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Dependence on forest resources and tropical deforestation in Ghana

Mark Appiah · Dominic Blay · Lawrence Damnyag · Francis K. Dwomoh · Ari Pappinen · Olavi Luukkanen

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Abstract In Ghana, forests provide many products on which the local population subsists. However, these resources are depleting due to a variety of factors including agricultural expansion and over-exploitation of forest resources. This paper presents an analysis of the level of local dependence on forest resources and its implications for forest management in Ghana. The paper also outlines the causes of continuing deforestation in the studied region from the perspective of the local residents and discusses what role they could play in addressing the problem. The aim is to share more light on the current causes of deforestation and make suggestions for improved community-based forest management practices that could help to reduce deforestation. Primary data was collected through personal interviews and focus group discussions with 431 household heads randomly selected from three Forest Districts in Ghana. The survey showed that income from agriculture constituted 60% of the average total rural household income. Forest income provided 38% of total household income, and off-farm income 2%. The four most highly ranked causes of deforestation are poverty-driven agriculture, lack of alternative rural wage employment other than farming, household population levels, and conflict in traditional land practices. This shows a shift in the view of local people who in the past were quick to blame logging companies and government policies for deforestation. The majority of the respondents depended on wild animals like snail, bush meat, wild honey and wild and cultivated vegetables. Given the reasons for deforestation, much thought needs to go into

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M. Appiah (✉) · O. Luukkanen
Viikki Tropical Resources Institute, University of Helsinki, Latokartanonkaari 9, P. O. Box 27, Helsinki 00014, Finland
e-mail: mark.appiah@helsinki.fi

D. Blay · L. Damnyag · F. K. Dwomoh
Forestry Research Institute of Ghana, P. O. Box KNUST 63, Kumasi, Ghana

A. Pappinen
Faculty of Forestry, University of Joensuu, Joensuu, Finland

agroforestry practices (e.g. snail farming, bee keeping, fish farming, and vegetable production) in efforts to reduce deforestation, which are currently less promoted.

Keywords Economic dependence on forest · Forest management attitude · Local knowledge · Tropical deforestation · Agroforestry

1 Introduction

Tropical deforestation in Ghana has become a topic of great interest among researchers, policy makers and development practitioners, especially during the past 12 years. This may be because most of the accessible rainforests are still shrinking due to the combined effect of forest fires, logging, agricultural colonisation, mining activities, wildland fires and other development projects. It is believed that at the start of the 1900's, one-third of Ghana's 238,500 km^2 land area was covered by natural tropical forest (Wagner and Cobbinah 1993). By 1989, Hawthorne (1989) estimated that only about 22% (18,000 km^2) of the original tropical forest remained or that 78% of Ghana's tropical forest had disappeared (Repetto 1990). The destruction occurred at 1.3% annually for the period 1981–1985 (Repetto 1988). The most recent study of Africa's vegetation changes, reported by IUCN (2006), estimated 3% per year deforestation rate for Ghana.

It is difficult to have reliable data on the actual rate of tropical forest resources and deforestation because of the different methods of forest resources assessment in tropical countries and the lack of uniform and generally accepted definitions (Goldsmith 1998). Nevertheless, this suggests that tropical forests in Ghana face an ever-increasing set of pressures resulting in the loss of forest and associated biodiversity throughout most of Ghana. Unfortunately, these forests support vital economic and ecological functions, providing commercial trade and employment opportunities (Wagner and Cobbinah 1993). For more than 20 million Ghanaians, particularly people living in the rural areas, the forest is the only source of wood that is used locally as fuel wood, and for construction and furniture. The forests also provide a suitable environment for farming practices (e.g. cocoa cultivation) (Blay et al. 2007).

This view that the rural household is dependent on forest resources is a well-shared one among researchers and development practitioners. In recent years, there has been increasing interests to understand the contribution that forest resources make to local employment, income and the wellbeing of rural communities (Arnold and Townson 1998; Mamo et al. 2007). With few exceptions (Mamo et al. 2007), however, the level of rural dependence on forest resources have often been overlooked in poverty surveys (Cavendish 2000). There is very little investigation on the level of dependence across different socio-economic groups. Empirical information on dependency of forest resources may help to improve macro-level poverty estimates and serve as an input into conservation policy, particularly the establishment of protected areas by determining the potential loss to rural dwellers that would have reduced access to forest resources (Mamo et al. 2007).

Since forest is the source of many products on which the local people depend, complete protection of remaining natural forests, although highly desirable, faces socio-economic constraints, which makes such a goal difficult or impossible to achieve. Therefore, to manage the existing level of forest cover or increase it, efforts of the government of Ghana to curb deforestation have revolved around the promotion of economic development through the promotion of reforestation and sustainable utilisation of natural forest resources with local involvement (Blay et al. 2007). Their approach essentially puts local

people in the centre of forest resources management with the understanding that local communities are significant players in forest management and are believed to have a significant understanding of their local environmental problems (Hares et al. 2006). Thus, their perceptions in deforestation discussions cannot be ignored (Lawrence 2000). However, collaborative management faces problems of differing views in terms of forest management goals, methods, utilisation, and preferences, particularly between different stakeholders such as the government and local people. This has often resulted in the failure of many community-based forest management projects that had good chances of success (Fisher 1995).

This paper presents an analysis of the level of local dependence on forest resources and its implications for forest management in Ghana. The paper also outlines the causes of continuing deforestation in the studied region from the perspective of the local residents and discusses what role they could play in addressing the problem. The aim is to share more light on the current causes of deforestation and make suggestions for improved collaborative community-based forest management practices that could help to reduce deforestation.

2 Methods

2.1 Study area

The study was undertaken in Ghana where the majority of the labour force is into agriculture (Table 1) where farmers are rapidly destroying the forest along a retreating frontier of slash-and-burn agriculture. Farming communities in three forest districts, namely, Dormaa District, Offinso District and Begoro District were selected (Fig. 1).

The above study areas lie between latitudes 4°3′ and latitude 8°0′ in the southern part of Ghana where the climate and topography are heterogeneous, with the mean annual rainfall in these forest areas ranging between 1,250 and 1,500 mm. The mean daily temperature ranges from about 25°C in the wet season (March–October) to about 27°C during the dry season (November–February) (Blay et al. 2007).

Table 1 Socio-economic data on Ghana

(a) Demography	
Population	22,409,572 million (2006)
Growth rate	2.07% (2006 est.)
(b) Employment	
Labour force by occupation	Agriculture: 60%, Industry: 15%, Services: 25% (1999 est.)
(c) Land use	
Land use practices	Arable land: 17.54% permanent crops: 9.22% other: 73.24% (2005)
Agriculture products	Cocoa, rice, coffee, cassava (tapioca), peanuts, corn, sea nuts, bananas; timber
Industries	Mining, lumbering, light manufacturing, aluminium smelting, food processing, cement, small commercial ship building.
(d) GDP/income	
GDP composition by sector	Agriculture: 35.5%, Industry: 25.6%, Services: 39% (2005 est.)
Unemployment rate	20% (1997 est.)
Population below poverty line	31.4 % (1992 est.)

Source: http://www.cia.gov/cia/publications/factbook/geos/gh.html (updated 13 June 2006)

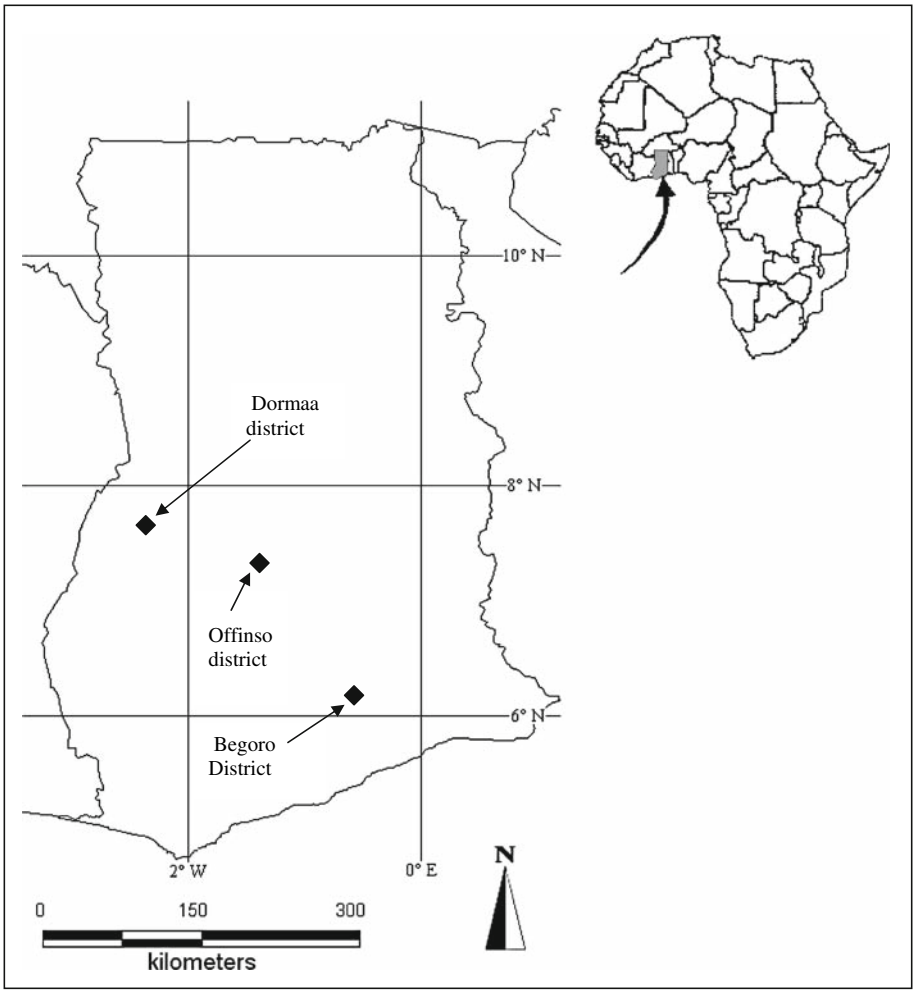

Fig. 1 Map of Ghana showing the study areas in three forest districts. Dormaa district is located in the dry-semi-deciduous forest zone, Offinso district in the dry semi-deciduous fire zone forest type and Begroro district in the in the moist semi-deciduous southeast forest type)

The selected study sites represent areas in Ghana where the government, international organisations and private individual and local communities are acting together as stakeholders in forest rehabilitation, resources conservation and management. For the local people in the Dormaa, Begoro and Offinso forest districts, the conversion of forests lands for farming is a significant way of life and the forests represent their primary source of food, income, and security (Abbiw 1990; Falconer 1992; Wagner and Cobbinah 1993; Appiah 2001). However, many of the rural people either lack any access to land or secure stake in the land they farm. Consequently, high levels of deforestation and forest degradation persist in these areas (Blay 2004). Furthermore, the forests in the area have been subjected to heavy timber exploitation (Hall and Swaine 1981) raising concern for reforestation.

By 2005, the population of each of the studied communities was approximately one thousand people with 90% of them indigenous to the area. The non-indigenous people were poor farmers who migrated from different areas in Ghana with poor or insufficient land to settle in the studied areas where virgin forest was still accessible.

2.2 Sampling method, data collection and analysis

Data was obtained through literature review, direct observation in the field and interviews with resident farmers and key informants. Collection of secondary data relied on relevant literature such as the conference documents, Ghana's forest policy documents and project reports.

Primary data was collected mainly through a survey using personal interviews of 431 households in total representing 14% of the population in the targeted ten communities living in scattered hamlets in and around forests reserves. Within the three main forest districts in Ghana (Dormaa, Offinso, and Begoro), an average of 143.6 farming households were randomly selected from each of the district register of farmers provided by the Forestry Research Institute of Ghana (FORIG) and interviewed (Fig. 1). A household was defined as the basic farming unit comprising husband, wife and children following the example of Appiah (2001), and Blay et al. 2007. Group interviews were also arranged involving the sub-chiefs (community heads) and their local residents to discuss some general issues.

Thirty people (including traditional Chiefs, Head of the District Assembly, District Heads of the Forestry Department and farmer groups' leaders) anticipated to be familiar with the subject under investigation were also interviewed. The Forestry Research Institute of Ghana researchers, who were collaborating with them on on-going reforestation project, guided the selection of these informants.

The survey used a questionnaire, which was first administered to household heads and second to key informants with moderate modification during field work between December 2004 and February 2005. The interviews were conducted in the local dialect (Twi) of the farmers using a pre-tested semi-structured questionnaire and responses were immediately recorded on the questionnaire pages during the interviews. Information was collected on: (i) household background i.e. income, income sources, age, education, household size information, farming practices, (ii) off-farm activities, (iii) causes of deforestation, (iv) farmers role in preventing deforestation, and lastly (v) opinions on other issues such as land tenure.

Except for a few semi-structured (e.g. asking respondents to indicate the contribution to household income by source from a list of sources); or "yes/no" questions, queries were open ended and responses were classified afterwards, though for clarity it was often necessary to give examples of the kinds of information needed. Agricultural and forest products were valued according to local market prices. The questions were designed to elicit information of a range and depth that is not attainable with a standard framed questionnaire (Freudenberger 1994; Chambers 1997).

The accuracy of responses to quantitative questions cannot be fully justified, as some of the information was based on recollection. However, with the familiarity of the project staff (interviewers) with the area, some of whom are co-authors of this paper, we believe this danger was minimised. The aim of the questionnaire was to solicit information on the contribution of agriculture and forest resources to the livelihoods of local people and its implications for the existence of the remaining forests. In addition, it aims to get

information on the possible roles of local people in curbing deforestation. Questionnaire responses most relevant to the objectives of this paper are presented.

Descriptive statistics (mean, standard deviations, frequencies etc) and regression, generated through the Statistical Package for Social Scientists (SPSS) software, were used to analyse the data.

3 Results

3.1 Household gender and age characteristics

Of the 431 interviewed households, 388 (90%) were male-headed and 43 (10%) were female-headed, who were either widows or divorced. The average household size of respondents was 6.7 members. In terms of household age composition, 39% were in the 0–14 years group, 57% in the 15–64 years (working age) group, and 4% in the 65+ years group. The data suggests that the majority of the respondents were still in the active age groups contributing to family labour force, with a household dependency ratio of 0.75. The majority of the respondents did not have education enough to qualify them for white collar or formal jobs. Four hundred household heads had a mean of only 6.7 years (primary school) and four of them had 10 years (middle school) of formal education. Only 27 of the respondents had no formal education and were considered in this study as illiterate.

3.2 Occupation, household income sources and levels

The respondents were mainly engaged in slash-and-burn agriculture, with their land holdings raging between 625 m^2 and 5,000 m^2. Intercropping of tree and crop species characterised the farming systems. The responses showed that a greater number of farmers in Dormaa and Begoro District cultivated yam, maize and plantain compared to the Offinso District where cultivation of tomato and garden egg was much more obvious. The main crops grown by farmers included cassava, yam, cocoyam, plantains, maize, kola (*Cola nitida*), pepper, tomato, garden egg, ginger, plantain, banana, oil palm, avocado, pawpaw, orange, sugar cane and coffee. Keeping of livestock (chickens, goats, sheep and ducks) was an additional occupation of the respondent farmers.

Household consumption and petty trading in firewood and other non-timber forest products (fodder, building materials, herbal medicines, chewing sticks, pestles, canes, nuts, wild fruits, honey, bush meat (giant rat, grasscutter, squirrel), artifacts and other household items) (Fig. 4) is integral to the way of life of the people.

The majority of the respondents (330; 23 female and 307 male) did not have off-farm jobs. Those (101; 20 females and 81 males) who had off-farm jobs were engaged in part-time work for timber or forestry related companies. They also often shared labour among neighbours during the farming seasons to earn some additional income.

Judging from the questionnaire responses, income from sale of agricultural crops and domestic animals (Figs. 2–3) constitutes 60% of the average total household income among sampled households. Forest products (Fig. 4) are also important livelihood sources providing 38% of household income of sampled households. Two percent of household income came from off-farm jobs. The estimated average annual income of farmers was 248 USD in 2004, lower than the national average per capita income of 450 USD.

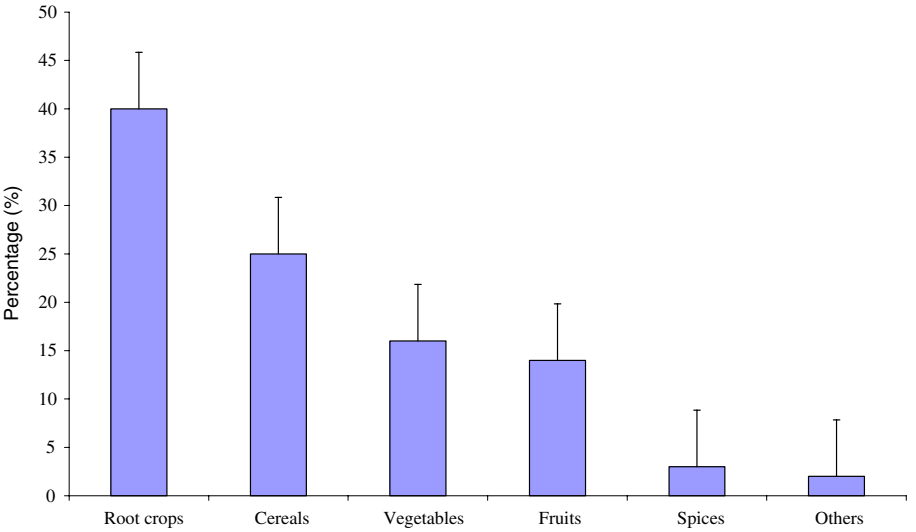

Fig. 2 Percentage contribution of cultivated crops to household income. Root crops = cassava, yam, cocoyam; Cereal = maize; Vegetables = tomato, pepper, garden eggs; Fruits = plantain, banana, oil palm, avocado, mango, pawpaw, orange; Spices = ginger, *Afromanmum melegueta*, *Piper guineense* and *Xylopia aethiopica*), Others = sugar cane, coffee. Bar represent standard error of mean

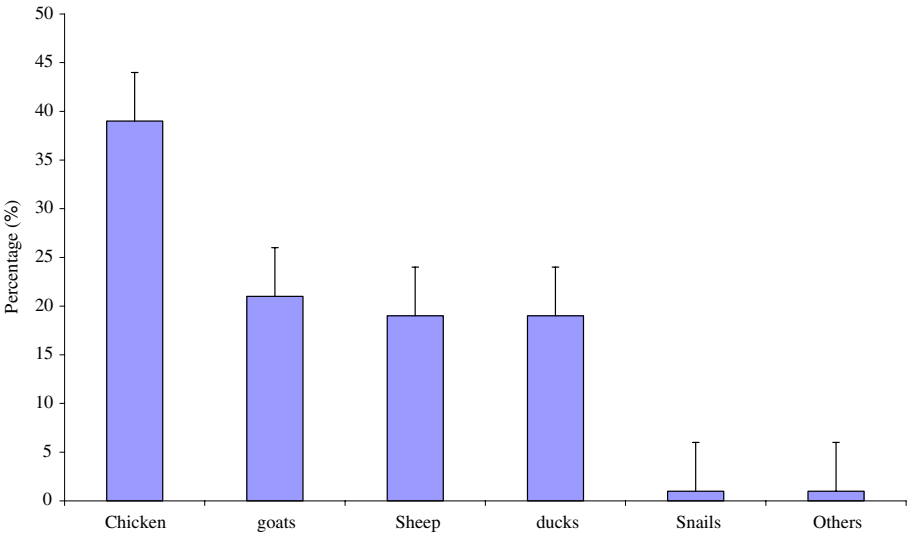

Fig. 3 Percentage contribution of domestic animals to household income. Bar represent standard error of mean. Others = snails, grasscutter and birds

3.3 Factors determining household income

Using regression of combined income from Agriculture and forest resources against household characteristics, we found significantly positive correlation between annual income and household size (*R*-squared or Coefficient of Multiple Determination = 0.94,

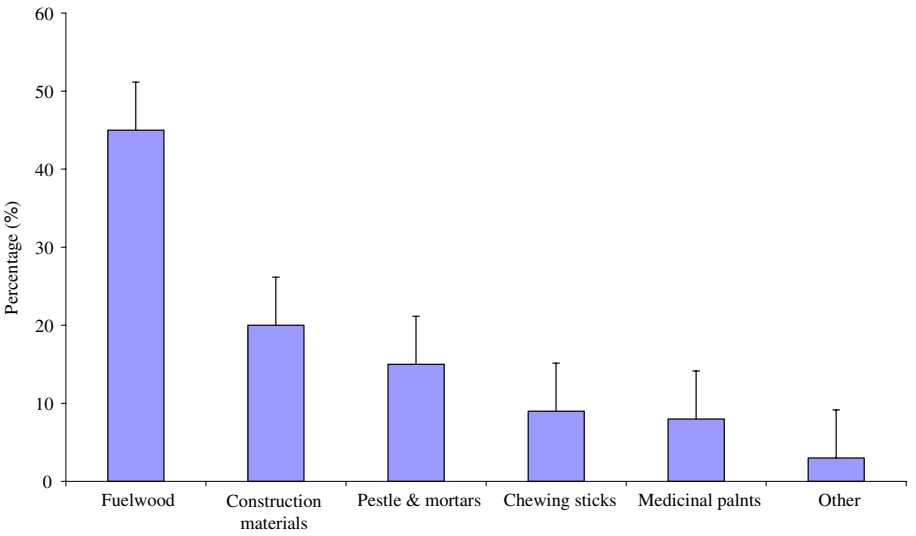

Fig. 4 Forest products and their percentage contribution to rural household income. Construction species = *Drypetes gilgiani*, *Garcinia afzelii*, *Eremospatha sp*., *Raphia hookeri*, *Picralima spp*, *Baphia nitida*, *Elaeis quineensis*, *Jatropha curcas*; Pestle& Mortar species = *Garcinia afzelii*, *Baphia nitida*, *Nauclea diderrichii*, *Milicia excelsa*, *cola nitida*); Chewing stick species = *Garcinia afzelii*, *Garcinia cola*, *Baphia nitida*; Medicinal species = (*Khaya ivorensis*, *Alstonia boonei*, *Ceiba Pentandra*); Other species = *Dacryodes klaineana*, *Ongokeas gore*, *Teighemella heckelii*, *Marantaceae spp*. Bar represent standard error of mean

p-value = 215.1, *p*-value = 0.000—the *p*-value indicates that the null hypothesis, which is "no relationship exists between the studied traits, is false, and that a relationship exist between traits). Thus, households with larger family sizes appeared to generate more income from the forest. No significant correlations were observed among the income, age, education or gender, therefore the data was ignored.

3.4 Determinants of continuing forest loss

When asked what factors were driving the trend of continuous depletion of forest resources in the studied areas, responses from 21% of farmers mentioned that farming for livelihood was an issue. Eighteen percent gave lack of alternative employment other than farming as a reason for the continuing depletion of forest resources. For 14% and 13% of the respondents, increasing rural household levels and conflicts in traditional practices respectively, are issues. Apart from these reasons, respondents mentioned other factors ranging from less priority being given to environmental issues, poor logging practices, inadequate knowledge of sustainable farming practices, to conflicting government policies. Some of the respondents felt exclusion from forest utilisation, management and the decisions leading to forest management were factors leading to deforestation (Fig. 5).

3.5 Responsibility sharing in curbing deforestation

When asked what the responsibility of local people should be in reducing deforestation, the majority (30.2%) of the farmers mentioned maintaining the forest through improved

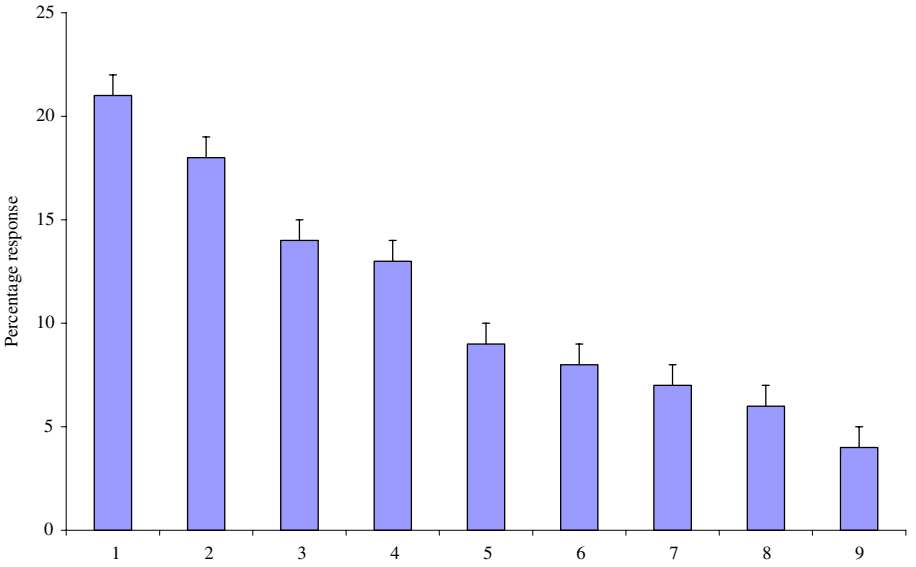

Fig. 5 Factors driving the trend of continuous deforestation in Ghana. 1 = poverty-driven agriculture; 2 = lack of alternative employment other than farming; 3 = increasing household population; 4 = conflicts in traditional practices, 5 = less priority given to environmental issues; 6 = poor logging practices; 7 = inadequate knowledge of sustainable farming practices; 8 = conflicting government policies; 9 = exclusion from forest management and decisions' leading to forest management. Bar represent standard error of mean

farming practices. They gave an example as combining the production of forest tree crops and agricultural crop and animal husbandry. Twenty-four percent said that involving local people in bush fire management was one way to prevent forest destruction, as wild fires are common in Ghana. Other areas of responsibility suggested by local communities included empowering them to prevent and report illegal activities, farmers setting aside part of their forests for conservation purpose and working in the forests within limits of forestry laws and regulations (Table 2).

Table 2 Suggested areas of local responsibility in curbing deforestation (n = 431)

Area of local responsibility	Percentage response
(1) Integrated tree crop & agricultural production	30.2
(2) Bush fire management	24.0
(3) Identification of forest fire offenders for punishment	18.0
(4) Setting forest aside for protection	13.5
(5) Report illegal logging activities	13.7
(6) Operate within forestry laws and regulations	0.4
Total	100

4 Discussion

4.1 Declining forest resources in Ghana: some reasons

4.1.1 Socio-economic dependence on agriculture/forest resources

Judging from the questionnaire responses, the local people are heavily dependent on their farming practices and forest products for their subsistence. Farmers' descriptions of agricultural practices suggest that their agricultural systems incorporated some elements of shifting cultivation including slash-and-burn field preparation within individual holdings. With this practice, they cultivate not only shifting plots of short-cycle crops but also long-cycle crops leading to the destruction of forest tree species and associated biodiversity. This process of forest destruction through increasing agricultural output to meet their subsistence needs explained by the local farmers is known to cause about 50% of deforestation in tropical forests (Barraclough and Ghimire 2000). Moreover, it shows resemblance to the process described by Myers (1996), Sierra (1999, 2000) in north–west Ecuador and western Amazonia, Steininger et al. (2001) in Bolivian Amazon, and by Appiah (2001) in western Ghana.

On the positive side, farmers indicated their intention to stay put and not follow a retreating forest frontier if there were possibilities of increasing output per unit area on a sustainable basis. Given this, we assume that improving the living standard for farmers or their farming practices may reduce the need to clear more forests. Similar opinion was shared by (Appiah 2001; Blay et al. 2007) who found that the introduction of financial incentives and integrated forest crop and agricultural cropping systems led to a substantial reduction of new forest area clearance in some areas in Ghana. It is thus more useful to effectively address local livelihood situations before thinking of being successful in our attempts to halt or reduce deforestation.

4.1.2 Limited sources of livelihood

Data revealed that only 2% of the sampled household had paid jobs other than farming. According to the respondents, the lack of alternative sources of employment was one of the factors contributing to the continued deforestation in the studied areas. As suggested, in the absence of other rural wage jobs, the only way for them to make their living was to channel all their labour into agricultural activities, which led to more forest being cleared. There is a shared support for this view by many researchers (e.g. Deininger and Minten 1996; Geist and Lambin 2002), in particular, the opinion for a need to secure rural income through diversification of income generation activities.

The local responses raise the question as to whether adequate consideration is being given to agriculture and off-farm employment opportunities for local people. Because, often, most of the blame for deforestation has been put on farmers and their subsistence activities, omitting mentioned of the important role of the forestry institution in Ghana in creating other economic opportunities that could compete with agricultural activities for labour, especially in a country where 60% of her labour force depend on agriculture for a living.

4.1.3 Rural population and household levels

The current data is insufficient to explain how the population in the studied region has increased over time, however, according to the respondents, there is a rising rural population that is generating increased pressure over farming land, forcing farmers to resort to shorten rotations, which they say leads to more forest clearance and in some cases permanent nutrient lost. From the household size perspective, the average number of people living in each household was large (6.7), above the national average of 5.1 and 5.3 for Sub-Sahara Africa (Bongaarts 2001). It was observed that the annual household income increased with household size, suggesting that the larger the families, the greater the availability of family labour for agriculture and forest extraction. With the significant number of family members under the age of 20, the children were perhaps useful in providing a hand in farming and forest resources extraction. Thus, indicating that rural household size is a major determinant of forest clearing in the studied regions.

Forest adjacent communities with large families and very limited sources to obtain income, food, and energy, would naturally clear more forests to meet those basic requirements. As needs for money, energy, food, and forest products increase with increasing household members, it would be useful either to increase the output of land currently under cultivation, or to increase the cultivated area. However, in most cases, the option of an increase in yield is quite difficult because it would require costly inputs like fertilizer, increased labour or because of the lack the knowledge on how to improve the existing farming systems as mentioned by farmers. In those cases, farmers tend to clear more land as is the situation in the studied region.

4.1.4 Conflicts in traditional practices

Another key point raised by farmers as causing deforestation in Ghana concerns conflicts in traditional land tenure. As is known, forests in Ghana are divided into those in reserves and those outside reserves. In terms of ownership of forest land, Ghana has retained the traditional customary system of communal ownership where the Chief (often referred to by his seat of office as the 'stool') is the custodian of the land on behalf of the community. However, according to farmers, today these communally owned forest land are not looked upon as opportunities for collective management of valuable resources. They think that rather than being managed for the common good, they are abused and highly exploited. The local people gave the reason that corruption that has engulfed traditional practices, which uphold the cultural values and land tenure. Many factors indicated by Appiah (2001), including those mentioned above have contributed to the almost total destruction of forests outside reserves in Ghana.

4.1.5 Less priority to environmental issues

The respondents also indicated that they give less attention to environmental issues because clearing more forest land for agriculture to meet household needs was their top priority. As one farmer (name withheld) puts it, "survival" was his number one priority, "everything else come, if at all, later." Thus, poor farmers are likely to clear more forest due to their lower preference for environmental issues. Indeed, for people such as those sampled in this survey, it is the conversion of the forest to agriculture, and the services and

infrastructure, which result from this that is often their immediate goal. This goal brings into question a need for well planned environmental education.

4.1.6 Logging, policy and institutional failures

Logging, policy, and institutional failures were crucial elements of deforestations in Ghana (Prah 1997). Although logging and institutional failures are still mentioned by farmers as some of the causes of deforestation, they are not highly ranked when compared to factors such as poverty-driven agriculture, lack of off-farm employments and rural population levels. This perhaps can be explained by the improvement on favourable political conditions for achieving sustainable forest management and reducing deforestation (ITTO 2006). For some time now, Ghana has also introduced new systems to improve efficiency, transparency, and accountability and benefit sharing in forestry, particularly in forest production and logging activities (ITTO 2006).

4.1.7 Exclusion from forest utilisation

When asked what factors were driving the trend of continuous deforestation in the studied areas, the respondents also gave exclusion from forest utilisation, and decisions leading to forest management as a factor leading to deforestation. As they explained, restrictions from forest utilisation (particularly those that are in protected areas) place constraints economically on them or in terms of alternative sources of income and has led illegal forestry activities and overexploitation of forest resources in accessible areas leaving such areas completely degraded.

Even though the natural forest resources need protection from the destructive actions of people, the challenge is that, as much as 60% of household income came from agricultural products and 38% from forest products. Considering these livelihood sources for the large numbers of the people in the studied communities, any efforts to restrict agricultural activities and forest production extraction may negatively affect the basis of rural subsistence as well as further limit employment opportunities, which is already scarce in rural areas. This could be more apparent if forest and agricultural lands are claim for plantation development. There is already a significant shift in the timber production from natural forests to plantations in most areas in the region with a prediction of subsequent large-scale development of industrial fast-growing plantation forestry, especially on degraded lands for tropical forestry (FAO 2001). The obvious way forward to ensure forest sustainability is to utilise local people in planning forest utilisation and management. In the past and increasingly now local people have shown that they can collaborate for sustainable management and governance of common forest resources.

4.2 The role of local communities in reducing deforestation

Responding to questions concerning their role in reducing deforestation, the farmers were keen to mention their involvement in forest management through farming systems that combine trees and agricultural crops as an important approach. This supports the opinion that community-based agroforestry practice is an important way to achieve forest rehabilitation and sustainable forest management (Appiah 2001; Maikhuri and Rao 2002; Russell

and Franzel 2004). Further more it suggest that the understanding of local people to their local environmental problems linked to forest loss and how they can be addressed using agroforestry is not restricted to particular group of farmers or to a defined region. However, as indicated also by other studies (Hares et al. 2006), large numbers of local people possess knowledge of their environment. Therefore it is important to take advantage of farmers' interests in using agroforestry as the means to forest rehabilitation and sustainable forest management by supporting the available indigenous farming technologies with scientific inputs that could enhance the utilisation of diversity within the systems and maximise tree-crop interaction. Recently the production of non-timber forest products such as medicinal products, fodder, cane, foods, and fibre, rather than for wood only (Leakey et al. 1996; Simons and Leakey 2004) has received a great deal of attention. More interests will be generated if efforts are made to ensure forest species diversity within the farming systems.

As suggested by the farmers, the participation of local people in bush fire management is essential for reducing deforestation. In many cases bush fire plays a very destructive role, rather than a good ecological role in the Ghanaian forests and is quite often very difficult to control (ITTO 2006). This problem has been a national concern and considered as a crucial element of forest degradation as pointed out by the farmers. The majority of the farmers indicated that when they used fire in the field preparation process, the fire easily got out of control and spread onto other forests. Even though the size and frequency of occurrence could not be documented of such fires, many surrounding abandoned farmlands had persistent cover of grasses and shrubs that suggested degradation due to repeated burning. Thus, it does indicate that fire continues to reduce the size of forest during land preparation for agriculture and that local participation in not only preventing bush fires, but also reporting forest offenders as a necessity.

Farmers' setting aside part of their forest land for sustainable forest management practices was suggested as one of the ways to reduce deforestation, although they agreed that it has to go hand in hand with improved farming practices This view is a remarkable shift in the point of view as farmers who in the past were hesitant to set any part of their land aside because of the limited land available for agricultural practices.

For a group of farmers, reporting illegal operations within the forests and working within the limits of the forestry laws and regulations were suggested as ways that the local communities could help in reducing deforestation. As they acknowledge, in Ghanaian tropical forest, particularly those outside the reserves, unregulated and illegal activities of chainsaw operators and poaching are widespread (ITTO 2006) and need the collaboration of local people to put a stop to such actions.

5 The way forward: where to focus

In the light of the above results and discussion, the following key areas may be taken into account as practical alternatives to the major causes of deforestation; shifting cultivation and lack of alternative livelihood sources. Considering these areas could reduce the need for more forest clearance, and to a greater extent, improve the livelihood of local people.

5.1 Agroforestry: snail farming, apiculture, fish farming

Evidently, agricultural practices in Ghana still entail elements of shifting cultivation including slash-and-burn field preparation within individual holdings. Farmers cultivate

mainly shifting plots of short and long-cycle crops together with trees (agrisilviculture). Obviously, among local livelihood strategies and farming practices, snail farming, apiculture, and fish farming still receive less attention. These practices have shown to be potential alternative sources of income and employment, and for that reason a practical alternatives to shifting cultivation (Appiah 2003), which is the main source of employment for the majority of the local people and the major cause of the dwindling forest resources.

There is a distinct lack of information about snail farming in Ghana, especially among the poor rural communities. Although, within the studied areas of Ghana, Giant African snails are much appreciated as food and significant source of income. Since snails are normally collected in the wild, one of the practical ways to divert the focus on shifting cultivation and provide options of employment other than the traditional practices is to encourage the keeping of snails in either pasture production system or paddocks, which can be cost-effective and very simple to establish. For instance, the paddocks can be constructed from local materials (e.g. bamboos) that are not expensive and easily available (Appiah 2003).

Snail farming, provided they can be adequately advertised and promoted, would attract the participation of local people who have to search vast areas of forest to find a single snail. This could offer farmers a significant quick income where snail meat could replace wild snail gathering gradually with rational production techniques. Although certain species of Giant African snails do represent a threat to agriculture, snail farming integrated with crop rotation can actually improve soil quality by increasing crop yields.

Also, there is a history of experience with the honey production of bee keeping in some areas of Ghana (Appiah 2003). Farmers already know the value of honey since they collect it in the wild. Therefore, helping farmers to integrate honey production with tree growing would be helpful in providing alternative sources of livelihood. In Malawi, for instance Beekeeping has been an effective way for the poor people to strengthen their livelihoods. In the 2006 alone, over 7 tonnes of honey was sold by 100 Beekeeping groups involved in Small Beekeepers' Development and Research Association (SBDARA) Project (Bees for Development 2007). Farmers in Ghana could be assisted in the establishments of beehives and educated by bee keeping experts on the management of beehives through basic and easily affordable local workshops.

An important alternative source of income and food is the rearing and management of fish in pond with trees planted around fishponds. Experimental fish pond projects established by local farmers in western Ghana (Appiah 2003) enjoy high local participation and proved to be successful in providing food and income for farmers. Similar benefits can be assured if efforts are made to introduce similar projects to the current study areas where there are numerous streams and where a need for a diversity of rural livelihood sources is an issue. For example, private companies or the fisheries department of Ghana can help to ensure that fingerlings and fish food are supplied in the initial stages of the venture.

5.2 Vegetable farming

As in the study area, people in other rural parts of Ghana depend on traditional vegetables which include many wild and cultivated species. The pods, fruits, and leaves of this species serve as food and are also sold for income. Among the most common ones are: tomato (*Lyco-persicon esculentum*), egg plant (*Solanum melongena*), spinach (*Amaranthus* spp.), sweet pepper (*Capsicum annuum*), onion (*Allium cepa*), shallots (*Allium escalonicum*), okra (*Hibiscus esculentus*),and hot pepper (*Capsicum frutescens*). Many of these

vegetables mentioned above can easily be grown as they are tolerant to the climate, and more importantly have great demand both locally and internationally.

However, only a few farmers are engaged in the cultivation of vegetables (particularly tomatoes and peppers). The majority of them are engaged in the cultivation of traditional cereal (e.g. Maize (*Zea mays*) and root crops (e.g. cassava). Thus, vegetable production receives comparatively less attention. Studies by Olasantan (2007) on the status of vegetable production in Tropical Africa support this view. This may be related in part to the degree to which households are knowledgeable about the nutritional value of vegetables and to the scale of investments in irrigation infrastructure needed during prolong absence of rain and extreme temperatures (Olasantan 2007). However, with vegetable production having the potential to improve livelihood (Olasantan 2007) there is a need to promote the many high-value traditional vegetables that can be exported as well as used locally. Even the exotic vegetables such as cauliflower, carrots, lettuce and cucumber grown mostly around the cities under irrigation can be promoted among the rural farmers as they do well throughout the year. For this, there is a need for the government to mobilize extension officers and financial resources to support in building the capacity of local farmers in vegetable production as an alternative to the traditional practices that are taking a toll on the forest resources. Before that happens there should be an effort to highlight the nutritional importance of vegetables to the majority of the local people who may not fully understand the nutritional value of vegetables.

5.3 Planned forest extraction/utilisation

The potential of Ghana's forests as a major resource for the improvement of rural livelihood is not yet fully realized. One of the ways to enhance the potential of the forests for development is to improve access to forest resources and by planning its utilisation to ensure the continuous availability of both wood and non-wood forest products which are currently being over-exploited. Effort is needed to increase peoples' perception of the value of forests through environmental and economic evaluation of forests and forest lands and providing information on resource management alternatives and the costs to human welfare for not having the forests. In addition the value of the forests should and can be increased through eco-tourism, which could ensure a non-destructive use of the forests, and also possibly through the controlled supply of genetic materials. These could boast the interest of local people to cooperate in the management and planned utilisation of forests.

Events that lead to continuing deforestation in the studied region involve many different interconnected factors. It is difficult to propose a single solution to the problem of deforestation. However, the view of local people presented in the discussion and the proposed way forward could be useful information to guide in efforts to reduce pressure on the remaining forest.

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