-1,500	3	2	4
1,500-2,000	2	1	1
2,000 and above	2	0	1

Table 17. Effects of MTS on household's ability to afford various livelihoods components.

Consequence/effect	Akwansrem	Feyiase	Miaso
Household's daily care	21	19	22
Access to farm produce	23	20	19
Children's education	8	13	15
Putting up a building	10	9	6

Farmers' perception of the benefit-sharing in the MTS Scheme

In general, peasants were satisfied that forty percent (40%) was a suitable amount for the peasant to receive but the method in which the revenue from the sale of the timber grown within the MTS will be shared was a remarkable consideration. This is because the agreement about the revenue division is not clear. Globally, peasants believed that the money from the sale of timber would be divided according to the amount of land or trees owned by the respective villagers. Most peasants (83%) suggested that the revenue should be divided up according to the width of cultivated land or the total of trees they had planted. Others had little idea and hoped the authorities would divide the money up fairly.

However, 53% of the respondents at Akwansrem, 67% at Feyiase, 48% at Miaso signified at present that there was no mechanism in place and that they were unaware of the operation of the mechanism and the division of the money. Majority (87%) of the respondents desired some sort of loan or part payment to maintain the farm and buy farm logistics. This is because peasants reported spending a lot of time in planting and conservation since they do not have money to hire laborers.

Results from the interview with the MTS chiefs about peasants' understanding of the MTS also disclosed similar views. MTS chiefs' understanding of the future of the MTS is uncertain. They signified that the confidence of the peasants in the MTS is impeded by a deficiency of clarity and certainty in the scheme and how the revenue will be divided up as promised. Without the release of funds for some years now, peasants' deficiency of capital to invest in planting, pegging, weeding, and conservation of the MTS. They also reported that deficiency of documentation signed and held by the communities in respect of the agreement had led to a feeling of insecurity.

Furthermore, there is a worry of fire, and there is a worry that if a peasant dies, the livelihoods due may not be put into the right hands. There is a general worry that illegal loggers may come and harvest the trees when they are mature enough and then the peasant would receive no money. There is also worry of devastation of the forests and therefore, the disturbance of the livelihoods provided by NTFPs. Delays in the allocation of the plots of land to be planted are sometimes realized as that there had been a tendency of seedlings to die or to be infested by insects. There is also the inevitable report of the inequitable distribution of the land by MTS chiefs, and some had to travel long distances in order to reach their plots. Forest officials reported the idea of thinning as a means for the peasant to generate livelihoods; once the trees are starting to grow themselves, some need to be cut down in order to permit adequate space and light for the others to grow.

Threats to the MTS

Farmers were questioned what they felt were particular menaces to the scheme, since menaces and fears affect participation. The result is summarized in Figure 7.

The result signified that most peasants (67.5%) were frightened of fire and its impact on the scheme's success. For the most part, it was a wildfire that people feared, but several peasants voiced apprehensions that deliberately starting fires was also a problem. It was noticed to some extent that envy existed between communities, particularly when one community is picked out to be engaged in a particular scheme while a neighboring village is not chosen. With regard to other fears or menaces to the scheme, 39 peasants raised apprehension at the prospect of illegal chainsaw lumber operations being performed in the MTS plots. Others raised apprehension that some peasants putting more effort into the MTS scheme than others could be a menace to the scheme as a result of weeds spreading from lazy peasants' plots. A number of peasants also signified that they neither had nor could afford the equipment, for example, proper rubber boots, cutlasses, and raincoats, which sometimes infringes upon their ability to be able to farm.

Sustainability of the MTS Scheme

Suggestions made by respondents showed that the scheme can be sustainable through the enactment and enforcement of laws, education, and clarity of the scheme and its benefits, percentage share of revenue periodically. However, most peasants noted that there should be some percentage payment of their benefits from the timber before harvesting time is due. Some peasants explained that this will help reduce bulk payment at the time of harvesting matured trees. All the MTS chiefs agreed with the peasants noting that the pre-harvest benefit from the timber would serve to attract and motivate peasants to continuously invest labor. Table 18 shows the suggestions made by the MTS peasants.

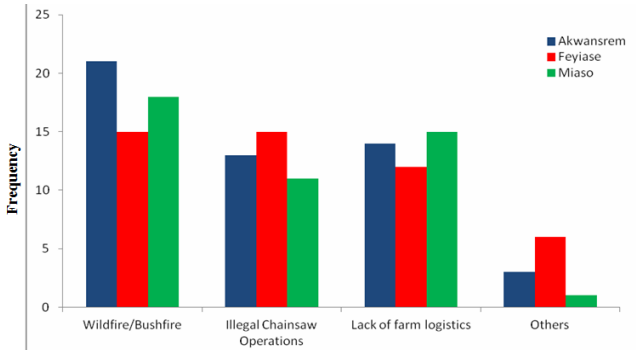


Figure 7. Threats to the MTS

Table 18. Suggestions on how to make the Modified Taungya System sustainable

Suggestions	Frequency			
	Akwansrem	Feyiase	Miaso	Total
Education	16	14	16	46
Enactment of laws	18	14	15	47
Periodic benefits from pre-harvested timber	20	15	18	53
Enforcement of laws	12	7	9	28
2,000 and above	2	0	1	

Discussion

Monitoring and assessing forest cover change of the WSFR

The researcher calculated the forest cover alteration of the WSFR from 1990 to 2010. Many studies have shown the alarming rate of forest cover loss in Ghana. According to Opoku (2006), forest cover loss between 1900 and 1990, was from 1.6 million ha to 8 million ha. Similar studies done elsewhere have signified that tropical forests are being cleared, burned, logged, fragmented and overhunted on scales that deficiency of historical precedent (Laurance and Bierre-gaard 1997). Again, satellite images of state-managed forest conservations taken in 1990 and 2000 reveal rapid denudation within most conservations (Ghana Forestry Commission 2002). The results of this study showed a similar situation between 1990 and 2000 (Figure 5).

However, the results of the forest cover alteration analysis showed different trends as well as variations in the rate of forest cover alteration between the decades considered. The forest region estimation showed that vast denudation happened during the first decade (1990-2000) resulting in a vegetation cover type alteration from closed-canopy forest to open canopy forest during 1900-2000. Similarly, a study performed by Ayivor (2007) in the Digya National Park signified a rapid alteration of the closed forest cover into open forest and grassland. The reason for the degradation within the closed canopy forest during the first decade (1990- 2000) could be that it was destroyed by illegal logging, increased agricultural activities and encroachment by human settlements as shown in this study.

The most remarkable forest cover type alteration for the second decade (2000-2010) was studied in the closed canopy cover. Thus, while there was a decline in forest cover during the first decade, there was, however, a remarkable increase in forest cover during the second decade (Table 4, Figure 5). The increase in region of closed forest canopy was more pronounced at the center of the conservation. It could also be noticed that some of the bare regions and open forest canopy had been changed into closed-canopy forests. Forest regeneration/recovery reestablishment studies have signified that forest vegetation recovery can usually be sped up by planting trees (Holl 2013) and that forest plantation, though generally intended for the production of timber, increases the total region of forest worldwide (Lund 2006). The region improvement within the closed forest canopy during the second decade (2000-2010) could, therefore, be attributed to success of the MTS projects in the WSFR.

The contribution of the MTS to forest cover recovery reestablishment

Reforestation is the primary goal of the NFPDP. Among the aims of establishing the 1994 Forest and Wildlife Policy was to ensure forest recovery reestablishment and sustainable utilization of forest founts (NFPDP 2003). Advancement made so far in forest cover within the WSFR can be said to be remarkable. For the 25 m x 25 m plot samples, Diversity values (1-D) of 0.93 and 0.40 were recorded for the natural forest transect and the MTS plot respectively. This signifies that multifariousness was higher within the natural forest. However, the average number of tree stems for the latter was 50 while that of the former was 28. Meanwhile, most peasants reported that between 600-800 trees are planted on 0.8 ha, annually. This means that downgraded regions within the conservation are being restored through the MTS Scheme. In a similar study done in the Offinso district in the Ashanti Region of Ghana, a total of 10,181 ha of downgraded forest lands were planted from 2002 to 2007; and this led to the recovery reestablishment of such lands. (Ghana Forestry Commission 2001).

According to Ghana Poverty Reduction Strategy (GPRS) Report, plantation cover was to broaden from the 2002 level of 20,000 ha to 60,000ha by end of 2008 (GPRS 2005). In 2004 alone, the GPRS showed a cumulative figure of 58,726 ha, thus exceeding the 2008 targets. The GIS and RS analysis in this study also showed that the second period (2000-2010) recorded a remarkable development of closed forest canopy, mostly from the alteration of the bare regions and open forest canopy to close canopy forest. According to Holl (2013), forest regeneration/recovery reestablishment studies done have signified that natural regeneration of downgraded forests may occur but at a very slow pace, biodiversity recovery can usually be quickened by planting some climax forest tree species, especially large-seeded, poorly dispersed species. It is not feasible to plant all the tree species that may have formerly grown in the original primary forest and it is usually unnecessary to do so (Holl 2013). In another study done in Gainesville, it was noted that forest plantations, though generally intended for the production of timber, increase the total region of forest worldwide (Lund 2006). The improvement of the region with a closed forest canopy during the second decade (2000-2010) could, therefore, be attributed to the success of the MTS projects in the WSFR.

Additionally, the Programs on Forests (PROFOR 2011) claimed a forest recovery reestablishment success story performed in Ghana by the Community Collaborative Recovery Project in the Pamu Berekum forest region situated in the Brong-Ahafo Region of Ghana. Plantations included *Tectona grandis* and *Cedrella odorata*, also mixed with *Terminalia superba*, *Terminalia ivorensis*, and *Cedrella odorata* (PROFOR 2011). This current study showed that the MTS plantations grow similar species, especially *Cedrella sp*. Forest recovery reestablishment is therefore expected to be more successful by the end of the next decade.

An increase in forest cover led to the decrease of farmlands around the forest conservations. This will potentially decrease the crop yield of farmlands in this region, though the aim of decreasing forest degradation and raising forest cover under the NFPDP could be said to be achieving its targets within the WSFR (GPRS 2005).

Benefits of the MTS to farmers livelihoods

The Forest of Ghana (both on and off conservation) provides both direct and indirect livelihoods benefited to the entire population (Blay et al. 2006). In the fringes of the forest, livelihoods are built nearly entirely on the use of local natural founts, be it from farming, forestry, chainsaw operations, charcoal production, or hunting and gathering (Marfo et al. 2002).

The results of the study showed that majority of all MTS peasants cultivated plantain as major crop while a number of them cultivated maize, cocoyam, and vegetables in different quantities. In a related study at Asuboi and Kunsu farming communities in Ghana, Amissah (2009) signified that majority of Taungya peasants cultivated plantain and cocoyam as major crops while cassava, vegetables, groundnut, and yam were cultivated as minor crops. This indicates that the program was beneficial in reducing poverty of Taungya peasants. The intervention for overcoming subsistence poverty lies in providing sufficient food to meet the family requirement (O'Donnell 1992).

Reports from the Forest Service Division (FSD) also indicate that MTS made substantial contributions to food production, particularly in plantain and maize crops in 2003 and 2004, although the report did not provide figures to quantify crop production (FPDC 2002). Records at the Ministry of Local Government and Rural Development (MLGRD) (2006) also showed that in 1998 the Mankranso district's average yield per hectare for plantain, cocoyam, cassava, and maize was higher than the regional figures. There is no doubt that MTS had improved crops production in the study region and subsistence poverty can be said to have been reduced for peasants.

According to Webster (1990), Basic needs strategy adopts direct assistance to meet basic needs through employment and providing capital for investment in agriculture to improve livelihoods. Although, majority of the MTS peasants were employed while a few of them were unemployed previously, majority of the respondents saw the MTS as a great alternative source of employment and for that matter livelihood (Table 14 and Table 15). This was confirmed by those who were engaged in the sale of their crops (Table 14 and Table 15). The MTS chiefs also confirmed that small-scale subsistence farming with crops like maize, cassava, cocoyam, and plantain is the main provider of livelihoods, together with NTFPs that can be harvested from the forest. They further emphasized that the peasants can make a reasonable livelihood from the agricultural crops since the crops belong to them and they gather all the revenue from their sales. Other sources of livelihoods apart from the 40% share in trees grown are from site preparation, supply of seedling stocks, nursing and planting of seedlings as well as pegging (Marfo 2009). The financial contributions, technical assistance, and provision of planting materials to peasants increased the financial and physical capital of MTS peasants (FPDC 2002).

Furthermore, in all three communities, majority of peasants reported that it was now easier to access farm produce and land for farming. Other peasants reported putting up a building, household's daily care as well as provision of children's school fees was easier (Table 17). This means that both physical and social capital of peasants was improved. These reasons are consistent with the reasons that the peasants raised for participating in the MTS scheme. These reasons were: access to farmlands, increased access to food crops and improved livelihoods. Others were concern for the environment and livelihoods. Although apprehension for the environment was not mentioned by a number of them, it was however clear from the interactions that the peasants were unhappy with the degradation that was taking place and hence desired that something was done about it. It must also be noted that livelihoods are rooted in the above reasons because access to farmland and food are all factors that lead to acquiring livelihoods. In a similar project in Pamu Berekum, successes attributable to the project included increased food production by the local peasants engaged in the project, which translated into increased livelihoods to the peasants and improvement in rural subsistence (PROFOR 2011).

The result of this study is also consistent with the third and fourth objectives of the MTS which are also consistent with the overall objectives pursued by the NFPDP discussed in the literature review. At the current stage of MTS it is clear that the MTS is having a positive effect on people's lives; the livelihoods generated from the agricultural crops are enabling peasants to achieve an improved standard of living.

Threats to the MTS

Denudation is caused by the exploitation of natural founts including logging, agriculture, biofuel production, and wildfires. For instance, in the transition region of Ghana, annual bush fires cause havoc to forest founts resulting in large tracts of conservations being burnt to the ground. In 1996, there were 127 incidences of bushfires in four major forest regions (Eastern, Ashanti, Western, and Brong Ahafo) leading to a loss of 27 km^2 (Ghana Forestry Commission 2002). The results of this study signified that wildfires, illegal logging, and deficiency of proper conservation of MTS farms plots are some menaces to the MTS. For the most part, it was a wildfire that people feared and the dramatic impact it would have on the scheme's success; especially, deliberately started fires. It was reported that to some extent, jealousy existed between communities, particularly when one community is picked out to be engaged in a particular scheme while a neighboring village is not chosen. This could mean that forest-fringed communities have identified tremendous benefits with the MTS scheme and those not engaged wished that their community was chosen for the program.

With regard to other fears or menaces to the scheme, some peasants raised apprehensions with the prospect of illegal chainsaw lumber operations being performed in the MTS plots. In a study done in the Atiwa district, Seneadza (2010) and Anane (2003) noted that forest cover loss was mainly caused by agricultural activities, illegal mining, illegal logging, and the establishment of infrastructure as a result of population explosion and the requirement for economic and social development. Similarly, clearing forests for the production of biofuel are causing major apprehension, as experts contend that it has a remarkable negative impact on forests without doing much to decrease greenhouse gas emissions (World Bank 2010). The result of the study signified that illegal logging still exists within the WSFR (Figure 7) and these activities wipe the natural forest canopy and subsequently bring certain flora and fauna species in the forest to endangered situations (Seneadza 2010).

Other apprehensions from the respondents were the lazy attitude of some peasants as well as deficiency of logistics (Figure 7). It was evident that some peasants seem to put more effort into the MTS scheme than others and hence posing as a challenge to the scheme. There were also a number of peasants who neither had nor could afford equipment, for example, proper rubber boots, cutlasses and raincoats, which sometimes infringes upon their ability to be able to farm. In a similar study in forest-fringe communities of the Tano Offin Conservation, it was emphasized that some peasants engaged in the MTS scheme, allowed weeds to spread on their plots (Ledger 2009).

Furthermore, apprehensions were raised at the deficiency of diversity in the livelihood options of the populations in and around the WSFR, in that there is over reliance on crops and with the potential for land degradation and wildfire, that option is not very secure. The purpose of the MTS scheme is not only to improve the livelihoods of the local rural population within the surroundings of the plantation sites but to also broaden the plantation sites in an economically and ecologically sound manner (Ledger 2009).

In relation to livelihoods, the result of the study showed that most peasants were enjoying both cash and non-cash livelihoods (Table 16). The challenge to them was the sustainability of the livelihoods they enjoyed. They were particularly worried about available plots in the future. Thus, if almost all downgraded portions of the conservation close to them are restored with planted trees, then there would be no land for farming and hence no livelihoods in the future. Nevertheless, peasants have a 40% share in the timber species planted.

Finally, Acheampong et al. (2016) in his work entitled "Management of Ghana's MTS: challenges and strategies for improvement" noted the following as MTS management challenges: Timelapse in livelihoods from canopy closure to timber harvesting, insecurity due to deficiency of signed agreement, deficiency of clarity in the benefit-sharing agreement, untimely provision of seedlings and distance from the community to MTS plot. Apart from timely provision of seedlings, all the other points were identified in this research as challenges/menaces to the MTS. However, there is also the report of the inequitable distribution of the land. This means that management of the MTS Scheme must take these issues seriously.

Sustainability of the MTS

The 1994 Forest and Wildlife policy of Ghana aims to maintain environmental quality and perpetual flow of advantages to all society (Opoku 2006). The World Bank has conjointly recognized that focusing solely on protection misses the chances for poverty reduction and developed administration and conservation of productive forest (World Bank 2005). In accordance with Mwavu and Witkowski (2008), societies have rules to keep the collective welfare from hazardous actions performed by individual members of society. However, a winning implementation of those rules relies on an enabling environment. The will of all stakeholders to support them may be a reflection of societies' aware and unaware ideologies entrenched through history (Tankpa 2010).

The Institute of Statistical, Social and Economic Analysis (ISSER 2008) declared that occasionally the interests of autochthonous people, who depend on the forest for their subsistence, are immolated for the economic advantage that is reaped from logging trees for timber export. With this method, the Forestry Policy of the Republic of Ghana, meant for the tenable management of the forest, is ignored. The government's objective of rising overseas exchange by exploiting forest founts (such as lumbering), plantation agriculture, and mining have usually given benefits for foreign countries and the corporations entangled within the trade of timber, money crops, and mineral founts (Southgate et al. 1991). There are rules that explain where, when, how, and how much timber could be extracted, however, they usually gave no effective enforcement in the Republic of Ghana (Hansen et al. 2009).

The 1992 Rio de Janeiro Summit created an interesting impact on Ghanaian environmental awareness resulting in the adoption of the 1994 Forest and Wildlife Policy. The design of this policy aroused the government's responsibility to manage the selected protected regions on a more tenable basis (Ayivor 2007). Forest conservation has a huge profit not solely in economic terms to society but also to the global ecosystem everywhere because of direct and indirect services offered by forest founts. Equivalently, all respondents during this study understood the necessity to adopt tenable ways in the administration of the MTS layout (Table 18). The recommended measures involved authorization and practice of laws to secure the MTS plots and also the conservation, to the clarity of the MTS and its advantages through education, and to share a percentage of revenue occasionally.

According to Sayer (2004) in "The recovery of forest biodiversity and ecological values in Asia," vast investments are being created in the development of tree plantations on downgraded land in Asia. These enthusiasts are usually politically driven and yearn to attain both economic and environmental advantages. Nevertheless, the dearth of clearness regarding the precise objectives of those arrangements implies that they usually fail to yield either native economic or global environmental advantages. There is usually a failure to bargain with all engaged stakeholders and to acknowledge and resolve trade-offs. Subsidies usually have had perverse impacts, and market forces may also become better drivers of economic objectives of recovery programs. Security of tenure and usage rights is a remarkable yet usually disregarded demand for achieving tenability. Identically, several peasants became aware of that so, in order that the MTS become tenable, after the end of the harvest of agricultural crops, there ought to be a flow of advantages, so the bulk payment could be reduced at the time of harvesting of matured trees. The pre-harvest timber profit would be acted as a stimulant to lure and encourage peasants to take position labor on a constant basis. In addition, there is a need for enough education and clearness on how and when the advantages from the timber would be shared because as noted during this study whereas the young peasants primarily cared about the agreement to be signed and

lawfully binding, the older peasants cared about whether or not their efforts would be secured for their next of kin (Ledger 2009).

REFERENCE

Acheampong E, Insaidoo TFG, Ros-Tonen MAF. 2016. Management of Ghana's modified taungya system: challenges and strategies for improvement. Agrofor Syst 90 (4): 659-674. DOI: 10.1007/s10457-016-9946-7.

Agyeman VK, Kasanga KR, Danso E, Marfo KA, Whiteman A, Asare AB, Yeboah OM, Agyeman F. 2003. Equitable revenue sharing from costs and benefits on) plantation development: A case study of public, private and local community partnerships in Ghana. Draft Report of the Community Forest Plantation Management Programme. Forest Commission, Accra.

Amissah JK. 2009. Utilising a Taungya Plantations Programme to Reduce the Poverty of Farmers in Ashanti Region: A case study of Asuboi and Kunsu Dotiem Farming Communities. Department of Sociology, University of Cape Coast. Ghana.

Anane M. 2003. Implementing Agenda 21: Religion and Conservation in Ghana. United Nations Non-Governmental Liason Service. New York.

Ayivor J. 2007. An Exploration of Policy Implementation in Protected Watershed Areas: Case Study of Digya National Park in the Volta Lake Margins in Ghana. [Thesis]. Ohio University, USA.

Blay D, Appiah M, Damnyag L, Dwomoh FK, Luukkanen O, Pappinen A. 2006. Involving local farmers in rehabilitation of downgraded tropical forests: Some lessons from Ghana. Forestry Commission. Accra, Ghana. DOI: 10.1007/s10668-006-9077-9.

Boakye E, Odai SN, Adjei KA, Annor FO. 2008. Landsat Images for Assessment of the Impact of Land-use and Land Cover Changes on the Barekese Catchment in Ghana. Eur J Sci Res 22(2): 269-278.

Brower JE, Zar JH. 1984. Field and Laboratory Methods for General Ecology (2nd ed.). Wm. C. Brown Publishers. Dubuque, IA.

Centre for Remote Sensing and Geographic Information Services (CERSGIS). 2012. University of Ghana, Legon, Accra.

CERSGIS. 2013. Geospatial Data Initiatives in Ghana. Centre for Remote Sensing and Geographic Information Services, University of Ghana, Legon, Accra.

Crowley E. 2010. Rural Employment and Decent Work. Building Employment and Decent Work into Sustainable Recovery and Development. International Labour Organization, Turin, USA.

FAO. 2001. Global Forest Resources Assessment 2000 - main report. FAO Forestry Paper No.140. FAO, Rome. Italy.

FAO. 2003. A journal of international forestry and forest industries. Forestry Paper No: 212. FAO, Rome. Italy.

FAO. 2006. Global Forest Resources Assessment. Progress Towards Sustainable Forest Management. Food and Agriculture Organization of the United Nations. Rome, Italy.

Forest Management Plan. 2013. Worobong South Forest Conservation, Akim Portion. Begoro District Forest. Begoro, Ghana.

FPDC [Forest Plantation Development Centre]. 2002. National Forest Plantation Development Programme. Forest Plantation Development Centre, Accra, Ghana.

Ghana Forestry Commission. 2001. Protecting Our Forest and Wildlife Resources for the Future: The Service Charter of the New Forestry Commission. Forestry Commission. Accra, Ghana.

Ghana Forestry Commission. 2002. Annual Report, Ghana Forestry Services Department, Accra. Ghana.

Ghana Forestry Commission. 2004. Progress report on the National Forest Plantation Development Programme. Annual report, 2003-2004. Forestry Commission, Accra, Ghana.

GPRS [Ghana Poverty Reduction Strategy]. 2005. Annual Report. Ghana Poverty Reduction Strategy, Accra, Ghana.

Hansen CP, Lund JF, Treue T. 2009. Neither Fast, Nor Easy: The Prospect of Reduced Emissions from Deforestation and Degradation (REDD) in Ghana. Intl For Rev 11 (4): 439-455. DOI: 10.1505/ifor.11.4.439.

Holl KD. 2013. Restoring Tropical Forest. Nature Education Knowledge. University of California, Santa Cruz, CA.

ISSER [Institute of Statistical, Social and Economic Research]. 2008. The State of the Ghanaian Economy in 2007. Institute of Statistical, Social and Economic Research (ISSER), University of Ghana, Legon, Accra, Ghana.

IUCN [International Union for the Conservation of Nature]. 1996. Communities and forest management. A report of the IUCN working group on community involvement in forest management with recommendations to the intergovernmental panel on forest. International Union for the Conservation of Nature, Washington DC.

Laurance WF, Bierregaard RO (eds). 1997. Tropical Forest Remnants: Ecology, Management, and Conservation of Fragmented Communities. University of Chicago Press, Chicago, USA.

Ledger J. 2009. Consequences of the introduction of the Modified Taungya System in Ghana's High Forest Zone for the livelihoods of forest-fringe Communities. KNUST. Kumasi. Ghana.

Lund HG. 2006. Definitions of Forest, Deforestation, Afforestation, and Reforestation. Forest Information Services, Gainesville, VA.

Marfo K, Anchirinah V, Wiggins S. 2002. Environmental policies and livelihoods in the forest margins of Southern Ghana. CSIR, Ghana.

Mas JF. 1999. Monitoring Land Cover Changes: A Comparison of Change Detection Techniques. Intl J Rem Sens 20 (1): 139-152. DOI: 10.1080/014311699213659.

MLF [Ministry of Lands and Forestry]. 1996. Forestry development master plan 1996-2000. Ministry of Lands and Forestry, Accra, Ghana.

MLGRD [Ministry of Local Government and Rural Development]. 2006. Medium-term development plan, (2005-2006). Offinso district assembly projections. Ministry of Local Government and Rural Development, Accra, Ghana.

Mwavu EN, Witkowski ETF. 2008. Land-Use and Cover Changes (1988-2002) around Budongo Forest Conservation NW Uganda: Implications for Forest and Woodland Sustainability. Land Degrad Dev 19: 606-622.DOI: 10.1002/ldr.869.

New Mexico State University (NMSU). 2013. The Transect Method. New Mexico State Universtiy, Las Cruces, NM.

NFPDP. 2003. Annual Report. 2003. National Forest Plantation Development Programme, Forestry Commission, Accra, Ghana

NFPDP. 2008. Annual Report. 2008. National Forest Plantation Development Programme, Forestry Commission, Accra, Ghana

O"Donnell M. 1992. A new Introduction to Sociology. McGraw-Hill Companies, New York.

Opoku K. 2006. Forest Governance in Ghana. An NGO perspective. A Report Produce for FERN (UK) by Forest Watch Ghana, March 2006. Zuidam Uithof, Utrecht, Netherlands.

Philippoff J, Cox E. 2013. Measuring Abundance: Transects and Quadrants from lessons developed by Erin Baumgartner and Chela Zabin. Smithsonian Environmental Research Center, Washington DC., USA.

Powell FC. 1982. Statistical Tables for the Social, Biological and Physical Sciences. Cambridge University Press, London.

PROFOR. 2011. Programs on Forest: Annual Progress Report 2011. Assessment of Forest Landscape. Recovery Opportunities in Ghana. Collaborative Landscape Recovery in Ghana. PROFOR, Accra, Ghana.

Sayer J. 2004. The Recovery of Forest Biodiversity and Ecological Values. Center for International Forestry Research, Bogor, Indonesia.

Seneadza OK. 2010. Deforestation in Ghana: New Challenges and New Strategies. Forestry Commission, Accra, Ghana.

Singh A. 1989. Digital Change Detection Techniques Using Remotely Sensed Data. Intl J Rem Sens 10 (6): 989-1003. DOI: 10.1080/01431168908903939.

Southgate D, Sierra R, Brown L. 1991. The Causes of Tropical Deforestation in Ecuador: A Statistical Analysis. World Dev 19 (9): 1145-1151. DOI: 10.1016/0305-750X(91)90063-N.

Tankpa V. 2010. Assessment of Spatio-Temporal Vegetation Cover Changes and Its Implications in the Atiwa District of Southern Ghana. [Thesis]. University of Ghana, Legon, Accra.

UNEP [United Nations Environmental Programme]. 2000. Global Environmental Outlook 2. Earthscan, London, UK.

Webster A. 1990. An Introduction to Sociology of Development. (2nd ed.). Palgrave Macmillan, London. DOI: 10.1007/978-1-349-20584-4_1.

World Bank. 2001. World Development Indicators. World Bank, Washington D.C., USA.

World Bank. 2005. Getting to Know the World Bank: A Guide for Young People. World Bank, Washington D.C., USA.

World Bank. 2010. Development and Climate Change. World Development Report. World Bank, Washington D.C., USA.

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Incentives and challenges for local institutions in coffee forest management: The case of Bilo-Nopha Woreda, Ethiopia

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Abstract. *Dibaba B, Berhanu A. 2018. Incentives and challenges for local institutions in coffee forest management: the case of Bilo-Nopha Woreda, Ethiopia. Asian J For 1: 31-46.* Because woodland biodiversity is threatened by various anthropogenic factors, the role of institutions in administrating natural provenances in general and woodland origins in specific increases over time. Therefore, this is the right time to find out the role of institutions in administrating natural provenances. An assessment of the role of local institutions in the management of coffee forestry, by taking the case of Bilo-Nopha Woreda, Illu Abba Bora zone as its object, became the main objective of this study. This study attempts to describe the utilization of regulation attributes, community attributes, and attributes of woodland provenances influencing the management of coffee forests in this study region, using the institutional analysis and development framework (IAD) adopted from Ostrom (2006). This study uses qualitative and quantitative research methods in the form of triangulation. From 16 Kebeles in the study region, the researchers purposively selected 3 Kebeles adjacent to the plantation woodland region. 125 households were selected from three Kebeles for quantitative interviews using a systematic random sampling technique. In addition to conducting in-depth interviews, key informant interviews and FGDs were conducted to support and strengthen data obtained through household surveys. The results reveal that both official and informal institutions manage coffee forests locally. Rules established by the government to secure coffee woodland areas decrease woodland utilization by local communities and make their ownership rights unsafe. This, in turn, will negatively affect their participation in coffee woodland management activities. Community contributions and forest provenances also influence management activities both positively and negatively. Some operate as incentives that increase management activities, including compactness, homogeneity, topography, and goods and services derived from forests; in contrast, others work as disincentives for management activities, including group size, distance, and inadequacy of clear boundaries. In addition to the challenges of administrating coffee forests, lack of ownership, illegal encroachment, and inadequate coordination between various stakeholders are the main difficulties that must be resolved to preserve coffee forests in the study region.

Keywords: Challenges, coffee, Ethiopia, incentives, local institutions

INTRODUCTION

The breadth, fluidity, and power of institutions make them hard to comprehend. Some scholars utilize the term institution to allude to an organization, such as the USA congress, a business firm, or a political party. On the other hand, other scholars utilize the term to allude to the regulations, norms, and strategies adopted by individuals operating within and across the organizations (Ostrom 1999). According to Yeraswork (1997) institution is any social adjustment initiated and managed by social regulations. Social regulation systems are shared and socially established regulation regimes determining a greater or lesser extent of who may or should participate, and who is excluded, and who should do what, when, and how about whom. Stellmacher and Mollinga (2009) said that beyond modeling human-human interactions, institutions could have a substantial role in modeling human-nature relationships. In this sense, institutions indicate a severe role in the relations between humans and woodlands as they can specify and manage human access to woodland provenances.

The conventional method of natural provenance management has tended to either ignore altogether or give peripheral attention to the significant role the institutions have come to play. However, empirical evidence shows that institutions form a fundamental link between people and their environments. Through these institutions, individual and collective actions associated with access to, control over, and the utilization of natural provenances are arranged (Teklu 2006).

Zewdie (2009) argued that natural provenance management is often formed by several overlapping institutions, i.e., official and informal from the social, political, economic, and cultural spheres. The official institutions operate at the local, regional, and national levels to administrate the woodland and woodland provenances; in contrast, informal/autochthonous institution of the community works at the local level to manage natural provenance in general and woodland origin in specific. Teklu (2006) also added the particular significance of local-level institutions in securing and administrating natural provenances. There is a sprouting acknowledgment of local-level institutions' importance and centrality when exploring and developing genuine provenance preservation and utilizing concepts.

In Ethiopia, both informal/customary institutions and official/state-triggered institutions participate in coffee woodland provenances management activities at the local level. Informal/customary institutions take precedence in

the management of natural provenance, while the involvement of official institutions in genuine provenance management, mainly woodland provenance, are recent phenomena (Zewdie 2009).

Distinctive studies signified that forests and woodland-derived natural provenances are not well administrated in Ethiopia, and their existence keeps on being endangered; Coffee woodland and the genetic origins of the wild coffee and the associated flora and fauna are vanishing rapidly due to the denudation of the ecosystems, especially in the past few decades. The underlying causes of the denudation are social, economic, political, and institutional (Tadesse and Demel 2001; Woods et al. 2012; Amogne 2013). In support of this idea, Mellese and Mohammud (2005) signified that, in Ethiopia, because of the less coordination among several institutions; poor institutional adjustments; deficiency of the necessary trained human resources, especially at the grassroots levels; lack of political commitment on the side of officials; inadequacy of the culture of listening to expert opinions before political authorities decide decisions; mismanagement; overemphasis on fast economic growth at the expense of the environment (through investment projects), among others, the country is suffering from terrible environmental decline.

As signified above, the role played by neighborhood institutions in the management of natural provenance in general and coffee woodland in specific is high. Therefore, having the explanations mentioned above in mind, the researcher wished to perform a study on assessing the role of local-level institutions in coffee woodland management activities in the case of Bilo-Nopha Woreda, Iluu Abba Bora Zone.

The objective of this research was: (i) To investigate the effectiveness of regulations in utilization to administrate coffee woodland in the study region. (ii) To examine the impact of local woodland user attributes in the management of coffee woodland. (iii) To identify the attributes of woodland provenances that influence the management of coffee woodland. (iv) To investigate the primary challenges of coffee woodland management.

MATERIALS AND METHODS

Description of the study region

Geographical setting

Iluu Abba Bora is located in the southwestern part of Oromia Regional State, Ethiopia. It is bounded by East Wellega and Jimma zones in the east. Iluu Abba Bora also shares a border with West and East Wellega in the North, SNNPR in the south, and Gambella Regional State in the west. The entire region of the zone is 1,633156.6 ha and is divided into twenty-two districts (Zewdie 2009).

Bilo-Nopha Woreda is found in Iluu Abba Bora zone of Oromia Regional State at about 615 km from Addis Ababa, the capital of Ethiopia, and 18 km from Mettu, which is the Administrated seat of Iluu Abba Bora zone. The whole land region of the Woreda is 39,000 ha, and the *woreda* comprises 16 *kebele.*

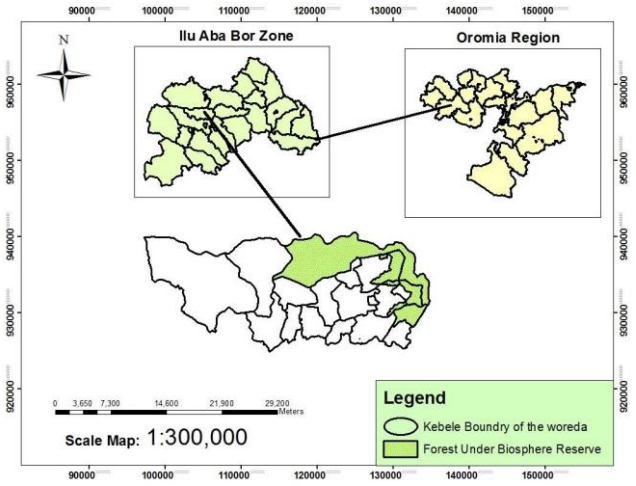

Figure 3. Map of the study region

Climate

Bilo-Nopha Woreda is situated between 8º2º42ººN and 8º31º18' North and 35º37º48ºE and 36º05º18ºEast. The agro-ecological region of the Woreda is 95% below highland (*badda),* and the remaining 5% is lowland (*Gammoojji*). The mean annual temperature of the Woreda is 18-23ºC, and the mean annual rainfall is from 1200-2100 mm per year. It is a unimodal type of rainfall that escalates from May to October and reduces in December. Concerning the topographic location, most parts of the Woreda are Mountains, and rift valleys cover some parts of the region. Bilo- Nopha Woreda is located 1700 meters above sea level.

Population and economic condition

According to the Woreda Administrative Report of (2013), the total population of Bilo-Nopha Woreda population is 30,383 from this the number of males are 16,001, and females are 14,382. Out of the total population in the Woreda, only 3,750 people live in the town region, and the rest 26,633 live in the country regions.

Concerning the ethnic composition, most of the respondents of the residents belong to Oromo ethnic groups. Other ethnic groups from Amara and Tigray also exist in the Woreda due to resettlement and in-migration in the preceding few decades. In the study region, distinct religious organizations are also lived; Orthodox, Protestants, and Muslims are dominant.

Most of the neighborhood society's economic activities are involved in agriculture and agriculture-related activities. Woodland provided goods and service like coffee, honey, timber extraction, etc. which are the primary agricultural activities of the community and accounts up to 75% of local subsistence strategies, on the other hand, crop production like maize, sorghum, and teff) and livestock increase like cattle, sheep, goats, donkeys, etc., accounts for 20% of the subsistence strategy of the community. Few urban dwellers account for 5% being involved in distinct small trade and daily labor activities.

Natural provenance endowment

South-western Ethiopia in general and Illu Abba Bora zone in specific is famous for their natural provenance endowments. Bilo-Nopha Woreda is one of the vast woodland regions that consist of many species, and it was incorporated into Yayo woodland priority areas (NFPA) for preservation in 1999. The whole land region of the Woreda is 39,000 ha, which is covered by distinct kinds of land uses. According to secondary data of Woreda land management, coffee woodland cover 20,230 ha of total land regions; on the other hand, Savannah woodland, grazing land, savannah, and marshland covered 9,063 ha of entire land regions. The cultivation register on rounds the remaining 9,707 ha of the land surface.

The woodland ecosystem is endowed with a variety of plant species. The most prevalent are *Hambabessa* (*Albizia gummifera*), *Waddessa* (*Cordia africana*), *Qararoo* (*Aningeria adolfi-friederici)*, *Hogda* (*Ficus vasta*), *Sondi* (*Acacia lahai*), *Alale* (*Albizia grandibracteata)*, and others with their unknown scientific names like *Bakkannissa*, *Lookoo, Abrangoo-Jaldessaa, Qassoo,* and *Lolchiissa* are some of the plant species that existed in the coffee woodland regions.

According to secondary data from the Woreda agriculture and woodland preservation office, the coffee woodland of Bilo-Nopha Woreda has distinct species of animals. Anubus baboon (*jaldessaa*), colobus monkey (*weenni*), and more than fifteen (15) other species of animals can be found in the coffee woodland region.

History of Bilo-Nopha forest conservation

During the imperial period, Bilo-Nopha Woreda coffee woodland region was held as prevalent property provenance and private goods of the neighborhood society. The current core zone region of the woodland was under the landlord's Conthe Troll, and the buffer zone region of the woodland was owned as private goods of local communities through *Gabbar* system. After nationalizing land during the military regime, a distinct peasant association and committee controlled the coffee woodland region. The association and individual private property with full utilization rights influenced the coffee woodland region. After EPRDF came to power in 1991, the coffee woodland region became under the de jure ownership of the governments to maintain distinct biodiversity in the coffee woodland regions.

The forestry management at the federal level has classified 58 most important high woodland regions in Ethiopia as National Forest Priority Areas since 1985 (Zewdie 2009). From the 58 National Forest Priority Areas in the country, the Illubabor zone has five National Forest Priority Areas. Yayu Forest, Gaba-Dhidhesa, Gabre-Dima, Sibo-toti Qobo, and Sale-Nono.

Due to its national and international significance, the Bilo-Nopha coffee woodland region has been designated as a site for wild Arabica coffee (*Coffea arabica*) preservation as a gene reserve by the government of Ethiopia since 1999; under the control of Yayo National Woodland priority regions which consists other five Woreda's that woodland region were adjacent, these including Yayo, Chora, Alge, Hrumu and Dorani. The coffee woodland region covers 13,305 ha of land from four adjacent kebeles, including (Ulmaya, Kitabir, Suli, and government woodland that bounded to those kebeles). After restricting the woodland region as a national woodland priority region for biodiversity preservation, coffees' woodland utilization and management activities are limited and strictly forbidden.

Research design

This study employed cross-sectional and approximating longitudinal research designs to gain data on the subject under investigation. To get information regarding the regulation in utilization to manage the coffee woodland region, the behavior of woodland user group, attribute of woodland land and its derived provenances and challenges of coffee woodland management, cross-sectional research design the most appropriate one.

An approximate longitudinal research design was also employed to get information regarding the participation level of neighborhood society in the management activities of coffee woodland before restriction and their past ownership right in the secured woodland regions.

Research method

Triangulation is primarily a way of assuring the legality of research results by utilizing distinct research methods and approaches. Besides, it has also added the benefit of authorizing the researcher to cover different aspects of their research goals or inquiry by utilizing different provenances, data, and research methods (Yeraswork 2010). Therefore, in this study, methodological triangulation was used to address the distinct goals of the study. Additionally, it is also utilized to sustain and verify quantitative data with qualitative one.

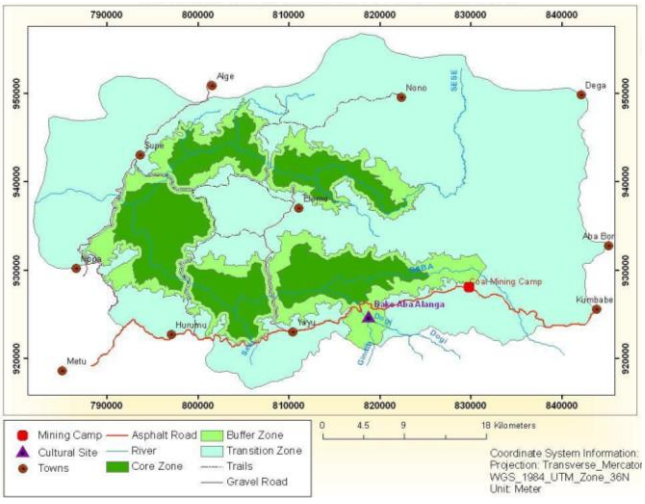

Figure. The proposed biosphere reserve map. Source: Adapted from Andnet (2010)

Methodological triangulation

The researcher has utilized a methodological triangulation to verify the research result briefly in the following Table 1.

Study population

The target population of this study was households of three selected kebeles who live in coffee woodland adjacent to Bilo-Nopha Woreda, including Ulmaya, Kitabir, and Suli.

Sample design and sample size determination

Many reasons make sampling more beneficial rather than complete enumeration. These include considerations regarding time, cost and available provenances, and practicability (Yeraswork 2010). Both probability and non-probability sampling techniques have been utilized to draw the required number of sample units for this study. Accordingly, kebeles were selected purposively from the entire kebele in Bilo-Nopa Woreda; therefore, the researcher purposively selected 16 kebele adjacent to the Woreda coffee woodland regions (bio-sphere reserve regions). And then, household heads for information have been chosen from the three kebeles using a systematic sampling method.

Purposive sampling was also employed to select the required number of in-depth interviews, key informants, and FGD discussants. Respondents for information were purposively selected based on their knowledge and experience, including (members of neighborhood society, well-known neighborhood society elders, and experts at a distinct level) on the subject under investigation.

This study has been conducted in the three selected sites of Bilo-Nopha Woreda, directly contacting the coffee woodland regions. The researcher utilized the following formulas for sample size determination from the total number of households in the three selected kebeles.

$S = X^2N\ P\ (1\text{-}P) \div d^2\ (N\ -1) + X^2\ P\ (1\text{-}\ P)$

S = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population variability (assumed to be 0.10 since the population is homogeneous in terms of geography, similar social class, and similar economic activity).

D = the degree of accuracy expressed as a proportion (0.5). The total number of households of the three selected kebele (N) is 1142.

The total households of Ulmaya Kebele (N_1) = 453, The total households of Kitabir Kebele (N_2) = 261, and The total households of Suli Kebele (N_3) = 428.

S (Total number of the sample) =?

X^2 = at 95% level of confidence is 3.841,

d= 5% or 0.05 and P=0.1

Therefore, using the above formula,

$$S = \frac{(3.841)(1142)(0.1)(0.9)}{0.05^{\ 2}(1142-1)+(3.841)(0.1)(0.9)} = 125$$ (Approximate)

sample of respondents will be used for this study.

On the other hand, to determine the proportion number of sample (respondents) in Ulmaya Kebele (n_1), Kitabir Kebele (n_2) and Suli Kebele (n_3), the researcher used the following formula.

$n_1 = S\ (N_1/N)$ and hence $n_1 = 125\ (453/1142) = 50$

$n_2 = S\ (N_2/N)$ and hence $n_2 = 125\ (261/1142) = 28$

$n_3 = S\ (N_3/N)$, which is $n_3 = 125\ (428/1142) = 47$

Hence, from Ulmaya Kebele, 50 respondents, Kitabir Kebele, 28 respondents, and Suli Kebele, 47 respondents have been picked out proportionally (Table 2). Systematic sampling was utilized in this study to allocate questionnaires. The interval is gained by dividing the specified sample population (as determined by the sample size formula) for the total population multiplied by a hundred percent.

Table 2. Sample size calculations

Kebele's	Total household	Sample population
Ulmaya Kebele	453	50
Kitabir Kebele	261	28
Suli Kebele	428	47
Total	1142	125

Table 1. Methodological triangulation

Objective	Units of analysis	Data sources	Methods of data collection
The effectiveness of regulation in utilization to manage the coffee forest in the study regions.	Forest user community Woreda management, agricultural and forest office, district manager of biosphere region	A. Sample of household heads, B. Key informants C. In-depth interviewee D. Forest user community as a group	Household survey In-depth interview FGD
Attribute to neighborhood society	Forest user community	A. Sample of household heads, B. In-depth interviewee C. Forest user community as a group	Household survey In-depth interview FGD
Attribute natural provenance	Forest user community district manager of biosphere region	A. Sample of household heads B. Key informants C. In-depth interviewee D. Forest user community as a group	Household survey In-depth interview FGD
Challenges of coffee forest management practice	Forest user community, Woreda management	A. Forest user community as a group B. Key informants C. In-depth interviewee	FGD In-depth interview

$K = n/N \times 100\%$

$K = 125/1142 \times 100\% = 11$. Thus, using the Kebele register, every 11^{th} was taken until 125 samples were picked.

Method of data collection

This study has utilized a methodological triangulation so as to substantiate the primary and secondary data collected from distinct provenances to achieve the stated objectives. To do so, both primary and secondary provenances have been employed. The sub-sections that follow describe the detail of primary and secondary data provenances.

Primary data collection

Household survey

The household survey was utilized to gain information regarding the socio-demographic characteristics, regulations in utilization to rule woodland provenance, attributes of the woodland provenance user groups, and woodland provenances regions. The survey instrument (questionnaire) consists of four parts; the first part asks respondents' demographic and socio-economic conditions. The second and third parts of the questionnaire asked about the attribute of the woodland utilization community and natural provenance and their significance in the management of coffee woodland. The fourth part of the questionnaire was about regulations that rule the woodland and their association with coffee woodland management. The final details of the questionnaire were prepared to ask about the participation of the neighborhood society in coffee woodland management.

The survey instrument was administered by translating it into the local language (*Oromiffa*). The researcher and enumerators undertook face-to-face interviews with the respondents since most could not read and write.

Conceptualization

Local institutions: refers to both official and informal/autochthonous institutions having a crucial role in the management of coffee woodland (Agrawal 2007)

Coffee woodland: is characterized by a high abundance of wild Arabica coffee populations and continuous, various vegetation structures (Andinet 2010).

Bio-sphere reserve region: secured woodland for sustainable preservation of biodiversity

Core zone: refers to the place exclusively established for biodiversity preservation or to ensure that all plants and animals' species and communities survive throughout the region (Zewdie 2009).

Buffer zone: refers to the region set aside as buffer the core zone from human interference while allowing preservation and sustainable utilization of woodland provenances (Zewdie 2009).

Participation: refers to the involvement of neighbor-hood society in coffee woodland management activities

Incentives: refers to any inducements that can enhance the management of coffee woodland

Disincentives: refers to any barriers that impede the management of coffee woodland

Operationalization

Operationalization can be seen in Table 3.

Table 3. Conceptualization

Concept	Variable	Indicator	Measurement
Socio-economic status	Income	Average total income per annual	**Scale** Actual total income per year in Birr
	Educational qualification	Level of education attained	**Ordinal** Can't read and write, can read and write, primary education, secondary education, college and above
Socio-demographic characteristics	Sex	Indicate male or female	**Nominal** Male or female
	Age	Length of time (year) that one has been alive	**Scale** Age in completed year
	Demarcation regulation	The current regulation that rules coffee woodland regions	**Ordinal** Completely fair, fair, not fair
Attribute of regulation in utilization	Collective decision making	Participation of neighborhood society in collective decision making of regulation design and enforcement process	**Nominal** Yes, no
	Ownership right	Use and management rights of coffee woodland provenances	**Nominal** Secure, insecure
Attribute of natural provenances	Distance from woodland	Actual distance of respondent's house from the woodland land in hrs.	**Ordinal** Less than 30 min, 30min-1hr, 1hr-1:30hr 1:30hr- 2:00hr above 2:00hr
	Multiple utilization	the significance of coffee woodland based on the various goods and services they provide	**Nominal** Yes, no
Attribute to the community	Heterogeneity	Impact of community difference in terms of occupation and ethnicity to manage coffee woodland	**Nominal** Yes, no

In-depth and critical informant interview

The researcher employed semi-structured interviews to supplement the ideas and questions designed in the household survey. Informants for in-depth interviews have been selected purposively based on their knowledge and experience on the subject under study. Therefore, six in-depth interviews were conducted to gather detailed information regarding local institutions' role in coffee woodland management in the study regions from neighborhood society members. To get more information about the topic under study, the researcher conducted key informant interviews with two well-known and influential Local community elders and three experts like Woreda administrator, director of agricultural and woodland preservation office, and district manager of bio-sphere reserve region.

Focus group discussion

Focus group discussion has also been utilized to triangulate the reliability and legality of the data collected by other methods. The main reason for using the focus group discussion is to understand the respondents' attitudes, feelings, beliefs, experiences, and reactions (Camic and Yardley 2003).

This study held three focus group discussions with households in the three selected kebeles. Each focus group discussion contained ten members of discussants. The member of the Focus group discussion is a neighborhood society that takes part in different social group activities, including men, women, and elders. They categorized based on their homogeneity to make them feel their ideas without frustration.

Archival analysis

The researcher reviewed several written documents, including journals, articles, books, and other documents that focus on the institution of coffee woodland management. The review of these documents helped identify the gaps in previous research on the subject under study and select appropriate research framework and tools for the analysis.

Method of data analysis

Quantitative data analysis

The quantitative data for the study were analyzed using descriptive statistics aided by the SPSS version. The findings, in turn, were analyzed qualitatively. Descriptive analysis of the data was carried-out using percentages and frequency.

Qualitative data analysis

Qualitative data collected through critical informant interviews and focus group discussions were analyzed according to the main themes of interviews and discussions. Here, qualitative data collected concerning challenges of coffee woodland management were analyzed separately as it is a different specific objective of the study. At the same time, additional data generated through interviews and FGDs concerning regulations in utilization, attributes of the community, and woodland provenance were simultaneously analyzed with survey data.

Ethical consideration

Yeraswork (2010) has clearly pointed out that "research must be managed by ethical norms and values", the researcher has been directed by the following obligatory ethical guidelines while collecting data from the sample of survey respondents and in-depth interviewees. (i) All information was collected from respondents and critical informants with their consent and willingness. (ii) All information obtained from the provenances was kept and treated confidentially. (iii) The data were analyzed and interpreted without naming any respondents or informants. (iv) Limitations and failures of the study were honestly explained. (v) The different assumptions and theories that were utilized from other provenances (books, journals, and research reports) were adequately cited and acknowledged.

RESULTS AND DISCUSSION

The socio-economic and demographic characteristics of the respondents

Socio-demographic characteristics of the respondents

The total numbers of informants were 125 individuals. The number of household heads who took part in study 118 (94.4%) was males, and the remaining 7 (5.6%) were females. Concerning the age categories, 47 (37.6%) respondents fell within the age group of 41-50, and the second larger age category, 33 (26.4%) respondents, fell under 21-30. The remaining 16.8%, 15.2%, and 4% fall under the age group of 31-40, 51-60, and above 60, respectively. Regarding religious affiliation, 45.4% of respondents were followers of Protestant Christianity; the remaining 32% and 22.6% of respondents were Ethiopian Orthodox Christianity and Islam. The survey result also shows that three ethnic groups exist in the study region-Oromo, Amhara and Tigray. Among those ethnic groups, 72% Oromo, 19.2% Amhara, and 8.8% Tigray were taken as sample respondents, respectively (Table 4).

Concerning household family size, Table 5 shows that almost half (49.6%) of the total respondents have a household size of 6-10 members. About 31.2% have 3-5 members. The remaining 15.2% and 4.0% have less than 2 and above 11 members. Generally, the study region is characterized by a relatively large family size as more than three-fourths of respondents have more than 5 members.

Educational status is the other characteristic of the community, which indicates the literacy level of households. The survey result signified that most respondents, which account for 50.4%, are "able to read and write." Respondents who "can't read and write" accounts for 36.8% total number of respondents. Specifically, 11.2-1.6% of respondents attended primary and secondary education, respectively (Table 6). This shows that the educational status of the respondents is relatively low. This could hurt the management of the coffee woodland region because deficiency of knowledge about the contribution of the coffee woodland region in preserving biodiversity.

The economic structure of respondents

As the survey data revealed, almost all of the respondents have land, either woodland or cropland. Concerning the size of land they own, 26.4% of respondents have between 1.6-2.0 ha land, and 24.8% of the respondents have between 0.6-1.0 ha land. The other 20.0% of the respondents have between 1.1-1.5 ha of land. The remaining 14.4% of respondents have less than 0.5 and above 2 ha land, respectively (Table 7). As secondary data from land management of the study Woreda reveals, 6,687 households in the Woreda have land; from this, the number of male landowners is 5,921, and the number of female landowners is 766. The data also reveals that the average landholding size of households in the study region is 2.32 ha. Concerning livelihood activities, agriculture that includes distinct kinds of crop production, woodland products, and animal production are the primary means of subsistence for the community in the study region.

Table 8 shows the primary livelihood strategy of the sample respondents is woodland and woodland-derived provenance, which accounts for 98.4% of the total livelihood strategy of the community. Products like wild coffee, honey, charcoal, timbers, and non-timber products are mainly utilized as provenances of livelihood by the neighborhood society. Crop production is the other livelihood strategy of sample respondents, which consists 66.7% of the sample population. Products like maize, teff, and sorghum are the primary products produced by the community in the study region. In addition, livestock rearing is another livelihood strategy of the community, which consists of 34.1% of the total livelihood strategy of sample respondents. In the study, the region farmer undertakes animal production activities including (cattle, sheep, goat, and donkey) side by side with farm activities.

Institutions of coffee woodland management

Institutions that encourage the protection of coffee woodland at various levels in a given society are essential to ensure the sustainable existence of coffee woodland. The different institutions have been formed at a particular time and place to respond to increasing pressure on natural provenances. Forest provenances are more likely to be sustainably utilized if an effective structure of institutional adjustments exists that gives rise to an authority system responsible for wise management of origins at the local level (Zewdie 2009). Both official and informal institutional adjustments exist in the study region and are involved in the coffee woodland management practice. That allowing section explains the existing local institution and their role in coffee woodland provenance management.

Informal institution

Community-initiated autochthonous institutions are principally based on the local people's autochthonous knowledge and long experience. The local community-initiated informal institutions found in the Bilo-Nopha community, specifically those adjacent to secured coffee woodland regions. Among customary institutions are currently operating and participating in coffee woodland management activities *Iddir*, the council of elders, and *Jiga* and *Laffee*, in the study region is identified.

Table 4. Frequency and percentage distribution of respondents based on their demographic characteristics

Socio-demographic characteristics	Frequency	Percent	Cumulative percent
Sex of respondents	118	94.4	94.4
Male Female	7	5.6	100.0
Total	125	100.0	
Respondent age	33	26.4	26.4
20-30	21	16.8	43.2
31-40	47	37.6	80.8
41-50	19	15.2	96.0
51-60	5	4.00	100.0
Above 60 Total	125	100.0	
Religious affiliation			
Orthodox	40	32.0	32.0
Muslim	28	22.4	54.4
Protestant	57	45.6	100.0
Total	125	100.0	
Ethnic group			
Oromo	89	72.0	68.0
Amhara	24	19.2	87.2
Tigray	12	8.8	100.0
Total	125	100.0	

Table 5. Frequency and percentage distribution of respondents by their household size

Household size	Frequency	Percent	Cumulative percent
Less than 2	19	15.2	15.2
3-5	39	31.2	46.4
6-10	62	49.6	96.0
11 and above	5	4.0	100.0
Total	125	100.0	

Table 6. Frequency and percentage distribution of respondents by their level of education

Educational status of household head	Frequency	Percent	Cumulative percent
I can't read and write	46	36.8	36.8
Able to read and write	63	50.4	87.2
Primary education	14	11.2	98.4
Secondary education	2	1.6	100.0
Total	125	100.0	

Table 7. Frequency and percentage distribution of respondents by their landholding size

Landholding size of respondents	Frequency	Percent	Cumulative percent
Less than 0.5ha	18	14.4	14.4
Between 0.6-1.0ha	31	24.8	39.2
Between 1.1-1.5ha	25	20.0	59.2
Between 1.6-2.0ha	33	26.4	85.6
Above 2.00ha	18	14.4	100.0
Total	125	100.0	

Table 8. Frequency and percentage distribution of respondents by their livelihood strategies

Livelihood strategy of Household	Frequency	Percent	Percent of cases
Depend on woodland	121	49.4%	98.4%
crop production	82	33.5%	66.7%
Livestock rearing	42	17.1%	34.1%
Total	245	100.0%	199.2%

Note: Total is greater than the sample because it is multiple responses

Iddir

Iddir is a voluntary association that plays a crucial role in administrating coffee woodland in the study regions. As Stellmacher and Mollinga (2009) signified, *iddir* is an Ethiopian phenomenon. It can be found all over the country and even among Ethiopian communities abroad, across all social classes, ethnicities, and religions. In the specific study region, family is indicated by the head of this association's household. The member of the *iddir* association held per week and pay for membership contributions to the *iddir* treasures. They also meet occasionally to nominate a member of *iddir* committee, which rules the activities of *iddir* association. It also plays a crucial role in managing woodland provenance in the study regions. As in-depth interview result with neighborhood society elders signified, the member of *iddir* social association have regulations that guide their behavior toward the utilization and management of coffee woodland. There is a regulation that punishes those who illegally utilize the secured coffee woodland regions; membership is punished in cash or imprisonment depending on their level of accusation. Some regulations obliged local communities to participate in collective action activities like protection or group meeting. In Nopha village, if the member of *iddir* groups does not participate in collective action activities of woodland management and group meeting, they punish 10birr and double if they repeat it.

Jiga and laffe

Jiga and *laffe* are self-help groups that focus on providing labor, financial and other support to the people exposed to distinct forms of hardship. As neighborhood society elders told the researcher, Jiga is an activity that is performed when the household loses one of its family members whereas, laffe is an activity performed when the household of a given community lost its relatives. The main difference between *jiga* and *laffe* is that the former one is morning work from 8-12 clock and later one is night work from 2-5, besides, the member of *jiga* group is large in number than the member of *laffe* groups. In the management of coffee woodland region, the role of *jiga* and *laffe* are indirect. As Woreda agricultural and woodland preservation office key informants stated, the member of *jiga* and *laffe work*groups utilized as a forum for official discussion between the local communities and government agents regarding the utilization and management of coffee woodland in secured regions. Through these workgroups awareness creation programs about the biosphere reserve regions and penalties of encroaching the woodland regions are given to the local communities. Their participants do not arrange this working system spontaneously; rather, they have fixed groups and regulations that distinguish members from non-members. *Jiga* and *laffe* working group's arrangement has regulations that state what, when, and how to manage coffee woodland to protect from damages resulting from illicit user and grazing.

Council of elders

Council of elders is a group of elders selected by neighborhood society and involved in various social activities such as conflict resolution and decision making in serious societal issues. According to information of elderly key informants, one of such councils of elders in the study region is "*Gummaa Abotti Gadda,"* which plays several roles in the life of neighborhood society. Among others, some of the roles that the council of elders performs are maintaining the culture of the neighborhood society, giving a decision regarding distinct issues, resolving conflict between individuals, and giving awareness creation about securing woodland provenance to the local communities are some of the primary roles of council of elders in the study region. *Sera kaka*/ regulation of swear is one of the mechanisms utilized to investigate repeatedly committed crimes through a group of councils of elders. Different kinds of crime, including distraction or illicit utilization of woodland provenances, lead to *kaka* by the council of elders. The community of the study region has developed a respect for their customary regulations. Fearing *kaka*, curse, and social sanction would help them forbid the community members from cutting trees in secured regions. The council of elders is fixed and permanent; they also have a high link with the local government administration and work with each other to manage coffee woodland regions.

Generally, customary institutions' role in managing woodland provenance is decreased from time to time in the study region. As elderly key informants signified, the role of customary institutions in the management of coffee woodland is now decreased due to government involvement through its official institutional structures.

The result of FGD discussant group also signified that the organization neighborhood society in distinct state initiated institutions decrease the influence of informal institutions that the neighborhood society perpetuated for a long time.

Formal institution

There are official institutions related to the utilization and management of coffee woodland. As information obtained from Woreda management and agricultural office indicates, distinct government and non-governmental institutions are involved in administrating the coffee woodland regions. Bilo-Nopha Woreda Management (BNWA), Agriculture and Forest Preservation Office (AFCO), Illubabor Forest Provenance and Wild Animal Enterprise (IFRWAE), Development Agent (DA), and

NGOs' like Sustainable Land Management (SLM), Ethiopian Coffee Forest Forum (ECFF), People Health and Environment (PHE) and Ethio wet-land are all official stakeholders who operate at the local level in the management coffee woodland regions.

The structure of Bilo-Nopha Woreda Management (BNWA) is arranged hierarchically through top-down control and bottom-up flow of information. As the Woreda communication offices report signified, the hierarchical structure is based on the geographical location of the regions.

The Woreda management is the official local government agency responsible for coordinating the activities of distinct stakeholders who took part in coffee woodland provenance management. Providing administrative, logistics, and giving solutions to the difficulty that is above the capacity of Kebele administrative is the main responsibility of Woreda management.

Kebele management is the other local institution that deals with the daily activities of the rural residents. Under this structure, three zones incorporate 3 up to 7 *gares* under them. In its role of woodland provenance management, the Kebele management usually imposes penalties on those violating woodland utilization regulations. The lower hierarchical structure reports the illicit utilization of coffee woodland to the kebele management, and then it is up to them to bring the accused people into justice. The Kebele management also has the power to control or allow *neighborhood* society to utilize products from the coffee woodland region.

Zone, *gare*, and *shane* are lower hierarchical structures in which the neighborhood society is arranged to perform distinct management and preservation activities of woodland provenances. *Zone* is where distinct *gares* are arranged and talked over on various issues like agricultural and woodland provenance managements. The main role of *zone* is giving solutions or transferring the subject reported by *gare* to discussion groups. *Gare* is the platform for providing possible solutions to the lower disagreement at the *shane* level. It controls and manage the daily activities of *shane* groups and gives simple decision like the encroachment of cattle in the secured regions of difficulty over commonly utilized provenances at *shane* level. *Shane* is the lowest structural in which farmers are arranged into 1to 5 cells based on their neighborhood; here, farmers have responsibilities to manage coffee woodland region through controlling each other activities and reporting the illicit utilization of secured woodland by their group members.

According to Woreda agricultural and woodland preservation office director stated, in the management of woodland provenance, the hierarchy shows that, if someone encroaches the secured coffee woodland region at *shane* level, a member reports to *gare* group discussion and the *gare* group transfers it to the *zone* if it is beyond their capacity to handle it, then the *zone* tries to give a possible solution or report it to the upper bodies or kebele.

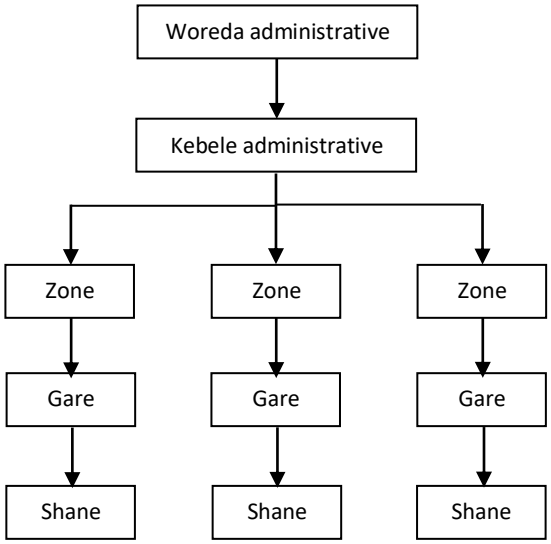

Figure 5. The Hierarchical Structure of Bilo-Nopha Woreda Management

Agriculture and woodland preservation office (AFCO) is the other official institutional adjustment involved in coffee woodland provenances management activities. They work in transitional zone region of the woodland, but also took part in activities like "cut and care" system (the principle that local communities should undertake regeneration activities if they want to utilize trees for distinct construction and home purpose), fire management system (wildfire of woodland for beekeeping), awareness creation service to neighborhood society and plantation of trees and coffee in biosphere reserve regions.

Illu Abba Bora Zone woodland provenance and wild animal enterprise are also involved in coffee woodland management and preservation activities in the study regions. The enterprise has five districts in the five selected biosphere regions and works in all Woredas that coffees woodland were adjacent to the community. The primary activities of this enterprise are organizing and controlling the activities of all members of district workers regarding the management of secured coffee woodland regions, demarcation of woodland boundaries at distinct management regions. As the enterprise manager stated, the enterprise is a self-help organization and not supported by government. It depends on self-generated income by conducting distinct activities like planting of distinct woodland products and selling them to the farmers. They raise the subject of human provenance as one of the big difficulties in effective management of coffee woodland in the biospheres' reserve regions. As key informants from agriculture and woodland preservation office indicate, the enterprise only stand for its own benefit than conserving the woodland region, it took part in few management activities like demarcation of distinct management zone in the years interval merely by marking red line on trees, otherwise, they give more attention to their own income generation activities.

At the Kebele level Development Agents (DA's) are responsible for planning and implementing distinct activities through the structure of official institution. Among the activities they are undertaking development of team-based afforestation, crop production, and preservation of coffee woodland and carrying out control of soil preservation activities are the primary ones. Development teams are important to manage coffee woodland provenances at local level; they work together with the neighborhood society and undertake awareness creation activities at FTC regarding the significance of woodland provenance in secured regions.

Furthermore, distinct non-governmental organizations (NGO's) like SLM, ECFF, PHE, and Ethio- wetlands are also other stakeholders that are taken part in the management activities of coffee woodland. Almost all of them are involved in activities like the Participatory Woodland Management (PFM), provision of equipment and material, awareness creation service about biosphere reserve regions. Some of the NGO's have an advisory board in the four Kebele which secured coffee woodland are adjacent. The advisory board has an office at local level to talk over on subject of woodland provenance management and difficulty associated with woodland management with local communities. As the Woreda administrator stated to enhance the livelihood of neighborhood society in their own garden coffee region without disturbing the secured woodland, the role of distinct NGO's is high. For example, ECFF provides portable solar machines that decrease neighborhood society dependency on woodland provenances.

Rules affecting community participation to manage coffee woodland

In the study region even though the degree of participation differs from individual to individual, all of the neighborhood society members have taken part in distinct kinds of management activities to secure the coffee woodland region. Among the management activities performed by local communities to secure the coffee woodland region planting distinct kinds of trees, regeneration activities, group meetings regarding the protection of coffee forest area, and collective action activities like group work are the primary ones. As elderly key informants signified, after coffee woodland region come under the control of state as a national woodland priority region, participation of neighborhood society in the management activities are decreased. The regulation commenced to rule the woodland was cause for a number of household's eviction from their coffee plots on which their livelihood was dependent for many years. Demarcation regulations and ownership rights are the primary factors affecting participation of neighborhood society in coffee woodland management activities. Thus, in the following sub-section, this demarcation and regulations would be discussed in detail.

Demarcation regulation and participation in coffee woodland management

In the study region, the current demarcation regulations utilized to rule the coffee woodland region are not respected by most of the sampled respondents. Majority of the respondents 73.6% perceived demarcation regulation as not fair and the other 23.2% of the respondents perceive the demarcation regulation as fair. The remaining 3.2% of respondents have observed the demarcation regulation as completely fair. Generally, the results obtained from household survey signified that the current demarcation regulation of coffee woodland is not fair for most of sample respondents.

Moreover, various studies also signified that the impact of coffee woodland demarcation on the livelihood of the neighborhood society is very huge and multi-dimensional. As Zewdie (2009) study signified, demarcation regulations have no advantage for the adjacent community; all it can bring is poverty resulting from the exclusion of community from accessing woodland products mainly wild coffee.

Similarly, in-depth interview results with neighborhood society elders and FGD discussant group revealed that demarcation of woodland provenance has brought impacts on decreased role of neighborhood society regarding the utilization and management right of coffee woodland in biosphere reserve region (core and buffer) zone. As they stated, there are some activities which the community is allowed to do but some others are forbidden and restricted by law.

As informant pointed out the core, zone was a securely secured site for conserving biological diversity by restricting access. In this management zone, many activities are prohibited, including expansion of agricultural land, management of wild coffee, inhabitancy, livestock grazing, timber extraction and collection of dead trees, wild honey harvesting, hunting, and grazing. As the biosphere management guideline shows, only four activities are allowed in the core zone region, i.e., enrichment of plants using autochthonous species, establishment of research plots, ecotourism and education and training center. Although the guideline says this, key informants at Woreda agricultural and woodland preservation office director show, local communities can also utilize distinct spices that do not exist in the buffer zone region, but they are not allowed to cut and carry.

The elderly key informants also add up that, buffer zone is surrounded or contiguous to the core zone. This region acts as a buffer for the core zone and accommodates more human activities. In buffer zone management more than ten activities are prohibited, including inhabitancy, introduction of coffee varieties, planting exotic trees, timber harvesting and hunting of wild animals are the primary ones. In this management zone activities like small-scale agricultural activities, (without expansion of the existing farmland), coffee woodland management (without expansion of woodland land), traditional honey production, and other few activities are allowed.

Preventing neighborhood societies from accessing core zone regions and limiting their utilization right to the buffer zone are intended to decrease pressure on woodland. The goal of current demarcation regulation is to preserve the remaining biodiversity in the coffee woodland region. As key informant interview with district manager of bio-sphere reserve shows, distinct activities are performed to

preserve woodland and its inhabited bio-diversity without affecting the livelihood of local communities.

Generally, demarcation regulation of coffee woodland set up by government to preserve primary coffee woodland in distinct parts of the country is one of the regulations that operated as disincentive for neighborhood society to take part in coffee woodland management activities in the study region.

Local community participation in decision-making process

Empowering local citizens and community organizations in decision-making processes, not only increases efficiency but also provides a real possibility to individuals or groups to transform their choices into desired actions and outcomes, FAO (2010). In the study region, the participation of neighborhood society in any kind of decision-making process is very low, and from the total respondents only few of them had a chance to take part in the decision-making activities at local level and most of them are not participates in any decision-making process regarding the management of coffee woodland at any level.

Table 9 signified that 87.2% of respondents are not taken part in decision-making process but only 12.8% of respondents have a chance to take part in decision making process at local level. This implies that majority of the respondents are neither the initiator nor the primary factor in making decision over any events affecting their lives.

Likewise, in-depth interview results with neighborhood society elders signified, government first demarcate the woodland without any prior participation and awareness creation among the local communities. However, only a few members of the communities were got the chance to take part in discussion and decision-making process. Indeed, the first target of the policy was saving the woodland from denudation and then after, turning in to neighborhood society participation and giving awareness creation about the regulation that rule the coffee forest regions. This "prior action and late participation" principle of government generate confusion in the local communities initially when the regulation was applied.

FGD discussant group also signified that the regulation that currently governs the coffee woodland is directly imposed by the government bodies without any prior participation of the community (Table 10). This regulation is discouraging the participation of the community in coffee woodland management through imposing restrictions over the utilization right of distinct woodland products, prohibition of entering the core zone and conducting distinct management activities; prohibition of selective utilization of trees for timber and their own household consumption; limited access of woodland provenance in the buffer zone and prohibition of collecting fuelwood from both core and buffer zone are some of the regulation that imposed on the neighborhood society without any intense participation of them in decision-making process.

The absence of community participation in decision-making process initially when the regulation commenced was another factor that operates as disincentive for local communities to take part in the management activities of coffee woodland at biosphere reserve regions.

Ownership right and participation in coffee woodland management

The respondents were asked whether ownership right of coffee woodland at the bio-sphere region is secure or not. The following frequency table is utilized to indicate the ownership right of respondents in secured coffee woodland region.

Table 11 shows that 88.8% of respondents answered the ownership right of coffee woodland in secured region as insecure and the remaining 11.2% of them, on the other hand, answered the ownership right of coffee woodland in secured region as secure. The survey results signified that majority of the respondents have insecure ownership right over their coffee woodland provenances and this, in turn, affects their participation in the management activities.

Yeraswork (2000) clearly stated the significance of secure tenure system in the management of land and land-related natural provenance. He argued that secure tenure system plays a key role in administrating natural provenances while insecure tenure system is detrimental to the adoption of preservation practices by local communities. Interview result with FGD discussant group also signified that, in the secured region, ownership rights of the local communities are not secure; they do not have a certificate for their buffer zone region (semi-woodland coffee) plots up to now and the bad demarcation experiences they have encountered in the past decrease their participation to manage coffee woodland.

Table 9. Frequency and percentage distribution of respondents based on their perception regarding the current demarcation regulation of coffee forests

Demarcation regulation	Freq.	Percent	Cumulative percent
Completely fair	4	3.2	3.2
Fair	29	23.2	26.4
Not fair	92	73.6	100.0
Total	125	100.0	

Table 10. Frequency and percentage distribution of households based on their participation in decision-making process

Participation in decision-making process	Freq.	Percent	Cumulative percent
No	109	87.2	87.2
Yes	16	12.8	100.0
Total	125	100.0	

Table 11. Frequency and percentage distribution of respondents regarding their own security

Ownership right	Freq.	Percent	Cumulative percent
Secure	14	11.2	11.2
Insecure	111	88.8	100.0
Total	125	100.0	

As it was mentioned above in the study region the use and management right of woodland provenance in distinct management zone is not similar. In this regard, in the core zone region of coffee woodland, local communities have limited operational level (access and withdrawal) right, i.e., they have the right to enter into the coffee woodland region and harvest only spices without any management activities. Any other activities like wild coffee harvesting, management, beekeeping, timber extraction, etc. are strictly forbidden. In the core zone, neighborhood society has no right over collective-choice level (management, exclusion, and alienation) right at all.

On the contrary, the neighborhood society has relatively both full and limited operational levels (access and withdrawal) right in the buffer zone. Products like wild coffee, traditional honey production, and distinct spices are accessed and removed by the farmers, but some products like timber harvesting, animal fodder, modern beekeeping, and fuel woods are not allowed to be accessed and withdrawn. In this management zone neighborhood society also has some collective-choice level (management and exclusion) right over products like semi-woodland coffee and honey but they do not have alienation right at all.

The above interview result revealed that neighborhood society has lost its ownership right in secured coffee woodland region and their participation in management activities are decreased as compared to before demarcation time in which they have secure ownership right. The ownership right of coffee woodland in biosphere region is the other regulation that operates as disincentive for the local communities to take part in the management of secured coffee woodland region.

Attributes of the coffee woodland user community

Cohesiveness, heterogeneity and group size

Community attributes have made crucial contributions to the enforcement and maintenance of the regulations constituting the management of the prevalent property forests. These community traits are the cohesiveness of communities (engendered by history/myth as to the prevalent origin, the existence of venerated community symbols, and fairly small size, homogeneity of communities, in terms of occupation and wealth) insulation from external forces such as commercial interests (Yeraswork 2001).

Cohesiveness is one important attribute of the community that positively influence the management of coffee woodland in the study region. In Iluu Abba Bora Oromo's *consanguine* and *affinal* kinship relations are widely observed. They trace *consanguine* kinship groups through matrilineal family that is prevalent among the Oromo people (Zewdie 2009). As elderly key informants signified, decades ago neighborhood society of Bilo-Nopha region was highly cohesive due to their prevalent cultural beliefs, norms, and values. They have a culture of prevalent life and their attachment was very high. In the past time, Oromo people had their own traditional beliefs *waqefanna*. It is belief in one God which is the creator of the whole universe and encompasses woodland ritual and sacred forests. At that time the utilization over coffee woodland region depended on the ancestral background which was known as *jahan noonnoo*. *Jahan noonnoos* is kinship system among Illu Abba Bora Oromo which discussed a rightful claim to share of the woodland from elders controlling the allocation. Hence, people who could have traced their descent from the ancestral background utilized and administrated the coffee woodland region and non-members were excluded from the utilization right. Through using their prevalent ancestral background, neighborhood society of Bilo-Nopha village maintain their coffee woodland for the past many years.

As literature signified, following the agrarian reform of 1975 the role of customary institution in general and the role of kinship, in particular, cease to exist and were substituted by peasant association and distinct committees established to preserve forest resources throughout the country. Afterward, local communities are also ethnically heterogeneous resulting from their origins in Tigray, Wollo, and Gonder through government-initiated inhabitancy programs.

As elderly key informants signified, following the abolishment of autochthonous institutions and arrivals of re-settlers from other parts of the country there was a difficulty of coffee woodland management in the study region. The competition over woodland products and agricultural land expansion was become high, where the woodland was accessed openly due to the devaluing of customary regulations. Locals were competing to hold the woodland for coffee plantation and landless individuals competed to hold the woodland either for farmland or coffee plantation.

The study region community is also known for its heterogeneity, in terms of occupation, belief system, and other characters. As the survey result signified, most of the communities in the study region depend on woodland and woodland-derived provenance, crop production, and cattle raising as their means of livelihood strategies, they also belong to distinct religious affiliation and ethnic groups.

In the same way, respondents were asked whether the heterogeneity of the community in terms of occupation and ethnicity has an impact on their participation in coffee woodland management activities or not. Accordingly, 83.2% of respondents answered heterogeneity of the community has no impact on their participation in coffee woodland management but only 16.8% of respondents responded that heterogeneity has impact on their participation in coffee woodland management (Table 12).

Table 12. Frequency and percentage distribution of respondents in terms of their perception regarding the impact of heterogeneity in coffee woodland management

Heterogeneity of the community	Freq.	Percent	Cumulative percent
No	104	83.2	83.2
Yes	21	16.8	100.0
Total	125	100.0	

The household survey result implies majority of the respondents perceive that heterogeneity of the community has no impact on their participation in coffee woodland management activities. In fact, it is signified in many literature that, the longtime attachment of woodland provenance users with the woodland concerned, which is very much specified by the 'rootedness' of a community. In this regard, most of the local Oromo population living in their home for many years have high affiliation with the woodland and they have their own norm, culture, and value towards woodland utilization and management than the re-settlers. In this regard study by Stellmacher, (2006) also revealed that attributes of the community especially heterogeneity and group size have a great impact in woodland provenance management.

Conversely, the result obtained from in-depth interviews with elderly key informants and FGD discussant group signified, heterogeneity of the community has no impact on the management of coffee woodland. Even though, the neighborhood society consists of distinct ethnic groups especially after the 1980 resettlement program of government both locals and re-settlers have prevalent interest to take part in management of coffee woodland region. The re-settlers to the region simply learn and accept the regulations of the established group and their cultural difference on the other front do not affect their participation in administrating coffee woodland.

The FGD discussant group also signified that before demarcation there is no effective regulation that rules the behavior of local woodland user community, and there was conflict even between the locals over economic interest, but after the coffee woodland region becomes under the custody of government, there are rules that provide a structure to guide which person has which specific right to utilize which woodland provenance to what extent, in which way goods and services are to be used, as well as preservation measures that are to be accomplished. Therefore, there is no disagreement between locals and re-settlers over the utilization and management of coffee woodland regions.

Group size of the local woodland user community is another factor affecting the management of coffee woodland. The study region woodland user community is large in size; the total number of coffee woodland users is 2,670 people living in 1,142 households from the three selected sites of study in Woreda.

As elderly key informants signified, high group size impede the coffee woodland through increasing pressure on woodland provenances and creating conflict of interest and illicit encroachment over the coffee woodland user. Moreover, Ostrom (1999) study states three negative impacts of large group size. First, cost for devising institutions increases with larger groups of appropriators. Second, larger groups enhance ethnic, cultural, and linguistic diversity, hence decreasing homogeneity and thereby complicating shared understanding about provenances and their management. Third, larger appropriator groups have more heterogeneous concerns, perceptions, and assets.

Attribute of the coffee woodland provenances

Topography, distance, size, and boundaries of the coffee woodland area

The woodland of southwest highland of Ethiopia is predominantly of the broad-leafed evergreen type. In the higher regions, above 2,400 m asl, bamboo (Arundinaria alpine) is found, while in the lower altitudes below 1200 m asl the high forest grade into lowland forest and then woodland savannas. The specific study regions of Bilo-Nopha Woreda have existed in the south-western part of the country and topographically it is not suitable for any agricultural activities and inhabitancy purposes. It is a mountainous land and difficult to conduct any kinds of activities in this region. The peculiar characteristics of the coffee woodland land are one of the main reasons that neighborhood societies maintain the woodland land for many years.

The other attribute of woodland provenance affecting the management of woodland products is distance from the woodland regions. Respondents were asked how much in hour their homes are far from coffee woodland region and the following frequency table was utilized to indicate the distance of woodland from the home of respondents.

Table 13 depicts that 28%, of respondents, answered that the distance between their home and coffee woodland region is approximately far from 30min -1hr and the other 20.8% respondents answered that the distance between their home and coffee woodland region is approximately far from 1hr-1.30hr and 1.30-2.00hr respectively. The remaining 19.2% and 11.2% of respondents were answered in less than 30min and above 2.00hr that their home is far from the coffee woodland regions. The above household survey result depicted, majority of the respondents are far in distance up to 2.00hr from the coffee woodland region and their participation is less in the management activities. As the further coffee woodland region is far from the home of neighborhood society, the lower participation of neighborhood society in coffee woodland management.

Similarly, a study conducted by Gunatilake, (1998) signified that the distance from the woodland is also considered as a contributing factor for coffee woodland management activities. Proximity to the woodland has an effect on natural provenance management. Those who are close to the woodland will rely more on natural provenance than those are far from it. This means if people travel small distances to collect natural provenance products, there is a high tendency of visiting on daily or weekly basis.

Table 13. Frequency and percentage distribution of respondents in terms of their distance from coffee woodland region

Distance from woodland	Freq.	Percent	Cumulative percent
Less than 30 min	24	19.2	19.2
30 min-1 hr	35	28.0	47.2
1.00 hr-1.30 hr	26	20.8	68.0
1.30 hr-2.00 hr	26	20.8	88.8
Above 2.00 hr	14	11.2	100.0
Total	125	100.0	

Table 14. Frequency and percentage distribution of respondents in terms of their perception about multiple utilization of coffee woodland

Goods and services from woodland products	Freq.	Percent	Percent of case
Cash income earning	120	36.8%	96.0%
Subsistence utilization	81	24.8%	64.8%
Biodiversity preservation	71	21.8%	56.8%
Soil erosion and water preservation	54	16.6%	43.2%
Total	326	100.0%	260.8%

Note: Total is greater than sample because it is multiple response answers

In the same way, to survey, the in-depth interview result obtained from selected neighborhood society elders and FGD discussant group also confirm that the core zone region is very far from the home of neighborhood society and it takes up to seven hours to reach into it. Buffer zone relatively near to the home of neighborhood society, and they took part more in this management zone than core zone region which far from their home.

Concerning size and boundaries, the coffee woodland region is very difficult for effective control. As in-depth interview results with selected neighborhood society elders signified, the size of the coffee woodland region is vast, and there are no clear boundaries for effective management. As elderly informants stated, the largeness of the coffee woodland regions by itself generates difficulties of effective control and management activities. Besides the largeness, the coffee woodland there is also no clear boundaries that exclude non-member to control illicit users. People from Suphe and Alge Woreda come up to Nopha inside of the coffee woodland regions to extract woodland-derived products. There are also no guards to secure and control the coffee woodland regions, because it is beyond the capacity of local management to hire many guards at a time.

As neighborhood society elders told the researcher, even though the coffee woodland region is large in size and there is also no clear boundary to exclude others, before demarcation neighborhood society by itself manage the coffee woodland region sustainably through using their own traditional mechanism without any difficulties. But after demarcation, illicit users have intensified due to government control of the woodland by prohibiting the utilization and management rights of people.

The qualities of the coffee woodland derived provenances

The other positive attribute that enhances the protection and maintenance of coffee woodland provenances is, its derived goods and services. Natural provenance is endowed with distinct provenance that is a necessity needed by the neighborhood society, these are its quality of being a provenance of abundant woodland products and/or services when humans invest time, labor and/or capital input to extract them from woodland provenances (Stellmacher 2006).

It is the fact that, the coffee woodland in the study region were administrated not only due to its inconvenient physical attribute but also administrated due to distinct goods and services they provide for the local communities, for instance, wild coffee, beekeeping, fuelwood, timber for construction and biodiversity preservation are some of the goods and services that coffee woodland in the study region provided for the communities. Consequently, the neighborhood society members have prevalent interest to manage the coffee woodland region.

Respondents were asked about the significance of coffee woodland based on the goods and services they provide. Accordingly, 96%, of the respondents perceive the significance of coffee woodland as provenance of cash income. The other 64.8% and 56.8% of the respondents were perceiving the significance of coffee woodland as subsistence utilization and preserving biodiversity respectively. A sizable few 43.2% of the respondents perceive the significance of coffee woodland as securing soil erosion and water preservation respectively (Table 14).

Similarly, the result obtained from in-depth interviews with neighborhood society elders and FGD discussant group also signified that the livelihood of most of the communities depends on woodland and woodland-derived provenances. They utilized woodland and woodland-derived product as a means of their income generation so as to fulfill the basic needs of their family members. Local communities secure and actively took part in the management of coffee woodland region as it has significant contribution to their livelihood strategies. In sum, attribute of woodland land and its derived goods and service operations as incentive and disincentive to manage coffee woodland in the study region.

Challenges of coffee woodland management

Coffee woodland of southwestern Ethiopia witnesses alarming denudation at annual rate of up to 9%. This is mainly due to the expansion of small holder's agriculture and overutilization of timber and non-timber woodland products driven by poverty, this development does not only promote change of local climate, land degradation, erosion and scarcity of woodland products-all worsening poverty cycle but also leads to the irreversible detriment of woodland bio-diversity and the coffee gene pool (Stellmacher and Mollinga 2009).To decrease denudation and maintain distinct biodiversity in the coffee woodland region, government set up the national forest priority area (NFPA) program that is utilized to preserve woodland in distinct management zone. The regulation that forbids and restricts the utilization of distinct coffee woodland products in secured regions by neighborhood society generates other difficulties in the lives of woodland adjacent communities.

Result from in-depth interviews with neighborhood society members and FGD discussant group signified, deficiency of sense of ownership is one of the primary difficulties affecting the management of coffee woodland after demarcation regulation imposed on neighborhood society to rule the secured regions. Different forms of ownership existed before demarcation including private goods and prevalent property provenance. After demarcation, however, most of the community members have no both operational-level (access and withdrawal) and collective-choice level (management, exclusion, and

alienation) rights. This makes the utilization and preservation of coffee woodland very difficult. Local community members have been administrating their coffee woodland provenance which was bequeathed from their forefathers through autochthonous provenance management mechanisms for the preceding years and still now claims ownership right. In the preceding years, the buffer zone coffee woodland region was their own individual plot and the core zone region was utilized as a prevalent property provenance. Before the current regulation used to administrate the woodland region, there was through autochthonous institutions like council of elders, and distinct local arranged workgroups that prevalent property provenance was administrated and any kind of illicit utilization over coffee woodland provenances were handled. Due to the 1975 agrarian reform, the role of that autochthonous institution was weakened and substituted by distinct another government official legal structure like peasant association. Now, after the bad demarcation regulations, neighborhood society dispossessed their prerogatives and ownership right both at the core and buffer zone regions.

Similarly, the effects acquired from FGD discussant group also found out that the application of demarcation rule without any intense attendance of the neighborhood society members in choice-making process, decrease their attendance in coffee woodland management activities. As discussants said, after demarcation of coffee woodland location, neighborhood society senses deficiency of the impression of possession even for their semi-woodland plot inside the demarcated regions. This is because they do not possess certificates or green cards that insure their warranty for private lands.

Illicit encroachment is the other dispute affecting the management of coffee woodland in the study site. The illegal utilization of various woodland products like timber logging and cutting trees have accelerated in the preceding few years due to neighborhood societies dispossessed woodland provenance ownership that they utilize and administrated for the preceding few years. As elderly key informants signified, monitoring all parts of the coffee woodland site is very hard, because it includes13.305 ha undisturbed woodland land and there may be also no guards that manipulate the woodland site vicinity. Illicit encroachment of coffee woodland areas in the secured vicinity increases due to the deficiency of effective rule that administrate the woodland areas particularly after it ends up under the possession of government.

On contrary to what the Nopha Woreda administrator stated, that is, there are enhancements in administrating illicit encroachments after demarcation of woodland as a countrywide priority area, but the result received from elderly key informants signified the opposite of what was stated by Woreda administrator. As they signified, presently illegal encroachment could be very high compared to the preceding years whereupon nearby societies administrated their own woodland in line with the guidelines handed of their conventional customs.

Up to now, the neighborhood societies are claiming their possession of the woodland areas, and nonetheless, there are conflictual relationships that exist between neighboring communities and government agents. As the informants stated, confrontation over the de jure ownership of woodland provenance in study site worsens the growth of illicit encroachment, fast denudation, and degradation of woodland area provenance populations.

In distinct cases, inadequacy of adjustment and clear-cut area of responsibilities in distinct shape of official institutions are the other *dispute* of coffee woodland management inside the study areas. As key informant interview with bio-sphere reserve supervisor indicated, there is false impression from distinct stakeholders in comprehending the standard of the rule that administrates coffee woodland at the core and buffers management regions. On one hand, government agents understand that there may be no difference between the core and buffer management area in the impression that both regions are secured and any form of utilization and management activities are strictly prohibited. On the other hand, distinct stakeholders like NGO's realize that there is a distinction in the core and buffer management zone via using UNESCO Man and Biosphere principle. In keeping with the rule, neighborhood community has some utilizations and management right over their buffer zone woodland sites. This false impression creates tremendous confusion on the neighborhood coffee woodland users. While the director of biosphere reserve stated, this year, because of false impression of distinct stakeholders about the rule that administrate coffee woodland site, 5 farmers were arrested in the other block of the coffee woodland area for using forbidden products in buffer management area.

These issues of thought are arising from inadequacy of coordination among dissimilar stakeholders participating in management activities. The coordination of dissimilar stakeholders is poor and less coordinated; all of them operate with no prevalent strategy and goals leading to prevalent ends. There is additionally very little accountability and transparency between dissimilar areas of position facilitating the practical management of coffee woodland. Therefore, inadequacy of well-coordinated relationship between distinctive stakeholders participating in management activities aggravates the issue of coffee woodland provenance management in the study locations.

In conclusion, although distinctive anthropogenesis factors like overpopulation caused by both natural increase and migration, exploitation of timber for economic and house consumption purposes, alteration of woodland land into agricultural and new inhabitancies have threatened the presence of various multifariousness that is found in coffee woodland areas. However, the principles that formulate to resolve the above issue led to the creation of other big issues on the livelihoods of the surrounding people within the study site. Since the rules used by the government are less participatory and are derived from the happening of foreign countries, surrounding society had no probability to take part in the scenario that has an effect on their lives. The unintended and uncoordinated nature of the rule resulted in eviction of surrounding society from their woodland land, insecurity of possession rights, illegitimate

encroachment over the secured coffee woodland and conflict between the indigenous communities and government agents.

REFERENCES

Agrawal A. 2007. Forests, Governance, and Sustainability: Common PropertyTheory and its Contributions.International Journal of the Commons 1 (1). DOI: 10.18352/ijc.10.

Andinet D. 2010. Local-level institutions and their influence on forest resource management: the case of Yayo Forest in Iluu Abba Bora Zone, Southwest Ethiopia. [MA thesis]. Department of development studies, Addis Ababa University, Ethiopia.

Amogne A. 2013. Forest resource management systems in Ethiopia: Historical perspective. Intl J Biodiv Conserv 6 (2): 121-131. DOI: 10.5897/IJBC2013.0645.

Camic RPM, Yardley L. (Ed.). 2003. Qualitative research in psychology: Expanding perspectives in methodology and design. American Psychological Association, Washington, DC. DOI: 10.1037/10595-000.

Gunatilake HM. 1998. The role of rural development in protecting tropical rainforests: evidence from Sri Lanka. J Environ Manag 53 (3): 273-292. DOI: 10.1006/jema.1998.0201.

Mellese D, Mohammud A. 2005. Legal institutional analysis for sustainable use of forest resource: the case of Sheka forest in southwestern Ethiopia. Proceedings of the 8th Annual Conference of Agricultural Economics Society of Ethiopia, February 24-26, 2005, Addis Ababa.

Ostrom E. 1999. Self-Governance and Forest Resources, CIFOR Occasional Paper No. 20. Center for International Forestry Research (CIFOR), Bogor.

Stellmacher. 2006. Governing Ethiopian Coffee Forests: A Local Level Institutional Analysis in Kaffa and Bale Mountains. [Dissertation]. Department of Political and Cultural Change, University of Bonn, Germany.

Stellmacher T, Mollinga PP. 2009. The institutional sphere of coffee forest management in Ethiopia. Intl J Soc For 1 (1): 43-66.

Tadesse W, Demel T. 2001. 'The Forest coffee ecosystems: ongoing crisis, problems and opportunities for coffee gene conservation and sustainable utilization. Department of Biological Society of Ethiopia, Addis Ababa.

Teklu T. 2006. Coffee forest conservation: local-level institutions influencing the conservation and use of coffee forests in southwestern Ethiopia. [Dissertation]. University of Hohenheim, Germany.

Yeraswork A. 1997. Forest, Animal and People: Surviving through Harmony- AStudy of the Desse'a Forest of Eastern Tigray. Conference on Environment and Development in Ethiopia, June 12-15, 1997.

Zewdie J. 2009. Institutions, incentive and conflict in the Conservation and Use of Coffea arabica. The case of Yayo Forest in Iluu abba Bora Zone, Southwest Ethiopia. [Dissertation]. University of Bonn, Germany.

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The local wisdom of the coastal community of Bakaran Village, Central Java, Indonesia, in maintaining rice to improve the food security

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Abstract. *Alfian RL, Iskandar BS, Gunawan B. 2018. The local wisdom of the coastal community of Bakaran Village, Central Java, Indonesia, in maintaining rice to improve the food security. Asian J Ethnobiol 1: 47-52.* Based on tradition, Bakaran Village, Juwana, Pati, Central Java has prohibited (pantang) to sell the cooked rice (*nasi*). This prohibition or *Pantangan* of the Bakaran community appears to be due to *Nyai Ageng Bakaran*, the village's founder. The present study aimed to elucidate the meaning of prohibition (*pantangan*) on the selling of cooked rice and its functions for improving food security in the village. The qualitative with ethnographical and ethnoecological approach was applied in this study. Several techniques were carried out, namely the observation, participant observation, the in-depth interview, and the literature study. The study shows that the Pantangan of selling the cooked rice was initially undertaken based on a story of Nyai Ageng Bakaran that provided a message to his community not to sell the cooked rice and better share it with others. This *Pantangan* has some meaning and values, such as instilling the importance of mutual sharing, helping, and caring among the community members. In addition, *Pantangan* teaches that prosperity is not always measured with money, but keeping people away from starving is a form of prosperity. The *Pantangan* functions as one of how the Bakaran community ensures the security of food needs. Indeed, the *Pantangan* also served as a form of actualization of their identity.

Keywords: Cultural identity, cooked rice, Pati, prohibition of selling, symbolic meaning

INTRODUCTION

Eating food as an activity and basic need cannot be separated from human life. Biologically, humans need food as a source of energy to sustain their life. The fulfillment of the essential requirement of food as the primary commodity becomes the right of every people (Suyastiri 2008). The realization of food security has a strategic role in national development (Budiyanto 2010).

The food materials provided by the ecosystems are continuously utilized to support human life. The intense interrelationship between local people and their environment to fulfill their food needs have created cultural adaptations to the local environment. This is because culture is a medium through which the interactions and transformations with the climate are gained while solving various problems. Any actions that result in the collective memory of the human groups are stored to retrieve the knowledge for the future (Maida 2011).

The discussion of eating, food, fulfillment of food needs, and human adaptations cannot be separated from ethnobiology, which classically studies interactions between people and their environment (Albuquerque and Alves 2016). Ethnobiology may be defined as the study of the knowledge of a particular ethnic group on plants, animals, nature, and related things (Anderson 2011). Today, ethnobiological research has become more complex, and it has been developing relationships between biology and cultural diversity (Ellen 2006). It explores the management of the natural resources, such as flora, fauna, and local ecosystem by the local community, based on the integration of aspects of the social systems. That includes the local knowledge or the traditional ecological knowledge, beliefs, perceptions, local languages, and other social factors and the ecosystems (Iskandar 2016). One of the focuses of ethnobiological research is the utilization and management of ecosystems about food production and consumption (Anderson 2011).

In the socio-cultural context, food has a broader meaning than just being a mere source of nutrients (cf. Minnis 2000). For example, the study on the food of the indigenous community of Jae revealed that, in addition to nutrition, food is also related to belief, status, prestige, solidarity, and serenity (Apomfires 2002). This study also showed that type and variety the food is deliberately selected, and they become the folk medicine system. The survey of the practice of eating of the Minahasa people indicated that the eating activity is a practice that forms the biological and social identity by showing the connection of the Minahasa people to their ancestors and the land where they lived, and their incorporation into the Christian community (Weichart 2004). Food is the primary identity marker of Minahasa people, separating them from others who do not have the same tradition.

In addition, another researcher also mentioned almost similarly that food plays an essential role in building family ties in various community groups in Southeast Asia. The tradition of giving each other among community members has vital meaning for building kinship ties. The community shares food among the still alive people, but the food is

commonly used as an offering to the deceased ancestors in traditional ceremonies. Thus, food has an important role and can be the basis for strengthening kinship relations and can play a role as an identity in describing the relationships between related groups in their relationships to share food with various community groups in Southeast Asia (Janowski 2007).

Another research mentions that the food in almost all communities of Southeast Asia is an essential basis for building relationships with relatives. It is the center of the development of kinship between people who are alive and with the deceased ancestors. Food also becomes an identity in describing the relationship of groups of related people (Janowski 2007).

The discussion of eating by Javanese people cannot be separated from their staple food, namely the cooked rice (*nasi*). Cooked rice has become the main staple food for most of Southeast Asia (Janowski 2007). The cooked rice is always served in each ritual or ceremony and daily life. This is reflected in the study on rice ritual kinship identities and ethnicity in Central Flores, which mentions that the rice and the cooked rice are the prestigious food sources of Central Flores. In the agricultural ritual, the cooked rice is as important as the currency exchange, and it is also offered to the ancestors, the nature spirits, and gods. In addition, the consumption of rice shows the level of a person's social class in the community (De Jong 2007). The cooked rice is mainly used as a source of nutritious food. It can also be used in several prestigious ceremonies in agricultural activities and rituals for the human life cycle in a family and has contributed to the construction and transformation of kinship and ethnicity identities.

For Bakaran Village, Juwana Sub-district, Pati District, Central Java, Indonesia, cooked rice is perceived as a foodstuff that cannot be considered arbitrary. The community of Bakaran Village has traditional wisdom about cooked rice. They have a past story related to the village founder, namely *Nyai Ageng Bakaran*, who escaped from the Kingdom of Majapahit. The Bakaran community has prohibited (pantangan) selling cooked rice based on this story.

This paper discusses the meaning and the functions of local wisdom regarding the prohibition (*pantangan)* of selling cooked rice in the Bakaran community, Pati, Central Java, Indonesia.

MATERIALS AND METHODS

Location

This research was conducted in Bakaran Village, Juwana Sub-district, Pati District, Central Java, Indonesia. The village of Bakaran has situated approximately 3 km to the west of the central government of Juwana sub-district, Pati district, Central Java (Figure 1). The village of Bakaran was divided into two new villages, Bakaran Wetan and Bakaran Kulon, after the Indonesian independence. Today, although the village has been administratively divided into two separate villages, the local people consider themselves as belonging to the community of Bakaran Village. This is because Nyi Ageng Bakaran undertook the ecological history of establishing Bakaran Village by cutting and burning the forest. As a result, they still consider themselves the descendants of Nyai Ageng Bakaran and belong to one culture of the Bakaran community. In this study, the two administrative villages are considered Bakaran Village.

According to ecological history, this village was established by *Nyai* Ageng by burning forests, and therefore, the village's name is Bakaran which means burning. In addition, initially, the extent of the village was determined by the area to which the burning ash of the forest vegetation spread. It was told that the wind carried the burning ash up to the Java Sea. As a result, the Bakaran Village is stretched from South to North to the Java Sea. Since Bakaran is a coastal area, most people are brackish fish farmers. The northern region of Bakaran Village has functioned as a brackish pond area located close to the Java sea (Figure 2. A).

The local people have commonly raised the milky fish (*bandeng*) and shrimps (*udang*). The middle part of Bakaran Village is used as a settlement and a central village administrative area. The territory of Bakaran Village is in the form of a cluster. Meanwhile, the southern region of Bakaran Village is a small part that is used for wet-rice fields farming (Figure 2. B).

The people of Bakaran Village, particularly the women, in addition to involving in agricultural activities, are also engaged in the handicraft activity of making *batik* (*pembatik*) (Figure 3).

Recently, the demand for *batik* production in Bakaran Village has increased. It has also been influenced by the local government's policy of Pati district, which has declared that the typical *batik* cloth of Pati district or Bakaran *batik* cloth must be used as formal office clothing of the Pati district. The average level of education of the Bakaran community is registered as the senior high school (SMA). The illiteracy level of Bakaran Village is low.

The majority of the Bakaran community people are Islams by religion, and a small number are Christians and Buddhists. Islam is predominantly considered part of the Nahdatul Ulama (NU). Consequently, the community has primarily practiced various traditional rituals, such as *ngalab berkah* to *punden* (pilgrimage to the founder sacred grave of the village or *ziarah ke makam* or *petilasan pendiri desa*), *slametan*, or *menjaga leluhur*, which are considered as traditions of the pre-Islamic time. This phenomenon is strongly influenced by the history that, in the past, the Bakaran Village was one of the centers of the believers of the Javanese origin (*Kejawen*).

The staple food of the Bakaran community is cooked rice. Although the *sawah* areas are not as big as the brackish pond (*tambak*), the community of Bakaran Village has enough cooked rice. The rice is internally produced by the community and obtained from the Juwana sub-district market. In addition, according to the local wisdom of the village community of Bakaran, there is a prohibition on the selling of cooked rice, due to which rice stock has been continuously maintained.

Method

The method used in this study was qualitative with an ethnographical and ethnobiological or ethnoecological approach (Spradley 2007; Iskandar 2012; Albuquerque et al. 2014). The ethnography approach was applied as the essence of ethnography is to pay attention to the meaning of events in an individual or community that is to be understood (Spradley 2007). In addition, the ethnography technique is also used to understand the indigenous or traditional people about their life or to get their worldview (Malinowski 1922 cited by Spradley 2007). Meanwhile, ethnobiology or ethnoecology emerged as that branch of the new ethnography that describes people's conceptual model of their environment (Milton 1996).

Several techniques, mainly observation, participant observation, and in-deep interviews, were applied in this study. The observation is undertaken to obtain data on the local environmental conditions of the settlement area, the brackish fish pond area, and the wet rice field. The participant observation was applied to observe and involve the researcher with various activities of the informants, including the daily eating of cooked rice, uses of the cooked rice, and the traditional rituals of the Bakaran community. In addition, a deep interview was conducted

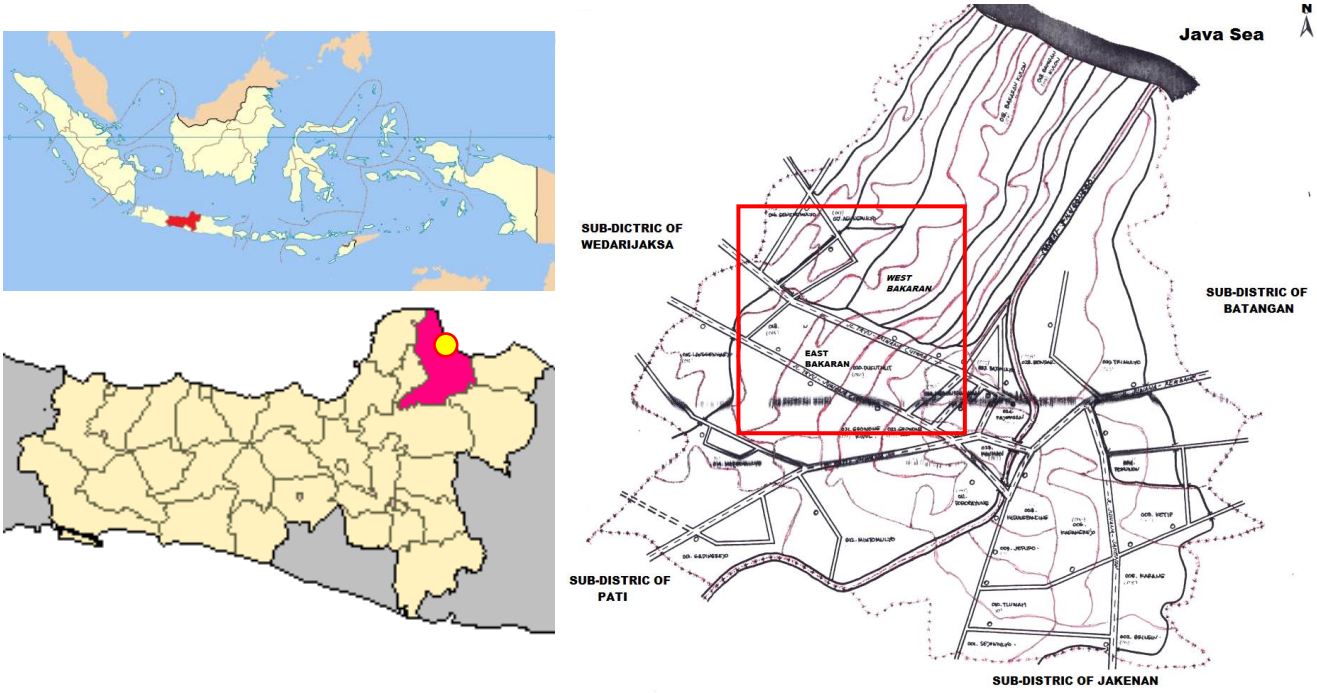

Figure 1. Location of the study area in Bakaran Village, Juwana Sub-district, Pati District, Central Java, Province, Indonesia

Figure 2. A. The brackish pond of the Bakaran Village. B. The wet-rice field (sawah) of the Bakaran Village

Figure 3. The women of the Bakaran Village engaged in 'batik' craft

With the competent informants who were purposively selected by the snowball sampling. The informants selected were the older adults (*sesepuh*), the formal staff (the village staff), and the informal leaders *(tokoh masyrakat).* The in-depth interview was considered an important tool to understand various aspects and activities about the prohibition of selling the cooked rice and crosschecking the data obtained through observation and participant observation (Koentjaraningrat 1991).

The analysis of data is intended to look for patterns (Spradley 2007), in addition, to determine the social basis of the existing structure (Geertz 2016). The study of information consisted of four activities: data collection, data reduction, data presentation, and making conclusions or verification (Miles and Huberman 1992). Moreover, to make a narration, some activities were carried out: cross-checking, summarizing, synthesizing, and making descriptive and evaluative narration (cf. Newing et al. 2011).

RESULTS AND DISCUSSION

The story of Nyai Ageng Bakaran: the beginning of the prohibition of selling of cooked rice

The discussion of the consumption of the cooked rice, the local wisdom, and the general culture of the Bakaran people cannot be separated from the past story of the Bakaran Village founder, popularly known as *Nyai Ageng Bakaran.*

Historically, *Nyai Ageng Bakaran* was one of the members of Majapahit Kingdom. She was responsible for providing food for the members of the kingdom. Before the collapse of Majapahit and infiltration, Islamization was done by the Sultanate of Demak. Consequently, many members of the Majapahit, who were not yet Islamized, decided to leave the kingdom. This is also because the King of Majapahit chose to leave his kingdom. During the escape, the community believed that the life of *Nyai Ageng Bakaran* was full of concerns and limitations. One of the informants mentioned as follows: *"sawijining dina, nate Nyai Ageng punika sampun pirang-pirang dinten mboten dhahar Mas. Lajeng ngoten Nyai ningali tebih punika wonten warung ingkang rame sanget. Nyai ingkang sampun putus asa kedah pripun ngewanikaken kangge nyedak ugi nyuwun sabungkus sekul amargi Nyai ugi rombonganipun sampun kaluwen. Ananging ingkang gadhah warung malah ngusir Nyai amargi dipun anggep ngeganggu tiyang ingkang tumbas maeman."* (Basir 2016, press com).

It can be translated as follows: "I inform you Brother (*Mas*) that once, *Nyai Ageng* had not consumed the cooked rice for several days. Then, *Nyi Ageng* looked at a very crowded small food shop (*warung makan*), present at a distance. Desperate and starved, *Nyai Ageng* and her group got closer to the shop and asked for a pack of the cooked rice. However, instead of giving them cooked rice, the small shop owner expelled them, considering that they are disturbing consumers who wanted to buy food from the small shop" (Basir 2016, press com).

This story is recognized as the background of the prohibition (*pantangan*) to sell cooked rice in the Bakaran community. The limitation, the concern, and the unpleasant treatment caused *Nyai Ageng Bakaran* to provide a message to each member of her entourage to appreciate and preserve every food that was owned, particularly the cooked rice, as the staple food.

Practice and meaning of the symbolic *pantangan* to sell the cooked rice

The origin of the prohibition (*pantangan*) to sell the cooked rice was the bad life experience of *Nyai Ageng* of Bakaran, as an escape from the Majapahit. In addition, she was unkindly treated by a seller of the small food shop when she asked for help to get the rice cooked. It caused the prohibition (*pantangan*) on selling cooked rice.

This prohibition (*pantangan)* has been obeyed by the community of Bakaran Village until now. They believe that if the prohibition is violated, it will bring disaster (*bendu*) for the person who broke─it. One of the informants mentions as follows: "*pantangan dodolan sega kuwi ora iso dilanggar mas. Bahaya tur iso kena ciloko nak ono sing wani ngelanggar pantangan kuwi. Iku tonggoku contone mas, biyen tau dodolan sego, awit dodolan nganti saiki loro-loronan terus ora mari-mar*i." (Basir 2016, press com).

It can be translated as: "Brother (Mas), I inform you that the prohibition on selling the cooked rice cannot be violated. It is dangerous and can be wretched if anyone dares to break the *pantangan* (taboo). For example, my neighbor in the past had sold the rice cooked. Consequently, she fell ill and has not been cured until now" (Basir 2016, press com).

Today, the community of Bakaran Village believes that cooked rice is the main staple food that each person needs. This story has been transmitted the concern of the *Nyai Ageng Bakaran*, resulting in the community believing that it must not be sold for personal benefit. Instead of selling, it may be given to other people who need it.

For the community of Bakaran Village, giving and sharing the cooked rice has several meanings. Firstly, the prohibition (*pantangan*) creates a value for each Bakaran community member to share, help, and keep each other. The importance of sharing is intended not only for physical sharing but also for sharing anxiety, happiness, and other feelings. The cooked rice is only symbolic in creating this important sense. When each community person can share others' feelings, they will help each other or among groups. As a result, the community will develop a mutual understanding when each community member can share feelings and help others. Finally, mutual care for each other is created.

Secondly, the prohibition symbolizes that each person should not only benefit himself or become rich. The message given by *Nyai Ageng* Bakaran is that material richness alone does not guarantee one's prosperity. If all community members, such as relatives, neighbors, and the general public, are saved from starving, that is a form of prosperity for Bakaran Village. Each Thursday, the community of Bakaran usually visits the sacred grave (*punden, makam,* or *petilasan*) of *Nyai Ageng Bakaran* to get blessings (*ngalab berkah*) or pay respect to *Nyai Ageng*. Many people will bring the cooked rice to the *punden* as a form of gratitude and distribute it to persons who conduct pilgrimage (Figure 4.A-4. B). In addition, each Thursday, the guardian of the grave (on behalf of *Nyai Ageng Bakaran*) also distribute the food (a parcel of the cooked rice, cassava, or other staple foods) as a form of sharing so that the people do not starve (Figure 4. C).

The functions of the prohibition (*Pantangan)* of selling the cooked rice

Though the prohibition on selling cooked rice is not changed (*ajeg*), in reality, the local wisdom is always negotiated according to the community's needs. For example, in the past, the community of Bakaran was not allowed to sell the hulled rice (*beras*) at all. Today, however, they are not allowed to sell only the cooked rice, but selling the hulled rice or other forms, such as the rice cake (*lontong),* is permitted.

Firstly, the prohibition on the selling of cooked rice has caused regarding rice as a sacred food; as a result, its utilization should not be for arbitrary purposes, such as for selling. The food, particularly the cooked rice, must be only consumed to fulfill the human need. This prohibition on the sale of cooked rice can finally realize the food security of the community of Bakaran through the local wisdom they believed. One of the old men mentioned as follows: "*wong Bakaran iku awit biyen nganti saiki orak pernah krungu ono sing kurang mangan mas. Wong bakaran iku apik-apik, nak weruh tonggone ora duwe lawoh yo diweki lawoh, ora duwe sega yo diwenehi sega. Dadi mboh duwe duit opo ora, wong Bakaran iku mesti iso mangan*." (Cempluk, 2016, pers. com.)

It can be translated as follows: "Brother, I inform you that the Bakaran people from the past until now have never heard about getting starved. The Bakarans are always good; if someone sees his neighbor does not have the fish, they will give fish. In addition, if someone does not have the cooked rice, they will be given the cooked rice. Therefore, whether they have money or not, the Bakaran people can always eat the cooked rice" (Cempluk 2016, pers. com.)

This function is in harmony with law No.41 2009, which defines food security as a condition of fulfilling both in quality and quantity of safe, evenly distributed, and affordable (Dewan Ketahanan Pangan, 2010).

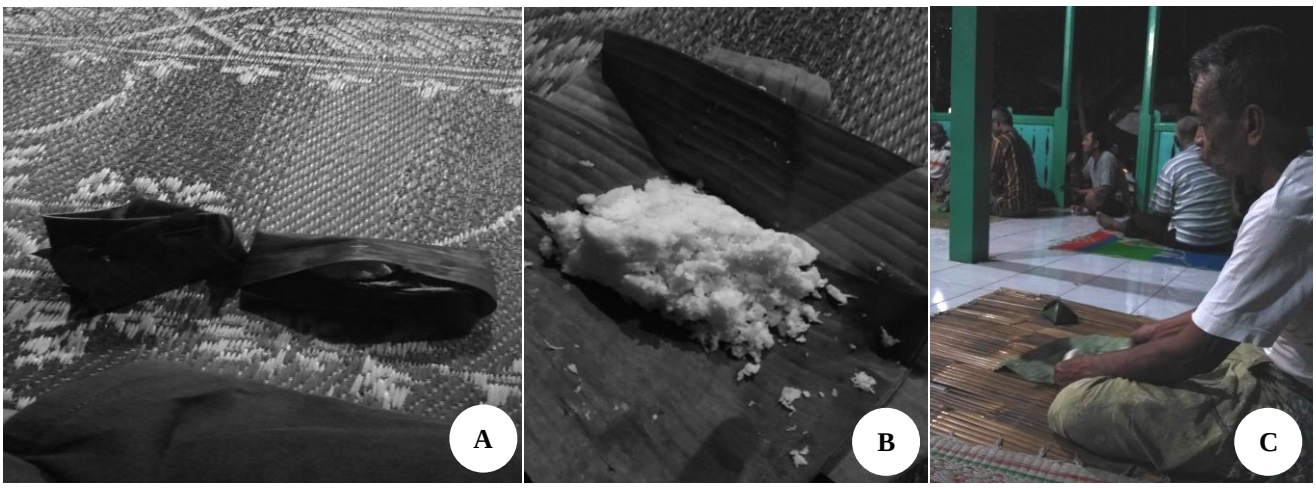

Figure 5. A-B. Serving food at the punden or the sacred grave of the Nyai Ageng Bakaran Village. C. The people of Bakaran Village eating together at the holy tomb of Nyi Ageng Bakaran

The second function is the socialization of the prohibition (*pantangan*) to sell the cooked rice always begins with the story of *Nyai Ageng* of Bakaran, which is a way the community rememorizes the story of the past, and is aimed at establishing identity awareness. Since the memory itself can be distributed by contexts of the story, the community will fully understand the cultural values and later on can support the identity and stop the values that do not help the neighborhood's identity (Rodriguez 2007).

The local wisdom of the prohibition (*pantangan*) of selling cooked rice is, finally, the distinctive culture of Bakaran Village's community. This identity can strengthen when associated with other groups with different cultures. This is because the culture itself is created, maintained, and transformed through interaction and relationships among them, which is defined as "we" and another, which is defined as "them" (Barth 1988).

To sum up, the local wisdom on the prohibition of selling rice is not steady from the past until now. Each generation's local wisdom is negotiated and interpreted differently based on the community's needs. The story is passed down intergenerational; the cooked rice has become one of the staple foods that is interpreted as sacred, must be kept, and is not for one's benefit. This local wisdom has a profound meaning for the owner of the culture, the Bakaran community, Pati, Central Java, to maintain the food security for their survival and as the cultural community binder. In conclusion, the local wisdom of the Bakaran community is related to sacred, taboo or prohibition, or mystical and essential for cultural adaptation with their environment.

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REFERENCES

Albuquerque UP, Cunha LVFC, Lucena RFP, Alves RRN. 2014. Methods and techniques in ethnobiology and ethnoecology. Springer, New York. DOI: 10.1007/978-1-4614-8636-7.

Albuquerque UP, Alves RRN. (eds). 2016. Introduction to ethnobiology. Springer, New York. DOI: 10.1007/978-3-319-28155-1.

Anderson B. 2008. Imagined communities. Insist Press and Pustaka Pelajar, Yogyakarta. [Indonesian]

Anderson EN. 2011. Ethnobiology: an overview of a growing field. In: Anderson et al. (eds.) Ethnobiology. Wiley-Blackwell, New York. DOI: 10.1002/9781118015872.

Apomfires F. 2002. Food of the traditional community of Jae: a cursory note in the nutrition research. J Antropologi Papua 1 (2): 1-16 [Indonesian].

Barth F. 1988. Ethnic Group and the Limitation of the Social Order of Cultural Differences. UI Press, Jakarta.

Budiyanto MAK. 2010. Model of the food security development based on the banana through revitalization of local wisdom value. J Teknik Industri 11 (2): 170-177. [Indonesian]

De Jong W. 2007. Rice rituals, Kinship identities, and ethnicity in Central Flores. In Janowski M, Kerlogue F. (eds). Kinship and food in South East Asia. NIAS Press, Denmark.

Dewan Ketahanan Pangan. 2010. The general policy of the food security 2010-2014. Dewan Ketahanan Pangan, Jakarta. [Indonesian]

Ellen RF. 2006. Ethnobiology and the science of humankind. Wiley-Backwell, London.

Geertz C. 2016. The cultural interpretation. PT. Kanisius, Yogyakarta. [Indonesian]

Iskandar J. 2012. Ethnobiology and sustainable development. PPKPK-AIPI, Bandung [Indonesian].

Iskandar J. 2016. Ethnobiology and cultural diversity in Indonesia. Jurnal Umbara 1 (1): 27-42. [Indonesian]. DOI: 10.24198/umbara.v1i1.9602.

Kanowski M. 2007. Introduction: feeding the right food: the flow of life and the construction of Kinship in Southeast Asia. In: Janowski M, Kerlogue F (eds). Kinship and Food in South East Asia. NIAS Press, Denmark.

Koentjaraningrat 1991. Research methods of the community. Gramedia Pustaka Utama, Jakarta. [Indonesian]

Maida CA. 2011. Sustainability and Communities of Place. Berghahn Books, New York.

Miles MB, Huberman AM. 1992. Data analysis of qualitative: a sourcebook on new methods. UI Press, Jakarta.

Milton K. 1996. Environmentalism and cultural theory: exploring the role anthropology in environmental discourse. Routledge, London.

Minnis PE. 2000. Introduction. In Minnis PE. (ed), Ethnobotany: A reader. The University of Oklahoma Press, Oklahoma, USA.

Newing H, Eagle CM, Puri R, Watson CW. 2011. Conducting research in conservation: social science methods and practice. Routledge, London. DOI: 10.4324/9780203846452.

Rodriguez J, Fortier T. 2007. Cultural memory resistance, faith, and identity. University of Texas Press, Austin, TX.

Spradley JP. 2007. Method of Ethnography. Tiara Wacana, Yogyakarta [Indonesian].

Suyastiri NM. 2008. Diversification of the staple food consumption based on local potential in realizing the village household of the Semin Sub-district, Gunung Kidul District. J Ekonomi Pembangunan 13 (1): 51-60.

Wichart G. 2004. Minahasa identity: a culinary practice. J Antropologi Indonesia 28 (74): 59-80. [Indonesian]