Chainsaw Operators, Alternative Livelihood Options and Climate Change Mitigation

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1 INTRODUCTION

Ghana's forest resources have been dwindling at an alarming rate particularly from the 1980s (Blaser *et al.*, 2011). Though there are uncertainties about the actual rate of deforestation, the rate of change in Ghana has been rapid and increasing (Appiah *et al.,* 2009; FAO, 2010a). The present rate of deforestation is among the highest in Africa (FAO, 2010a). The average estimated annual rate of deforestation between 1990 and 2000 was 2% (approximately 135, 000 ha), which is higher than the average annual rate for both Central and Western Africa which stands at 0.6 % (FAO, 2010a). The causes of deforestation and forest degradation vary, but have resulted from a complex interaction of different social, cultural, economic, management and political factors (Damnyag *et al.,* 2011; Blaser *et al.*, 2011). These include slash and burn agriculture, fuelwood harvesting, wildfires, logging, illegal chainsaw milling, surface mining, infrastructure development and urbanization (Appiah *et al.,* 2009; Blaser *et al* 2011; Kusimi, 2008; Forestry Commission, 2003). Other causes include weak enforcement of forest laws, high population pressure, unclearly defined land and tree tenure, high incidence of poverty, corruption, and overcapacity of the forestry industry (Blaser *et al.,* 2011).

It is estimated that Ghana loses total gross revenue of about US$133,650,000 annually as a result of losses in stumpage fees mostly from illegal logging (Damnyag *et al.,* 2011). Chainsaw milling is widespread in Ghana and it has been the most important part of the informal wood sector (Hansen and Treue, 2008; Marfo, 2010). Currently, the use of chainsaw to produce illegal lumber accounts for more than 80% of the annual lumber traded on the domestic market, which is estimated at about 600,000m3 per year (Marfo, 2010). Chainsaw milling operations do not only involve the operators, machine dealers and lumber brokers, but there is active involvement of chiefs, farmers, and landowners. Despite several efforts to deal with illegal chainsaw milling, the practice still persists. Chainsaw milling continues to receive massive support because it provides easy and cheaper access to domestic lumber for households and infrastructural projects in both urban and local areas (Quartey, 2010). The practice is also seen as a means for rural employment and livelihood support for local communities. It is estimated that chainsaw milling provides jobs for about 130,000 people and supports the livelihood of about 650,000 people (Marfo, 2010).

Since the livelihoods of most local communities in Ghana, especially those fringing forests, almost entirely depend on forest and other natural resources, restricting their rights to use of resources may result in conflicts unless it is accompanied by alternative livelihood strategies in order to offset the potential impacts on their livelihood (Kaimowitz, 2007). In Ghana, attempts to enforce the ban on chainsaw milling without commensurate alternative strategies have often resulted in conflicts and even loss of lives (Mayers *et al.,* 2008; Marfo, 2010). The development and promotion of alternatives is therefore one of the main community-based initiatives to address illegal chainsaw milling in the country (cf. Inkoom *et al.*, 2005). Making alternative sources of livelihood available to chainsaw- dependent communities and chainsaw operatives will both improve the rural economy as well as replace existing chainsaw milling activities (cf. Mogaka *et al.,* 2001).

It should also be emphasized that livelihood support and climate change mitigation are two social and environmental imperatives for sustainable forest management. To reduce threats to deforestation and forest degradation caused by activities like illegal chainsaw milling, which substantially support rural livelihoods, policy interventions must contemplate this reality. Climate change mitigation activities that have potential for improving the livelihoods of local people will have a wider appeal and acceptability and therefore a higher chance of success.

This study therefore sought to assess the preferences of chainsaw dependent communities for forest- based alternative livelihood interventions that also have potential for climate change mitigation. In particular, the study attempted to answer the following research questions:

1. What forest-based interventions have the potential to support both rural livelihoods and climate change mitigation efforts simultaneously?
2. What are the specific preferences of chainsaw operatives for such interventions and the reasons behind their preferences?
3. What measures should be in place for the preferred forest-based alternative livelihood interventions to be successfully implemented?

This introductory section is followed by a review of literature on forest-based alternative livelihood activities and forest-based climate change mitigation options. The subsequent section provides a description of the methodology used for data collection and analysis. This is followed by the presentation and

discussion of the results. In the conclusion section, the main findings of the study are highlighted and recommendations made to ensure the successful implementation of forest-based alternative livelihood activities.

2 FOREST-BASED LIVELIHOODS AND CLIMATE CHANGE MITIGATION

2.1 Alternative livelihood activities promoted in Ghana

The development and promotion of alternatives is one of the main community-based initiatives to address unsustainable utilization of forest resources in the country (Inkoom *et al.*, 2005). The major alternative livelihood activities promoted in forest communities can be grouped into three broad categories, namely forest-based, forest-related and non-forest based activities (Inkoom *et al.*, 2005).

The forest-based activities include, but not limited to, agroforestry technologies, rattan and bamboo collection, medicinal plants gathering, establishment of woodlot nurseries, and forest enrichment planting (Simons and Leakey, 2004; Blay *et al.,* 2008; Obiri and Oteng-Amoako, 2007; Boateng, 2008). Other activities include snail rearing, mushroom cultivation, bee keeping and grass cutter rearing. Even though initial stock for some of the activities under the forest-based option may be obtained from the forest, their onward development does not always depend on the forest. Forest-based activities are important especially during periods when agricultural tasks diminish, and the need for cash is acute. Majority of forest-based cash earning activities, however, decline during planting and harvesting periods when farm labour requirements are high, but increase during the hunger season when people need money to buy staple foods (Inkoom *et al.*, 2005; Blay *et al.,* 2008). This seasonality which characterizes forest-based livelihood activities is a very important factor to be considered in designing alternative livelihood programs for forest-dependent communities.

Forest–related livelihood activities may also involve temporary or permanent employment opportunities such as forest guards, boundary cleaners, plantation developers, load bearers, and stock survey labourers (Inkoom *et al.* 5005; Blay *et al.,* 2008). Forest-related activities mostly benefit fringe communities who, as a result of government forest policy of collaborative forest management, are engaged in the provision of various services in forest reserves for the forest authorities (Blay *et al.,* 2008). Though these

may provide regular streams of income, they could be seasonal with low levels of income compared to other activities community members may have been involved in the past.

The third category are activities that may not have linkages to the forest, including petty trading, soap making, bead-making, pottery, aquaculture and piggery (Appiah, 2003; Boateng, 2008). Other activities in this category include batik tie and dye, kente weaving and cloth making, and poultry farming (Inkoom *et al.*, 2005). Many of these activities have the potential to be successful, but require training and initial access to capital inputs which may be difficult for most rural communities (Inkoom *et al.*, 2005). These programmes may therefore need strong financial support from government and non-governmental organizations to make them effective.

Alternative livelihood activities have been promoted extensively in some forest communities in Ghana by the Ministry of Lands and Natural Resources under the Community Forest Management Project, the Forestry Commission and other NGOs, albeit on pilot basis (Owusu and Nketiah, 2005). These activities have been promoted in forest districts with significant forest resources mostly in the Eastern, Brong Ahafo and Ashanti Regions. Alternative livelihood activities which have been implemented in the past include snail farming, mushroom farming, grasscutter rearing, bee-keeping and plantation development (Table 1).

Table 1: *Alternative livelihood activities promoted in some forest districts in Ghana*

Forest District	Alternative Livelihood				
	Grasscutter rearing	Snail rearing	Bee – keeping	Mushroom cultivation	Plantation Development
Sunyani	√		√		√
Nkawie	√	√			
Juaso	√	√	√		
Offinso	√	√		√	
Kumawu	√		√	√	√
Kintampo			√		√
Mampong	√		√		√
Goaso	√	√			
Dormaa Ahenkro	√	√		√	

Source: Owusu and Nketiah (2005)

2.1.1 Organizations promoting alternative livelihoods

Different governmental and non-governmental organizations have been involved in the promotion of alternative livelihoods in different local communities in Ghana. Most of these activities have focused on promoting grasscutter rearing, snail farming, bee-keeping and mushroom farming (Table 2). These alternative livelihood activities have been initiated and promoted as components of bigger projects like the Community Forest Management Project. The main target groups for these activities include farmers, chainsaw operators, women groups and the youth in forest fringe communities. There have been varied objectives for the promotion of these livelihood activities, but the common ones include poverty reduction and reducing dependence on forest resources.

Table 2: *Organizations that promoted alternative livelihoods and their activities*

Organization	Alternative livelihoods	Location
Centre for Biodiversity Utilization and Development (CBUD)	Snail farming, grasscutter rearing, Prekese, indigenous leafy vegetables	Goaso, Sunyani, Dormaa Ahenkro and Bechem Forest Districts
Brong-Ahafo Regional Grasscutter Farmers' Association (BARGFA)	Grasscutter rearing	Sunyani Forest District
Rural Development Youth Association (RUDEYA)	Grasscutter farming, mushroom farming, bee- keeping, snail farming	Goaso Forest District
Tropenbos International-Ghana (TBI- Gh)	Grasscutter farming	Goaso Forest District
Action Aid International, Sunyani	Grasscutter rearing	Sunyani Forest District
World Vision International, Atebubu	Grasscutter rearing	Atebubu Forest District
German Technical Cooperation (GTZ)/ Market Oriented Agriculture Programme (MOAP)	Grasscutter rearing	Sunyani, Goaso, Bechem Forest Districts
Ministry of Food and Agriculture (MoFA)	Grasscutter rearing, snail farming, mushroom farming, bee-keeping, fish farming, etc	All Forest Districts
Ministry of Lands and Natural Resources	Grasscutter and sheep rearing	Most Forest Districts (e.g. Offinso, Techiman)

Source: Owusu and Nketiah (2005) with modification

2.2 Forest-based climate change mitigation options

Forest-based mitigation activities can considerably reduce emissions from sources and increase CO2 removals through carbon sequestration and, could potentially be designed to form synergies with adaptation measures (Locatelli *et al.,* 2011). Carbon sequestration by forests has attracted much interest as a mitigation approach as it is considered a relatively inexpensive means of addressing climate change (IPCC, 2007; CBD, 2009). Forests are able to sequester carbon from the atmosphere, and sustainable measures in forestry activities could also help to reduce emissions thereby mitigating climate change. Forest-based mitigation can also have substantial co-benefits in terms of employment, income generation, biodiversity conservation and poverty alleviation (IPCC, 2007).

According to the IPCC (2007) and CBD (2009) forest-based technologies that increase carbon sequestration include;

- afforestation, reforestation, forest restoration;
- increase of tree cover through agro-forestry, on-farm tree retention, tree planting in abandoned landscapes;
- enhancement of forest carbon stocks (in both soils and biomass) and sequestration capacity through reduced deforestation;
- management of biodiversity and wildlife by increasing protected areas;
- harvested wood product management;
- use of forestry products for bio-energy instead of fossil fuels; and
- wildfire management.

2.2.1 Climate change mitigation options with potential as alternative livelihoods for chainsaw dependent communities

The role of different types of land use in reducing atmospheric CO2 concentration and lowering the emissions rate of greenhouse gases (GHGs) has led to an increased research on the function of forestry and agroforestry systems as carbon sinks (Soto-Pinto *et al.*, 2010). Tropical deforestation and forest degradation are considered to be an important source of GHG

contributing to 17% – 19% of the global emissions (IPCC 2007). The use of fire in agriculture and illegal logging are also important drivers of climate change, especially in the tropics (Blaser *et al*, 2011). Undoubtedly, forests are the main land-based CO2 sinks (IPCC, 2007; CBD, 2009). However, it is uncertain how and to what extent forest carbon sinks and reservoirs may be managed to mitigate CO2 (Canadell and Raupach 2008). Recent research therefore seeks for areas of priority and adequate land-use practices in order to reduce effectively emissions caused by deforestation and at the same time that could provide additional livelihood benefits.

Land-use practices such as afforestation, reforestation, natural regeneration of forests, silvicultural systems and agroforestry can help in reducing CO2 concentrations (IPCC, 2007; Canadell and Raupach, 2008; CBD, 2009). According to Canadell and Raupach (2008), agroforestry systems are very important mitigation initiatives given the area currently destined for agriculture, the number of people who depend on land for their livelihoods and the need for integrating food production with environmental services (FAO, 1990; Soto-Pinto *et al.,* 2010). Agroforestry could therefore evolve into a technological alternative for reducing deforestation rates in tropical zones while offering a wide variety of products and services to rural communities (Sawyer, 1993; de Jong *et al.* 1995).

Agroforestry and Agroforestry practice in Ghana

The International Council for Research in Agroforestry (ICRAF) defines agroforestry as a collective name for land-use systems and technologies where woody perennials are deliberately used on the same land-management unit as agricultural crops or animals in some form of spatial arrangement or temporal sequence (Nair, 1993). It is a sustainable land management system that increases overall production, combines agriculture and tree crop, forest plants and or animals simultaneously and sequentially, and is applied to management systems that are compatible with local patterns (MacDicken and Vergare., 1990). The three major components of agroforestry systems are crops, trees and animals and depending upon the combination of these components, three major systems can be identified. These are Agrisilvicultural systems, Silvopastoral systems and Agrosilvopastoral systems (Nair, 1993).

An agrisilviculture system involves the combination of trees and shrub, vine or tree crops (Nair, 1993). An example of such system is the cultivation of maize, cassava, or plantains grown between selected timber tree species or

coconut or palm trees. Other examples include improved fallow, taungya, alley cropping (hedgerow inter-cropping), multipurpose trees on crop lands, plantation crop combinations, home gardens, trees in soil conservation and reclamation, shelterbelts and windbreaks, live hedges and fuelwood production. In silvopastoral systems, there is the combination of pasture and/or animals and trees on the same land management unit (Nair, 1993). Examples include trees on rangelands or pastures, protein banks, plantation crops with pastures and animals. Agrosilvopastoral systems involve the combination of trees, crops and pasture/animals on the same land management unit (Nair, 1993). Examples include home gardens involving animals, multipurpose woody hedgerows, apiculture with trees, aquaforestry, entomoforestry, multipurpose woodlots and various forms of shifting cultivation (Nair, 1993).

In Ghana, agroforestry is an important land use pattern which has been practised, particularly, by rural communities. The main feature of agroforestry in Ghana is the intercropping of trees and shrubs with crops (agrisilviculture system) to enhance the agricultural environment. Prominent among this practice is the taungya system. It is a forestry system that involves inter-planting trees with agricultural crops, particularly the local population's staple foods (FAO, 1984). Taungya begins as an agroforestry system during the initial three years, and then evolves to a plantation system when the trees form a closed canopy, and farmers are expected to tend the trees to maturity. Farmers are also expected after three years to move to other plots, mostly in degraded state-owned/managed forest reserves, to repeat the agroforestry practice.

The taungya system was introduced in 1930 to restore Ghana's forest cover, satisfy forest fringe community's demand for arable land and provide the Forestry Department's with labour for plantation development (FAO, 1984). However, the lack of ownership rights, financial benefits and decision- making role for farmers regarding trees planted on reserved land have proved to be a great disincentive for sustainable forest management (SFM) (Agyeman *et al.,* 2003). As a result of these challenges, the Ghanaian government, within its 1994 Wildlife and Forest Policy and forest plantations development programme, reviewed and reintroduced the traditional taungya system in 2002 as the modified taungya system (MTS). The MTS considered the financial benefits for all stakeholders involved in the system and also transferred ownership of trees from the government as a single owner to farmers, local communities, government and land owners (Kalame, 2009).

With regard to Ghana's forestry, the MTS is expected to promote SFM and poverty reduction by meeting future demands for industrial timber, improving environmental quality through the restoration of degraded forest lands, and increasing national food security through increased food production (FC, 2006). According to the FC (2006), an estimated area of 60,000 ha was reforested within three years (2002-2005) from the inception of the MTS. Preferred tree species for planting include a mixture of indigenous and exotic species such as *Triplochiton scleroxylon, Terminalia superba, Tectona grandis, Cassia siamea, Terminalia ivorensis, Cedrella odorata, Khaya ivorensis, Khaya anthoteca, Entandrophragma angolense, Eucalyptus species, Ceiba pentandra, Albizia zygia, Alstonia boonei, Aningeria robusta* and *Naulea dederrichi* (Blay *et al.,* 2008; Kalame *et al.,* 2011).

Agroforestry as carbon sink enhancement

The importance of agroforestry systems as carbon sinks has recently been recognized as an important component of climate change mitigation (Nair et. al., 2009). This is because the incorporation of trees or shrubs in agroforestry systems can increase the amount of carbon sequestered in both soils and vegetation as compared to a monoculture field of crop plants or pasture or both (Jose, 2009). Recent estimates show that of the 960 million hectares of land under cultivation, 10% to 15% are managed by rural farmers (Altieri, 2008). This global population of small-holder farmers has been identified as the main target for policies to intensify production in agroforestry systems in order to effectively increase carbon density and also refill depleted soil carbon reserves (Obsertein *et al.,* 2010). Nevertheless, the potential of agroforestry systems to sequester atmospheric carbon depends on the type of the system, species composition, age of component species, geographic location, environmental factors, and management practices (Jose, 2009; Soto Pinto *et al.* 2010; CBD, 2009; Luedeling *et al.,* 2011**).**

Recent studies by Nair *et al.* (2009) showed that the carbon sequestration potential, in ton ha-1 yr-1, of the vegetation component varied from 0.29 in a fodder bank agroforestry system of West African Sahel to 15.21 in mixed species stands of Puerto Rico. In addition, Kuersten and Burschel (1993) provide estimates of the amounts of carbon sequestered, in ton ha-1 yr-1, by agroforestry of 0.5–2.0 for shade grown coffee and cacao, 2.0–3.6 for fuelwood plantations, 0.3–2.0 for secondary forests, 0.1 for trees on pastures and annual crops, and for live fences. Nair *et al.,* (2009) estimated potential

sequestration rates (ha-1 yr-1) of 5.9 for cacao agroforests of Cameroon, 6.3 for shaded coffee in Togo and between 0.3 and 1.1 for agroforestry in the Sahel. Future projections in Ghana by Hapsari (2010), show that agroforestry (MTS) activities in the Afram Forest Reserve area (Dry Semi-Deciduous forest), can store 3,148 million tons of carbon in its woody biomass, and in its first 5 years it can store up to 1,796 million tons of carbon if trees are not exposed to bushfires.

Soil carbon estimates ranged from 1.25 tons of carbon ha-1 in a Canadian alley cropping system to 173 tons of carbon ha-1 in an Atlantic Coast silvopastoral system in Costa Rica (Soto-Pinto *et al.*, 2010). In general, agroforests on arid, semiarid, and degraded sites had a lower carbon sequestration potential than those on fertile humid sites; and temperate agroforestry systems had relatively lower rates compared to tropical systems (Soto-Pinto *et al.*, 2010). Attempts to quantify the global carbon sequestration potential of agroforestry systems by Dixon (1995) estimated a total of 585–1,215 million ha of land in Africa, Asia and the Americas under agroforestry and a global potential to sequester 1.1– 2.2 billion tons of carbon (vegetation and soil) over 50 years. A similar study by Nair *et al.* (2009) using an estimated 1,023 million ha of land under agroforestry worldwide, reported a carbon sequestration potential of 1.9 billion tons of carbon over 50 years.

Considering the large extent of degraded forests and croplands and the potential to improve them using agroforestry, there is enormous potential to sequester additional carbon in such systems. According to an estimate by IPCC (2007), improving current management practices (e.g. better management of trees on croplands) in existing agroforestry practices could sequester an additional 12,000 tons of C yr-1 by 2010 and 17,000 tons of C yr-1 by 2040. Additionally, 630 million ha of unproductive croplands and grasslands could be converted to agroforestry, representing a carbon sequestration potential of 391,000 tons of C yr-1 by 2010 and 586,000 tons of C yr-1 by 2040 (IPCC, 2007).

Potential of agroforestry for improving livelihoods

The numerous economic benefits of chainsaw milling as reported by several authors (Damnyag *et al.* 2011; Marfo, 2010; Adam *et al.* 2007; Odoom, 2005) requires that initiatives to deal with chainsaw milling provide incentives that are competitive and profitable (Marfo and Acheampong, 2009). Consequently, measures for addressing the problem of chainsaw milling in

Ghana must focus on livelihoods and environmental sustainability (Sawyer, 1993; Obiri and Damnyag, 2011). Moreover, the livelihood option or initiative should have the potential of eliminating poverty by functioning as a lasting source of increase in household earnings, services, assets, civil and political rights (Warner, 2000; Ribot and Peluso, 2003; Farrington *et al*., 1999; Insaidoo *et al.,* 2012). The potential of agroforestry as a sustainable livelihood option that can eliminate poverty is rooted in the creation of a high value forest resource and improved productivity by the planting of economic tree species on farmlands (Nair, 1993; Insaidoo *et al.,* 2012). Agroforestry as a potential livelihood option in chainsaw dependent communities can contribute to the natural, human, financial, physical and social capital of its participants (Insaidoo *et al*. 2012), thus ensuring sustainability as described by Carney (1998) and Scoones (1998).

Establishment of Woodlots

Woodlot establishment involves the cultivation of multi-purpose woody perennials that are managed over time to produce, among other things, fuelwood, poles, and stakes for crop production (Nair, 1993; Sawyer, 1993). Woodlots can be established on lands that are not being used for the cultivation of food crops such as excess lands in low population density areas and marginal lands which are generally unsuitable for crop production in high population density areas (Obiri *et al.,* 2011). In Ghana, woodlots were established as part of the government's tree planting initiative in the 1980s to increase wood supply in rural communities with high wood deficits (Obiri *et al*., 2011).

An estimated 16 million m3 of wood valued at approximately US$ 200 million is consumed in various forms as energy per annum in Ghana (Agyeman *et al*., 2004). This accounts for more than 76% of total energy consumed (ECG, 2006). In rural communities, fuelwood makes up more than 95% of energy consumption. It is also estimated that the total fuelwood collected from the forest for domestic use amounts to 2.2% of gross domestic product (Agyeman *et al*., 2004). This makes fuelwood collection one of the main sources of cash income for the rural and urban dwellers who defy conservation practices to earn a living (FAO 2010b; Aabeyir *et al.* 2011). Commercial collectors sometimes use chainsaws to harvest primary tree species such as *Pterocarpus erinaceus, Anogeissus leiocarpus and Cylicodiscus gabonensis (*Aabeyir *et al.,* 2011*).* The over-exploitation of these wood resources for fuelwood and other wood products has resulted in the deforestation and a subsequent

reduction in fuelwood resources (Aabeyir *et al.* 2011). Moreover, the task of collecting fuelwood has become increasingly tedious as reduced availability of fuelwood have increased the distances that must be travelled to obtain sufficient supply (FAO, 2010b).

The problem of fuelwood scarcity and its related implications on livelihoods and the environment can be solved through woodlot establishment. Woodlots reduce the pressure on the natural forests and woodlands, providing a sustainable economic livelihood for the rural poor and acting as carbon sinks (Sawyer, 1993; FAO, 2010b; Obiri *et al.,* 2011). In the scarcity of preferred species, fast-growing species such as *Albizia spp., Terminalia superba, Gmelina odorata, Senna siamea, leucaena leucocephala, Celtis spp., Azadirachta indica* can potentially provide a sustainable source of fuelwood for household and industrial uses (Sawyer 1993; Foli *et al.* 2009; FAO 2010b; Obiri *et al.* 2011). The mitigation potential of fuelwood is rooted in the substitution of biomass for fossil fuels, and the sequestration of carbon in woodlot plantations (FAO, 2010b). In the absence of losses, energy from burning wood is carbon- neutral, since the carbon released on combustion is taken up in the next cycle of the plant or tree growth.

Cultivation of short-rotation timber species

Plantation establishment involving the cultivation of short-rotation (7-20 years) species can potentially provide livelihood opportunities in chainsaw communities through the production of high quality timber. Some short-rotation species include exotics such as *Tectona grandis* (Teak), *Cedrela odorata, Eucalyptus spp. and Pinus spp* (Sawyer, 1993; Foli *et al.* 2009). The short-rotation of these exotics makes it economically viable because they yield quick returns on investment. Moreover, there is more information on their growth requirements as well as fewer management problems associated with their cultivation (Foli *et al.* 2009). For instance, teak can be planted in areas with high bushfire incidence because of its fire resistance. It is also used as transmission poles for rural electrification as well as raw materials for domestic wood processing industries. Recently, *Pinus spp.* have been found to be a workable substitute as transmission poles because the high value of teak has rendered it cost ineffective to continue to use it for transmission poles (Foli *et al.,* 2009). In addition, *C. odorata* is becoming increasingly popular locally for sawn timber and veneer production making it a potential substitute for some of the mahoganies which have high disease and pest susceptibility (Foli *et al.* 2009). Nevertheless, some indigenous species that have proven to

be fast growing in plantations (Foli *et al.* 2009) include *Terminalia superba, Khaya ivorensis, Antiaris toxicaria and Ceiba pentandra.* These can be grown in mixed plantations with exotics to enhance biodiversity.

Short-rotation timber plantations can potentially supply wood to the local industries such as the wood carving industry, a major commercial enterprise with a large export potential (Obeng *et al.,* 2011).

The industry provides livelihood support for about 5000 and 1500 people as wood and canoe carvers respectively (Osei-Tutu *et al.* 2010). In the case of wood carving for handicrafts, the overdependence on a few preferred hardwood species such as *Diospyros spp.* (Ebony), *Cordia spp.* and *Holarrhena floribunda* has resulted in dwindling of these species in the wild (Sawyer, 1993; Obeng *et al.* 2011). This poses a major threat to many livelihoods and the environment. The substitution of these fast diminishing species with short-rotation species such as *Cedralla odorata, Triplochiton scleroxylon* (for canoe carving), *Tectona grandis* and *Azadirachta indica* could meet the increasing wood demands of the industry and sustain livelihoods and the environment at large (Sawyer, 1993; Obeng *et al.* 2011).

Cultivation of Non-Timber forest products (NTFPs)

Non-timber forest products (NTFPs) such as bamboo, rattan, medicinal plants, chew sticks, dyes, spices, gum and resins constituted about $63,331,823 and $60,931,268 of Ghana's annual foreign exchange earnings for 2006 and 2007 respectively (Osei-Tutu *et al.,* 2010). This value shows the high market potential for NTFPs. However, overexploitation and increasing local and international demand for NTFPs has resulted in the dwindling of the resource base in natural stocks. This is evidenced in collectors travelling long distances to collect raw materials, resulting in high harvesting costs and low returns (Osei-Tutu *et al.,* 2010). For instance, Blay (2004) reported that traders in chewing sticks (*Garcinia spp*.) continue to import chewing sticks from Liberia and Cote D'Ivoire to supplement domestic stocks. Studies however show that several NTFPs traditionally collected from the wild can now be domesticated to supplement the dwindling stocks (Osei-Tutu *et al.,* 2010).

Bamboo and rattan production and utilization also has an enormous livelihood potential of alleviating many of the social and environmental problems associated with chainsaw milling. The global market for bamboo is estimated at more than $2 billion (ENS, 2004 cited in Obiri and Oteng-Amoako,

2007). They are used, among others, for making handicraft, furniture, building, decorating, poles, kitchen ware, paper and fuelwood (charcoal and briquette) in many parts of the developing world (Obiri and Oteng-Amoako, 2007). Rattan, which is in short-supply (Adu-Anning, 2004) provides employment and income for collectors and processors, who utilize the NTFP in producing baskets, furniture, serving trays, etc. Moreover, bamboo and rattan have the potential of supplementing Ghana's annual economic timber species shortage of about 3 million m3. In this regard, the cultivation and utilization of these NTFPs has potential of reducing deforestation in addition to providing income opportunities for forest-dependent communities.

Medicinal plants play a major role in healthcare delivery in Africa with an estimated 80% of the population using medicinal plants because of poverty and the limited number of medical professionals (Ofori *et al.* 2011). Medicinal plants such as *Rauwfolia vomitora, Vitellaria paradoxa* (shea tree)*, Alstonia boonei, Cola nitida, Kegalia africana, Pycnanthus angolensis, Garcinia spp., Tamarindus indica,* and *Khaya senegalensis* are used for the treatment of convulsions, waist pains, fevers, high blood pressure, anaemia, measles, etc. Split stems of *Garcinia spp.* contain medicinal properties that offer natural dental care and have been commercialized in major West African cities providing cash revenues and employment for hundreds of people (Blay, 2004). Fruits of *Tetrapleura tetraptera* (prekese) are used extensively as appetizers and flavours in alcoholic beverages and soups. The fruits have a high market potential and can be sold either in the raw state or processed into tea bags or syrups (Osei-Tutu *et al.,* 2010). The cultivation of these and many other medicinal plants is necessary to ensure their continued availability and also create more livelihood opportunities for forest dependants.

3 STUDY AREA AND METHODS

The study was conducted in three Forest Districts (Nkawie, Juaso, and Goaso) due to their vast areas of off-reserve logging operations and their reputation of persistent 'illegal' chainsaw operations. Seven communities were visited in the three districts: Obogu, Banso and Menamenaso in the Juaso Forest District; Akrodie in the Goaso Forest District; and Akota, Otaakrom and Barniekrom in the Nkawie Forest District. A total of 92 respondents who were mainly chainsaw operatives were drawn from the five communities for the study. The selection of the respondents was purposive, considering chainsaw operators and other people involved in the chainsaw milling business. Contact with the respondents was negotiated with the assistance of facilitators who are field staff of the FC and have been involved with the control or assessment of chainsawing in the past. The facilitators contacted the relevant respondents to arrange a date and time for the fieldwork.

Methods of data collection included desk study, administration of semi-structured questionnaires, informal and key informant interviews. The desk study was meant to review literature on the various alternative livelihood activities promoted in Ghana, the various organizations that promoted them, and forest-based climate change mitigation activities that have potential for improving the livelihoods of local people. The questionnaires (See Annex 1) were designed to obtain data on the willingness of chainsaw communities to engage in alternative livelihood activities, their preferences for forest- based alternative livelihood activities which also have potential for climate change mitigation, and their views on measures that should be put in place for their preferred forest-based activities to be successfully implemented.

Responses obtained through the questionnaire administration were assigned numerical codes and SPSS was used to summarise and analyse the data. Simple descriptive statistics and frequencies were generated. Cross tabulations of relevant variables were also done to reveal patterns and relationships.

4 RESULTS AND DISCUSSION

This section presents the findings of the study. Interpretations and discussions have been provided alongside the presentation of the results. The section begins with a discussion on the characteristics and occupation of respondents. This is followed by an analysis of their willingness to engage in alternative livelihood activities, their preferences for forest-based alternative livelihood options with potential for climate change mitigation, and their views on measures that must be in place for successful implementation of alternative livelihood activities.

4.1 Characteristics of respondents

Out of the 92 respondents interviewed, 98% were males and 2% were females. This depicts the actual situation on the ground since more males are engaged in chainsaw operations than females. Chainsaw milling is generally regarded as a male activity, possibly due to the laborious nature of the operation. Majority (45%) of the respondents were between 30 and 39 years of age while 15% were between 50 and 59 years (Figure 1). The energy demand and nature of activities of chainsaw operations may account for the smaller number of respondents between 50 and 59 years. Majority (80%) of the respondents interviewed were married. Only 20% were unmarried. Majority (45%) had Junior High School education, 30% were educated to the Senior High School level while 7% had no education (Figure 2). Ninety six percent of the respondents admitted that they were the breadwinners of their families. This could account for their involvement in chainsaw operations as a major source of income to support their dependents.

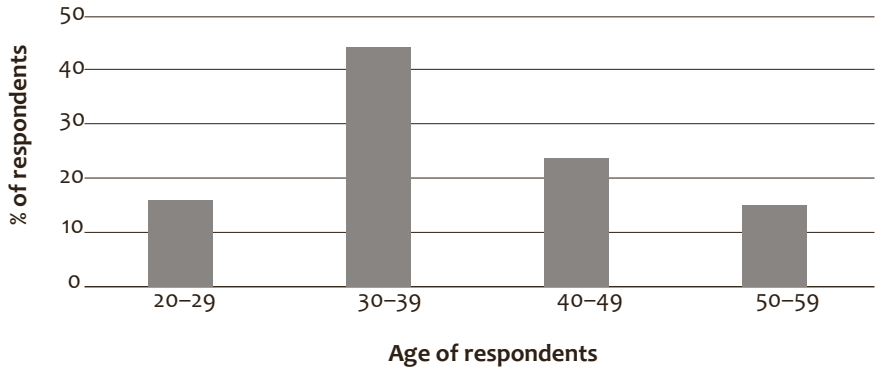

Figure 1: *Age of respondents (N=92)*

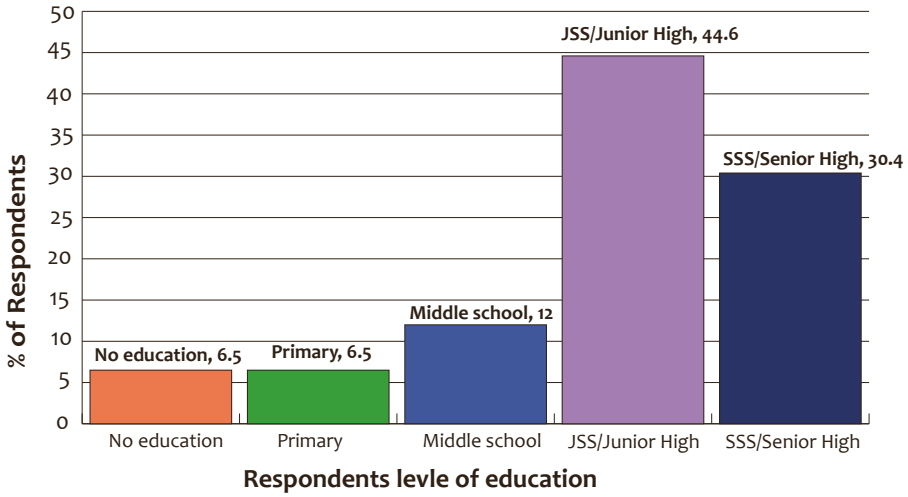

Figure 2: *Level of education of respondents (N=92)*

4.2 **Occupation of respondents**

Majority (58%) of the respondents reported that chainsaw operation is their main or major occupation, 23% mentioned farming, while 10% maintained that their main occupation is ownership of chainsaw machine. Other main occupations mentioned by the respondents were carpentry (4%), carrying of chainsaw lumber (3%) and driving (2%). (Table 3). Chainsaw operation is one of the major income generating ventures in most rural areas in Ghana and has therefore attracted large number of rural dwellers in the country.

Table 3: *Main occupation of respondents*

Respondents' main occupation	Number of Respondents	% of Respondents
Farming	21	23
Chainsaw operation	53	58
Carpentry/Masonry	4	4
Carrying of chainsaw lumber (lumber carriers)	3	3
Chainsaw machine ownership	9	10
Driving	2	2
Total	**92**	**100**

The respondents were also asked to mention their minor occupations or any other activity that offered them supplementary income. Twenty nine percent (29%) reported farming as their minor income generating venture while 15% mentioned chainsaw operations. Other activities mentioned by respondents as their minor occupations were machine ownership (13% of respondents), wood carrying (10%), carpentry (7%), livestock rearing (6%), masonry (4%), trading (4%) and craft making (4%) (Table 4). Taking together the major and minor occupations of respondents, chainsaw milling was found to be a source of livelihood for all the 92 respondents interviewed. Sixty-five of them consider it as a major source of livelihood while 27 of them see it as a minor source of livelihood.

Table 4: *Other occupations of respondents*

Respondents' Other Occupation	Number of Respondents	% of respondents
Livestock rearing	4	5.6
Masonry	3	4.2
Carpentry	5	6.9
Farming	21	29.2
Driving	6	8.3
Crafts making	3	4.2

Respondents' Other Occupation	Number of Respondents	% of respondents
Carrying of chainsaw lumber (lumber carriers)	7	9.7
Chainsaw machine ownership	9	12.5
Chainsaw operation	11	15.3
Trading	3	4.2
Total	**72**	**100**

4.3 Willingness to engage in alternative livelihood activities

To explore the willingness of respondents to participate in alternative livelihood programmes which also have potential for climate change mitigation, they were first asked whether they were aware of any alternative livelihood activity in their communities and whether they had ever been involved in alternative livelihood activities. Fifty-four percent of the respondents reported that they were aware of alternative livelihood activities in their communities while 46% stated otherwise. Although most of the respondents were aware of alternative livelihood activities in their vicinity, only 20% said that they had actually engaged in these activities. The study found that alternative livelihood activities respondents are involved in include plantation development (41% of respondents), grasscutter rearing (35%), snail rearing (12%) and mushroom cultivation (12%) (Figure 3). The dominance of plantation development as an alternative livelihood activity in the study communities may be due to the various government plantation development initiatives in forest fringe communities. Forest-related activities mostly benefit fringe communities who, as a result of government forest policy of collaborative forest management, are engaged in the provision of various services in forest reserves for the forest authorities (Blay *et al.*, 2008).

The other alternative livelihood activities such as grasscutter rearing, snail rearing and mushroom cultivation usually require some level of training and initial capital and this could be the reason why most community members do not involve themselves in these activities. According to Inkoom *et al.* (2005), even though many of these alternative livelihood activities have the potential

to be successful, they however require training and initial capital which may be difficult for most rural communities. These programmes may therefore need strong financial support from government and non-governmental organizations to make them effective.

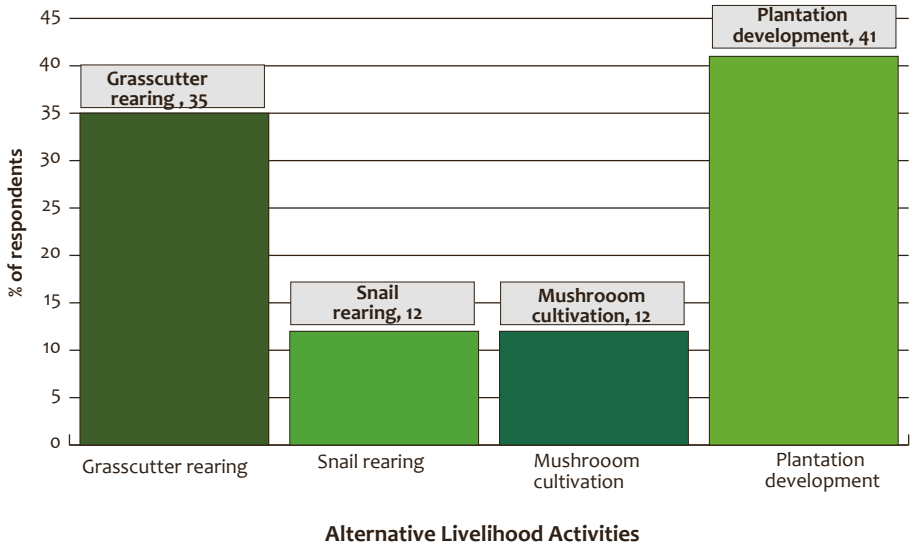

Figure 3: *Alternative livelihood activities respondents are involved (N=92).*

All the respondents were willing to engage in alternative livelihood activities. They gave several reasons to explain why they were willing to embrace alternative livelihood activities, including the need to generate extra income to support their families (45% of respondents); chainsaw business is risky (29%); chainsaw business has no future or has become less lucrative (28%); forest and timber resources are being depleted and need to be restored (27%); the need to improve their standards of living (8%); alternative livelihood activities generate employment prospects (6%); food production needs to be increased (3%) and water bodies are drying out (1%) (Table 5). The large number of respondents willing to engage themselves in alternative livelihood activities in order to generate income to support their families means that climate change mitigation interventions will have wider acceptability and greater chance of success if they significantly contribute to improving the livelihoods of local communities.

Table 5: *Reasons for respondents' willingness to participate in alternative livelihood activities*

Reasons	Number of Respondents	% of Respondents
Provision of extra income to support the family.	41	45
Chainsaw business is very risky.	26	29
The chainsaw business has no future or have become less profitable.	25	28
Forest and timber resources are being depleted and need to be restored.	24	27
To improve our standard of living.	7	8
Alternative livelihood activities create employment opportunities.	5	6
To increase food production.	3	3
Water bodies are drying out.	1	1

Note: Respondents were able to give more than one reason. N = 92 in each case.

4.4 Forest-based alternative livelihood options with potential for climate change mitigation preferred by respondents

In order to understand the preferences of the local communities for alternative livelihood activities (alternative to chainsaw milling) which also have potential for climate change mitigation, the respondents were asked to select from a predefined list a maximum of 3 forest-based alternative livelihood activities they preferred and give reasons for their choice. The forest-based livelihood activities were those that were deemed to have the potential to contribute to climate change mitigation. Even though the respondents were provided with a list to select from, they were also allowed to mention other forest-based activities they preferred which were not in the list. Majority (78%) of the respondents reported that they prefer agroforestry

practices, 76% mentioned cultivation of fast- growing indigenous timber species such as *Terminalia superba* and *khaya ivorensis,* 71% indicated that they prefer the cultivation of short-rotation exotic timber species such as teak and cedrela, 44% preferred the establishment of fruit plantations such as mango and citrus, while 10% were in favour of the cultivation of non-timber forest products (NTFPs) such as bamboo and rattan (Table 6). Only 3% said that they would like to engage in the establishment of woodlot or fuelwood plantations.

Table 6: *Preferred forest-based alternative livelihood options*

Alternative Livelihood Option	Number of Respondents	% of Respondents
Agroforestry.	71	78
Cultivation of fast-growing indigenous timber species such as *Terminalia superba* and *Khaya ivorensis.*	69	76
Cultivation of short-rotation exotic timber species such as teak and cedrela.	65	71
Establishment of fruit plantation eg mango and citrus.	40	44
Cultivation of non-timber forest products eg bamboo and rattan.	10	11
Establishment of woodlot/ fuelwood plantation.	3	3

Note: Number and percentage of respondents do not add up to 92 and 100 respectively because of multiple responses. N = 92 in each case.

The higher percentage of respondents who prefer agroforestry as an alternative livelihood activity points to the fact that agroforestry is an important land use activity in Ghana which has been practised, particularly by rural communities, over a long period of time (FAO, 1984). Agroforestry as an alternative livelihood can evolve into a technological alternative for reducing deforestation rates in tropical zones while offering a wide variety of products and services in the form of food and income to rural communities as well

as helping in climate change mitigation (Sawyer, 1993; de Jong *et al.* 1995). According to the IPCC (2007), increase of tree cover through agroforestry, on-farm tree retention, and tree planting in abandoned landscapes is a positive way of mitigating climate change. Canadell and Raupach (2008) also report that agroforestry systems are very important climate change mitigation initiatives given the area currently destined for agriculture, the number of people who depend on land for their livelihoods and the need for integrating food production with environmental services. Since majority of local people depend on small pieces of land for their yearly farming activities they

will like to incorporate agroforestry trees on their farms rather than to use their entire land for only tree planting. This will therefore provide the farmers with income and at the same time aid in their food security.

Several reasons were given by the respondents to explain why they prefer the forest-based activities. Some of the reasons given by those that said that they prefer agroforestry as an alternative livelihood activity include the fact that agroforestry can provide their households with food and extra income to support their families. Some also claimed that agroforestry can contribute to the restoration of the lost forest cover. The respondents' preference for agroforestry because of food production corroborates the assertion by Meade *et al.* (2005) that most farmers involved in agroforestry are more concerned about how to feed their families on a regular basis and therefore farmers and local individuals who do not have access to lands face the deepest level of poverty in Ghana.

Similarly, the reasons given by those that supported the cultivation of short-rotation exotic timber species included provision of construction materials, supply of lumber to the local market, provision of extra income to support the family, restoration of the lost forest, provision of poles for electrification projects, the trees can coppice after harvesting, the trees can resist fire, the plantation will serve as an insurance for my children in the future, and the trees grow very fast (Table 7).

Table 7: *Reasons for choice of forest-based alternative livelihood options*

Alternative Livelihood Option	Reasons for Preferring Option
Agroforestry	• Provision of food • Provision of extra income to support the family • Restoration of the lost forest
Cultivation of fast- growing indigenous timber species	• Extra income to support the family • Restoration of the lost forest • Provision of construction materials • Supply of lumber to the domestic market • It will serve for construction purposes • It will provide us housing materials and materials for furniture
Cultivation of short- rotation exotic timber species	• Provision of construction materials • Supply of lumber to the local market • Provision of extra income to support the family • Restoration of the lost forest • It will serve as an insurance for my children in the future • The trees grow very fast • It will serve for construction purposes • It will provide us housing materials and materials for furniture • Provision of poles for electrification projects • The trees can coppice after harvesting • The trees can resist fire
Establishment of fruit plantation	• Provision of food • Provision of extra income • Restoration of forest cover • It will help my children in the future

Alternative Livelihood Option	Reasons for Preferring Option
Cultivation of non- timber forest products	• Provision of food • Extra income to support our livelihoods • It will help to restore the lost forest
Establishment of woodlot/fuelwood plantation	• Provision of extra income to support the family • Restoration of the lost forest

None of the respondents mentioned climate change mitigation or adaptation as a reason for their choice of particular forest-based alternative livelihood activities. This could be due to the fact that local communities are not fully aware of the role that forests and trees play in climate change mitigation and adaptation. It could also be due to the fact that local communities see climate change mitigation and adaptation as outside their control and therefore do not appreciate that interventions that aim to improve their livelihoods can also have positive effects on climate change. Sensitization and education of local communities on climate change mitigation and adaptation, particularly the role of forest and trees in this regard, would therefore be helpful.

4.4.1 Agroforestry as an alternative livelihood activity

Agroforestry options or systems respondents prefer

The 71 respondents who selected agroforestry as their preferred alternative livelihood activity were asked to identify the systems or options of agroforestry they are interested in by choosing from six combinations, namely (1) trees with food crops e.g. modified taungya system; (2) trees with the rearing of ruminants and rodents; (3) trees with fish pond; (4) trees with snail rearing; (5) trees with bee- keeping; and (6) trees with vegetables. These combinations reflect agroforestry systems common in Ghana. The majority of respondents (77%) chose trees with food crops, 55% selected trees with the rearing of ruminants and rodents, 37% mentioned trees with fish pond, while 22% indicated that they prefer trees with vegetables (Table 8).

Table 8: *Agroforestry systems preferred by respondents*

Agroforestry Option	Number of Respondents	% of Respondents	Reasons Given by Respondents for Preferring Option
Trees with food crops e.g. modified taungya system	71	77	Opportunity for food production; provision of extra income; provision of lumber for construction purposes
Trees with rearing of ruminants and rodents	50	55	Provision of meat for consumption; lumber for construction purposes; extra income to support the family
Trees with fish pond	34	37	Source of employment; lumber for construction purposes; extra income to support the family; fish for consumption
Trees with snail rearing	23	25	lumber for construction purposes; extra income to support the family; snails are becoming scarce
Trees with bee-keeping	22	24	lumber for construction purposes; extra income to support the family; source of employment
Trees with vegetables	20	22	lumber for construction purposes; extra income to support the family

Note: Number and percentage of respondents do not add up to 71 and 100 respectively because of multiple responses. N = 71 in each case.

The respondents gave several reasons for their agroforestry preferences (Table 6). The common reasons that cut across all the options are that

agroforestry can make lumber available for construction purposes and it is a source of extra income to support the respondents' families.

Preferred trees in agroforestry systems

Figure 4 presents results on preferred trees in agroforestry systems. Majority (66%) of the respondents said that they prefer timber trees in their agroforestry systems, 19% maintained that they prefer cash crop trees such as cashew while 15% claimed that they prefer fruit trees like mangoes and citrus.

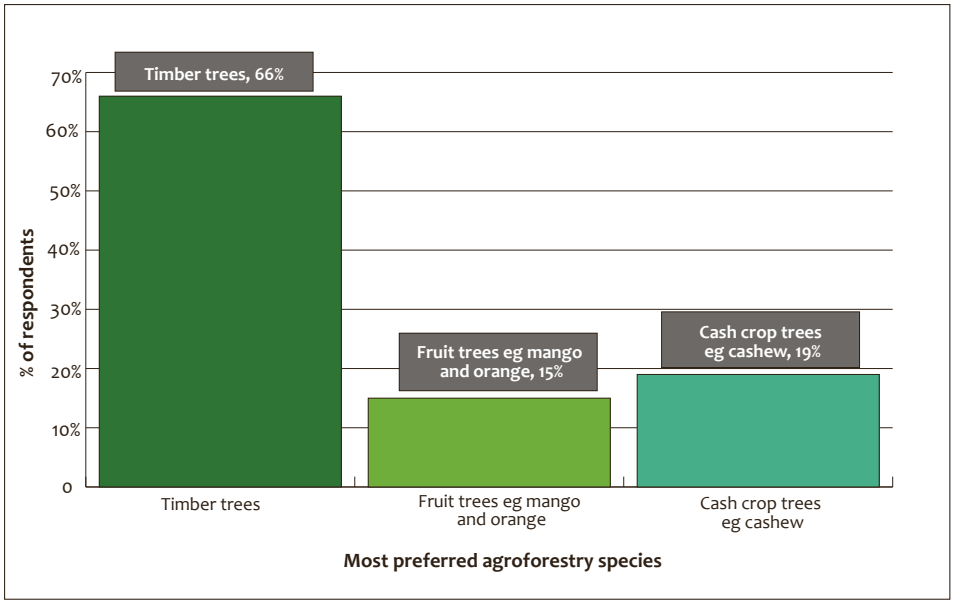

Figure 4: *Preferred agroforestry tree species (N= 71)*

Most of the respondents that preferred timber species in their agroforestry system explained that their preference is based on the fact that incorporating timber trees in their agroforestry system can help to restore the dwindling forest cover as well as making timber or lumber available on the domestic market and for construction purposes. Some said that incorporating timber species could provide them extra income because of high market demand for timber. For those that preferred fruit trees, the reasons they provided are (i) provision of extra income to support the family; (ii) provision of food to feed the family; and (iii) growing fruits is a source of employment. For those that preferred cash crop trees, their choice was based on the extra income they could potentially obtain to support the needs of their families,

the employment generated by the cultivation of cash crops such as cashew and cocoa as well as the relatively high demand and price of cash crops.

Preferred timber species in agroforestry systems

Majority of the respondents (62%) who mentioned timber species as their preferred trees in their agroforestry systems reported that they will prefer fast-growing indigenous timber species such as mahogany and ofram whilst 38% said that they are in favour of short-rotation exotic timber species such as teak and cedrela. For those that preferred fast-growing indigenous species, the high demand of wood of such species on the domestic market and therefore their potential for income generation and the fact that such species are indigenous and could therefore aid in the restoration of the countries dwindling forest cover were their motivation. The respondents that preferred short-rotation exotic species gave reasons such as the fast growth rate of such species, the ability of such species to provide both poles and timber for construction purposes, and their fire resistance and coppicing ability to explain their choices.

Even though the vast majority of respondents preferred fast-growing indigenous timber species, Foli *et. al.* (2009) reported that exotic species such as *Cedrela odorata* is becoming increasingly popular locally for sawn timber and veneer production, making it a potential substitute for some of the mahoganies and other fast growing indigenous species which have high disease and pest susceptibility. Obeng *et. al.* (2011) also reported that, short-rotation timber plantations can potentially supply wood to the local industries such as the wood carving industry. Although some indigenous species such as *Terminalia superba, Khaya ivorensis, Antiaris toxicaria and Ceiba pentandra* have proven to be fast growing in plantations, these species can be grown in mixed plantations with exotics to enhance biodiversity (Foli *et al.,* 2009).

4.4.2 Plantation development as an alternative livelihood activity

As much as 93% of the 92 respondents were in favour of plantation development (either the cultivation of short-rotation exotic species or fast-growing indigenous species) as an alternative livelihood option. As mentioned earlier, most (76%) of the 92 respondents mentioned the cultivation of

fast-growing indigenous timber species while 71% of them mentioned the cultivation of short-rotation exotic timber species1.

Plantation species preferred

Majority (70%) of the respondents that indicated that they preferred short-rotation exotic timber species reported that they would like to grow teak, 27% preferred cedrela whilst 3% preferred *Pinus spp*. The respondents who preferred teak explained that teak has high fire resistant ability and hence can be grown in areas that are fire prone. Few respondents indicated that they preferred the *Pinus spp* possibly because pinus has been found to be a workable substitute as transmission poles since the high value of teak has rendered it cost ineffective to continue to use it for transmission poles (Foli *et al.,* 2009). Similarly, most of the respondents (60%) who preferred fast-growing indigenous timber species were in favour of *Terminalia superba* (ofram), 30% preferred *Khaya ivorensis* (African mahogany) and 10% preferred *Ceiba pentandra* (onyina). The large number of respondents preferring *Terminalia spp.* could be attributed to its fast growth and quality timber as compared to the other two species (Foli *et al.,* 2009).

Preferred plantation types

Majority (68%) of the respondents who selected plantation development as an alternative livelihood option preferred mixed species plantations whilst 32% preferred monoculture plantations. The significant number of respondents who were interested in mixed species plantations could be attributed to the fact that mixed plantations contribute to high level of biodiversity in an area compared to that of monoculture plantations. Erskine *et al.* (2006) assert that the structural simplicity and resource homogeneity of monoculture plantations render the plantations less varied, thereby influencing the abundance and richness of plant and animal diversity they sustain. The study has found that most of the respondents are willing to either plant or preserve trees on their lands because of their interest in the restoration of the country's forest cover, hence being aware of the biodiversity benefits of mixed plantations can influence their choice between monoculture and mixed species plantations. For those respondents that preferred monoculture plantations, their choice could be as a result of the

1 Respondents gave multiple responses so percentages will not add up to 100.

high productivity and the ease of managing these monoculture plantations as reported by Kelty (2006).

The respondents advanced several reasons to support their choice of mixed species plantations over monocultures. Some preferred mixed species plantations because they thought they could have access to different trees at the same time on their lands, others were of the view that mixed plantations help in the restoration of lost forest cover, others preferred mixed plantations in order to avoid the risk of loss and increase their profits, whilst a few preferred mixed plantations because they believed that each tree served different purposes in plantations. Some were also of the view that mixed plantations make the control of pests and diseases in the field easier. This supports the findings of Kelty (2006) who reported that one of the major benefits of using species mixtures is their potential to reduce the effects of insects and pests on plantations. It is widely believed that planting high-risk indigenous species in mixtures with other short rotation exotic timber species has the potential to substantially reduce damages caused to the species stand (Jactel and Brockerhoff, 2007). The major reason given by the respondents who preferred monoculture plantations was that monocultures help to avoid competition among different species of trees.

4.4.3 Cultivation of non-timber forest products as an alternative livelihood activity

Even though only 11% of the 92 respondents mentioned the cultivation of non-timber forest products (NTFPs) as their preferred forest-based alternative livelihood activity, all the respondents were made to identify their most preferred NTFP for cultivation and give reasons. Majority of the respondents (64%) preferred cola, 63% preferred prekese (*Tetrapleura tetraptera*), 42% mentioned bamboo, 31% mentioned chewing sticks, 25% said that they would prefer medicinal plants, 15% preferred rattan, while 11% chose the gum copal tree (Table 9).

Increasing local and international demand for NTFPs has resulted in over-exploitation and dwindling supply of NTFPs. There is therefore the need to increase the sources of supply of NTFPs through cultivation in order to supply both the local and international markets. The respondents' interest to go into NTFP production is a step in the right direction since several studies have shown that NTFPs traditionally collected from the wild can now

be domesticated to supplement the dwindling natural stock (Osei-Tutu *et* al., 2010).

Table 9: *Respondents' most preferred non-timber forest products for cultivation*

Preferred ntFP	Number of Respondents	% of Respondents
Cola	58	64
Prekese (*Tetrapleura tetraptera*)	57	63
Bamboo	38	42
Chewing sticks	28	31
Medicinal plants	23	25
Rattan	14	15
Gum copal tree (*Daniellia ogea*)	10	11

Note: Respondents gave multiple responses. N = 92 in each case.

Reasons given by the respondents to explain their preference for the cultivation of NTFPs include generation of income, their use for medicinal purposes, and the high market demand for NTFPs. According to Blay (2004) traders in chewing sticks and other NTFPs continue to import chewing sticks from Liberia and Cote D'Ivoire to supplement domestic stocks. Thus, production of these NTFPs as an alternative livelihood activity for chainsaw operators will help them generate extra income to support their families. Bamboo and rattan production, for instance, has an enormous livelihood potential and can help alleviate many of the social and environmental problems associated with chainsaw milling.

4.5 Motivation to participate in alternative livelihood activities

After identifying their preferences for the forest-based alternative livelihood activities, the respondents were asked to mention the conditions, factors or incentives that will motivate them to participate in the forest-based alternative livelihood activities. Most of the respondents (45%) mentioned

access to financial or credit facilities as the best motivation to encourage them to engage in the alternative livelihood activities, 25% reported that they will engage in the activities if they will improve their standards of living, 24% mentioned restoration of the lost forest cover as their motivation, while 19% said that regular monitoring and supervision will be a source of motivation. Other motivational factors reported by the respondents are training and capacity building of local people in forest-based alternative livelihood activities (17% of respondents), access to land (14%), getting assistance from the government (13%), and the fact that the chainsaw business has no future (11%) (Table 10).

Access to financial assistance was recognized by respondents as one of the most important motivating measures that can influence local people to participate in the alternative livelihood ventures possibly due to the fact that capital is always needed for the implementation and running of every business.

Table 10: *Respondents' views on factors that will motivate them to participate in forest-based alternative livelihood activities*

Factors/Incentives/Conditions that can Motivate Respondents	Number of Respondents	% of Respondents
Access to financial or credit facilities	41	45
Improvement of standards of living	23	25
Restoration of the lost forest	22	24
Regular monitoring and supervision	17	19
Training and capacity building	15	17
Access to land	13	14
Assistance from the government	12	13
Chainsaw business has no future	10	11
Chainsaw business is an illegal activity	7	8
Formation of association to protect the forest	5	6

Note: Respondents gave multiple responses. N = 92 in each case.

4.6 Measures for successful implementation of alternative livelihood activities

Having mentioned the factors that could motivate them to participate in the alternative livelihood activities, the respondents were then asked to identify measures that should be put in place for their most preferred forest-based alternative livelihood activities to be successful. Four main measures were mentioned by the respondents: credit facilities, training/capacity building, access to extension services, provision of seedlings, and access to market (Table 11). Credit facility was ranked as the most important measure for the success of the activities. This is because capital is always important in engaging in every business venture. Training or capacity building was mentioned because most of the respondents believed that they did not have the requisite expertise for engaging in the alternative livelihood activities. They felt that building their capacity to acquire the necessary skills will go a long way to encourage them to start the activities and also improve their chances of success in the venture. They regarded the provision of extension services as one way to improve their capacity to engage in the activities and be successful.

Table 11: *Measures for successful implementation of most preferred alternative livelihood activity*

Measures	No. of Respondents	% of Respondents
Credit facilities	88	96
Training/capacity building	80	87
Access to extension services	70	76
Provision of seedlings	81	88
Access to market	61	66

Note: Respondents gave multiple responses. N = 92 in each case.

The respondents lamented that the lack of access to land, lack of training/capacity building, lack of access to extension services, lack of ready market for the output of the forest-based alternative livelihood activities, and inadequate monitoring and supervision of the activities can work against the successful implementation of most of their preferred alternative livelihood activities.

5 CONCLUSION AND RECOMMENDATIONS

This study investigated the preferences of chainsaw-dependent communities for forest-based interventions that have the potential to support both rural livelihoods and climate change mitigation efforts simultaneously. All the chainsaw operatives interviewed were willing to engage in alternative livelihood activities, citing reasons such as the need to generate extra income to support their families, the riskiness and the bleak future of the chainsaw business, the need to restore the lost forest and timber resources, and the need to improve their standards of living. Three main forest-based activities – agroforestry, cultivation of fast-growing indigenous timber species (such as *Terminalia superba* and *khaya ivorensis*), and cultivation of short-rotation exotic timber species (such as teak and cedrela) – stood out as the most preferred alternative livelihood options. Others preferred the establishment of fruit plantations (such as mango and citrus) and the cultivation of non-timber forest products (NTFPs) (such as bamboo and rattan) while a few were in favour of the establishment of woodlot or fuelwood plantations. For those that were willing to engage in agroforestry, trees with integration of food crops was the most preferred agroforestry system, with timber trees dominating the preferred tree species. Majority of the respondents who selected plantation development (either the cultivation of short-rotation exotic species or fast-growing indigenous species) as an alternative livelihood option preferred mixed species plantations over monoculture plantations.

The respondents mentioned several conditions, factors or incentives that will motivate them to engage in their preferred alternative livelihood activities. These included access to financial or credit facilities, the potential of the particular activity to improve their living standards, the potential of the activity to restore the lost forest cover, regular monitoring and supervision of the interventions, training and capacity building of local people in forest-based alternative livelihood activities, access to land, and assistance (in any form) from the government. They reported that credit facilities, training/capacity building, access to extension services, provision of seedlings, and access to markets are measures that must be in place for their preferred forest-based livelihood activities to be successful.

One of the key challenges facing alternative livelihood interventions in Ghana is the sustainability of such programs. Even though several alternative livelihood programs have been promoted in rural communities in Ghana,

many of these programs have either collapsed or are not doing well as they should. Many of these programs have been donor-funded and, usually, the majority collapse soon after external support for the programs are withdrawn. One of the reasons for this outcome is the failure of alternative livelihood programs to recognize the local spatial, biophysical and socio-cultural differences between local communities and the specific preferences of these communities for such interventions. To be successful, the design and implementation of alternative livelihood programs with potential for climate change mitigation must adopt a bottom-up approach. Local people's preferences and views should be taken into consideration in the design and implementation of such interventions to ensure that they gain local appeal and therefore wider acceptability and a higher chance of success.

Alternative livelihood activities that aim to encourage people to do away with chainsaw milling must have the potential to offer returns comparable to chainsaw milling. The idea of forest-based activities that can simultaneously contribute to climate change mitigation and also serve as alternative livelihoods for chainsaw-dependent communities has some appeal. However, the question that needs to be asked is whether the activities mentioned by the chainsaw operatives as their preferred alternative livelihood options can offer returns similar to that from chainsaw milling. An analyses of the economic viability of the identified forest-based alternative livelihood interventions is therefore critical. Again, if the focus of the interventions is more of discouraging people from engaging in chainsaw milling activities and less of mitigating climate change, then interventions outside the forestry sector need to be explored as they may offer higher returns than forest-based activities and therefore can serve as meaningful alternatives to chainsaw milling.

Even though the respondents mentioned several reasons for preferring particular forest-based activities, none of them mentioned climate change mitigation or adaptation as a reason for their choice. This could be due to the fact that local communities are not fully aware of the role that forests and trees play in climate change mitigation and adaptation. It could also be due to the fact that local communities see climate change mitigation and adaptation as outside their control and therefore do not appreciate that interventions that aim to improve their livelihoods can also have positive effects on climate change. Sensitization and education of local communities on climate change mitigation and adaptation, particularly the role of forest and trees in this regard, would therefore be helpful.

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ANNEX 1

CHAINSAW PROJECT-SURVEY QUESTIONNAIRE

DEVELOPING THE POTENTIAL OF CLIMATE CHANGE MITIGATION ACTIVITIES AS ALTERNATIVE LIVELIHOODS FOR CHAINSAW DEPENDENT COMMUNITIES

As part of efforts to address illegal chainsaw milling and climate change concurrently FORIG in conjunction with TBI-Ghana under the EU-Chainsaw project are cooperating to carry out this study. The information collected through this survey will serve as a basis for recommending viable strategies which can serve as alternative livelihood options for chainsaw dependent communities and, at same time, help in mitigating climate change in Ghana.

Your participation would be very much appreciated. Thank you.

Date of Interview…… Interviewer's Name……

Name of Community:……

Forest District and Region: ……

SECTION 1: Socio-economic characteristics of respondents

Q1. Name of respondents (optional): ……

Q2. Gender: (1) Male (2) Female

Q3. Age of respondent ..... years

Q4. Marital status: (1) Single (2) Married (3) widowed
(4) Other (specify): ……

Q5a. Are you the bread winner for your family? (1) Yes (2) No

Q5b. If yes, what is the household size (Specify): ……

Q5c. If married, how many children do you have? ……

Q6. Respondent's educational level: (1) No education (2) Primary (3) Middle school (4) J.S.S./Junior High (5) S.S.S./ Senior High (6) Tertiary

Q7a. What is your main occupation? (1) Farming (2) Trading (3) Hunting (4) NTFP collection (5) Livestock rearing

(6) Charcoal production (7) Chainsaw operation (8) Carpentry/ Masonry (9) Crafts making

(10) Other (specify) ……

Q7b. Other occupation(s) which brings supplementary income? (specify)

……

SECTION 2: Alternative livelihood options with potential for climate change mitigation

Q8. Are you aware of any alternative livelihood activity/program in your community? (1)Yes (2) No

Q9a. Have you ever been involved in alternative livelihood activities? (1) Yes (2) No

Q9b. If yes, which one(s): (1) Grasscutter rearing (2) Snail rearing (3) Bee – keeping (4) Mushroom cultivation

(5) Plantation Development (6) Soap making (7) Batik tie and dye

Others (specify) ……

Q10a. Would you like to participate in alternative livelihood program? (1) Yes (2) No

Q10b. If yes, why: ……

……

……

Q10c. If no, why: ……

…… ……

……

Q11. Which of the following forest-based alternative livelihood (AL) options (alternative to chainsaw milling) would you prefer and why? Select a maximum of 3. Rank the selected options in order of importance (1 = most important, 3 = least important)

Tick	**Alternative livelihood option**	**Why do you prefer option?**	Ranking in order of importance
	Agroforestry		
	Establishment of Woodlot/fuelwood plantation		
	Cultivation of short-rotation exotic timber species such as Teak and Cedrela		
	Cultivation of fast – growing indigenous timber species such as *Terminalia superba* – Ofram *and Khaya ivorensis* – African mahogany.		
	Cultivation of non-timber products eg. bamboo and rattan		
	Establishment of fruit plantations e.g mango, citrus		
	Others (specify)		

Q12a. If you were to engage in agroforestry, which of the following combinations would you prefer and why? Select a maximum of 3. Rank the selected options in order of importance (1 = most important, 3 = least important).

Tick	**Agroforestry option**	**Why do you prefer option?**	Ranking in order of importance
	Trees with food crops e.g. Modified Taungya System		
	Trees with vegetables		
	Trees with snail rearing		
	Trees with rearing of ruminants and rodents		
	Trees with bee-keeping		
	Trees with fish pond		
	Others (specify)		

Q12b. Which of the following trees would you prefer most in your agroforestry system and why? Select one only

(1) Timber trees (2) Fruit trees eg. mango and orange (3) Cash crop trees eg. Cashew (4) Multipurpose trees e.g. Leucaena

Others (specify): ……

Why? .....

.....

Q12c. If timber trees, what is your most preferred species and why? Select one only

(1) short-rotation exotic timber species, such as teak, cedrela, etc.

(2) fast-growing indigenous timber species such as Mahogany, Ofram, etc.

Other (specify): ……..……

Why? .....

.....

Q13. If you were to engage in the cultivation of short-rotation exotic timber species, which species would you prefer most and why? Select one only

(1) Teak (2) Cedrela (3) *Eucalyptus spp.* (4) *Pinus spp.*

Other (specify): ……

Why? ……

Q14. If you were to engage in the cultivation of fast-growing indigenous timber species, which species would you prefer most and why? Select one only (1) *Terminalia superba* – Ofram (2) *Khaya ivorensis* – African mahogany (3) *Ceiba pentandra* – onyina

Other (specify): ……

Why? ……

Q15.Would you prefer monoculture or mixed species plantations?

(1) Monoculture plantations (2) mixed species plantations

Give reasons: .....

Q16. Identify your preferred Non-timber forest product for cultivation and give reasons. Select a maximum of 3.

Rank them in order of importance (1 = most important, 3 = least important)

Tick	Preferred NTFP for cultivation	Why do you prefer NTFP?	Ranking in order of importance
	Bamboo		
	Rattan		
	Gum copal tree (*Daniellia ogea*)		

Tick	Preferred NTFP for cultivation	Why do you prefer NTFP?	Ranking in order of importance
	Cola		
	Prekese		
	Medicinal plants		
	chewing sticks		
	Other (specify)		

SECTION 3: Motivation and measures for successful implementation of activities

Q17. What will motivate you to participate in these alternative livelihood activities?

……

……

.....

Q18. What measures should be in place for your **most preferred forest-based alternative livelihood activity** to be successful? Please rank the measures in order of importance (starting from 1 as most important)

Most preferred forest-based alternative livelihood activity: .....

Tick	Measure for successful implementation of most preferred alternative livelihood activity	Ranking in order of importance
	Credit facilities	
	Access to market	
	Provision of seedlings	
	Training/capacity building	
	Access to extension service	
	Others (specified)	

Q19. Which factors in your opinion can militate against the success of **your most preferred alternative livelihood activity**? Please rank the factors in order of importance (starting from 1 as most important)

(1) Access to land (2) Lack of ready market (3) Lack of access to extension services

(4) No/inadequate monitoring (5) Long-term nature of some alternative options

Tick	**Factors that can militate against the success of most preferred alternative livelihood activity**	**Ranking in order of importance**
	Access to land	
	Lack of ready market	
	Lack of access to extension services	
	No/inadequate monitoring	
	Long-term nature of some alternative options	
	Lack of credit facilities	
	Lack of training/capacity building	
	Others (specified)	

THANK YOU

This report was produced within the framework of the EU Chainsaw Milling Project "Supporting the integration of legal and legitimate domestic timber markets into Voluntary Partnership Agreements". The project aims to find sustainable solutions to the problems associated with the production of lumber for local timber markets by involving all stakeholders in dialogue, information gathering and the development of alternatives to unsustainable chainsaw milling practices. In Ghana, the project is being carried out by Tropenbos International (TBI) in collaboration with the Forestry Research Institute of Ghana (FORIG) and the Forestry Commission (FC).

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