Ghana Journal of Geography

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Plantation Forest Management among Local Farmers in Offinso North District of Ghana

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article info

Article history:
Received 28th July 2023
Accepted 13th September 2024

Keywords:
Plantation forest,
Local farmers,
Forest management,
Offinso-North,
Ghana.

abstract

Deforestation has been on the rise from the world's tropical forest since the late 20th century. Africa has reportedly lost more than 19 million ha of its original forest. The government of Ghana in the 20th century, got alarmed with the accelerating rate of degradation, its effect on the environment, and the failure of centralized forest management system. This led to the introduction of forest decentralization which brought forth local peoples' participation in the restoration of the lost forest. Plantation forest unlike the Modified Taungya System has not been thoroughly explored in the Ghanaian literature, hence the justification for this study. This study is based on local farmers in the Offinso area in Ghana who are into reforestation and their contribution to increase in forested land cover in the country. The study adopted a mixed method approach to select 135 local farmers for the study. Data collected were analysed using descriptive statistics and thematic discussions. The study revealed that farmers into forest plantation farming benefit from their activities, and that the economic benefit of wood has helped in increasing the forest cover of the area through afforestation.

Introduction

Forestry is not only about trees, but also, the people to whom the trees play major role in solving their needs (Westoby, 1987 as cited in FAO, 2006). Forests play significant roles in the livelihoods of the forest fringes communities and the nation at large in serving as a source of foreign exchange, tourism, raw materials for industries and as a means of employment for those involved in forest related works. Forest comprises various individual strands at different height because of the variation in its development and characteristics (Mya, 2010). The reliance of human being on forest resources brings forth the need to put down strategies to encourage the act of sustaining forest resources. The products from the forest are mostly irreplaceable, therefore, the attitude of strong sustainability should be adopted to ensure a perpetual flow of the forest resources. Again, forest resources are non-excludable to a considerable extent, hence, the planting of trees should not be a matter of choice but a necessity to support life now and in future.

Environmental degradation and deforestation have been an area of studies to fight the changes in climatic phenomena over the years globally, but its focus now has been shifted more to the developing countries (Allen & Barnes, 2017). This is because majority of the citizens in these countries heavily rely on forest as a main source of livelihood. The depletion of forest in developing countries is mostly influenced by the fact that their main occupation is food crop farming (Osei-Mainoo, 2012). Other factors that have led to the depletion of forest include livestock rearing, high demand for fuel wood and infrastructural expansion (Arnold, 2001; Mujuri, 2007). Centralized means of forest management helped in achieving efficient and effective sustainability of forest resources, but it has lost its effectiveness over the years (Osei-Tutu, Pregering & Pokorny, 2015).

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http://dx.doi.org/10.4314/gjg.v16i3.4

It was therefore essential to decentralize forest management to involve local community members in protecting and sustaining forest resources to curtail the degradation within the forest areas and to help in reclaiming degraded lands, increasing forest cover and improving on the living condition of the rural folks.

Community Based Forestry (CBF) is synonymous to participatory forestry where the state, local people and sometimes non-state organizations are involved in forest management. According to Teitelbaum et al. (2006, p. 417), CBF is defined as "a public forest area managed by the community as a working forest for the benefit of the community." At the latter part of the 19th century, the practice of tree planting in establishing forest and or agricultural plantation became a common practice especially, in agroforestry, which later brought about a positive change in mostly open forest (Nair, 1993). CBF emerged with the aim of addressing the connection between forestry and the local people (Arnold, 2001) and for restoring landscape, conserving biodiversity and to improve rural livelihoods globally (Paudyal et al., 2017). It also came about after the increasing pressure on lands for the main livelihoods that cut across the globe, crop and livestock farming.

Gradually, there has been the introduction of smallholder forest management where household or private individuals have the right to own and manage forest lands aside the well – known centralized ones which are state-owned forest areas. According to Arnold (2001), these household practice longer term management as compared to those in the collaborative schemes, although on a relatively small area, yet associated with effective management. This forestry began in Nepal, India, Indonesia, China, Brazil, Costa Rica, and Ecuador and has shifted to several parts of the world including Ghana. CBF has been given several names in different countries. For instance, in West Africa, it is mostly identified as Forest co-management, in Mexico as Community management of forests, Ethiopia as Participatory Forest Management, India as Forest Management or Social forestry and in Nepal as Hill community forestry (Arnold, 2001).

Community forestry shows the relation among people's activities, forest and the outputs of forest. It is hypothetical that peoples' participation in forest governance with their own lands brings about effective sustainable forest management and a reduction in poverty in forest fringes communities. Hardin (1968) related community forest management to *the tragedy of the commons*,

where as a result of ownership of resources not being clarified, people extract resources they see as common excessively without replacing them due to free access resulting from low management. This then leads to tragedies such as loss of biodiversity, dying of water bodies and change in weather patterns. There can be an effective sustainable community management of forest resources when boundary of the resources can be identified and the changes in the resource condition is frequently monitored (Hardin, 1968).

Again, the tragedy can be eliminated when there is privatization of resources where there is high degree of ownership and management. The achievement of community forestry in Nepal confirms that sustainable forest management can be achieved through the collaboration between the local people and the government which is also known as decentralized forest management (Arnold, 2001). This practice has influenced forest areas positively, especially, those under the various community-based forest (CBF) strategies (Gilmour, 2016). Most of the world's forest are under several forms of CBF management because of the increase in the world's population, most of who greatly depend on forest resources as means of livelihood. The various forest management strategies differ regarding the degree of participation of the stakeholders; that is either solely government or private individuals or Non – Governmental Organizations (NGOs). In 2016, the FAO estimated that about one-third of the world's forest regions practice participatory forest management to achieve forest sustainability.

In the late 20th century, the government of Ghana became conscious of the accelerating rate of deforestation, its effect on the environment and a failure of centralized forest management system (Osei-Mainoo, 2012). This led to the introduction of the new Forest and Wildlife Policy in 1994 and various forest strategies including Private plantation, Taungya System (TS), Modified Taungya System (MTS) and Solely Government system (Osei-Mainoo, 2012). These forest management strategies aimed to sustain the country's forest and wildlife. However, the annual loss of forest cover in Ghana as at 2010 was 135, 395 ha (FAO, 2012). In 2010 for example, Ghana still recorded 2% rate of deforestation mostly in the forest reserves (Schroeder et al., 2010)

This sprang forth an organisation+ with their aim to spearhead tree planting, thus establishing forest on their own lands. Several studies in the area of forest decentralisation and deforestation have focused on collaborative forest management using state lands (forest reserves) across the globe and its effectiveness within a period. However, not much has been done on how local people have re-established forest with their lands resulting in the creation of off reserves. It is therefore imperative to establish the factors that influenced the re-establishment of lost forest and the incentive measures to promote forest sustainability. There are studies made in Ghana in relation to forest faming: Blay et al. (2008) look at how local people depend on forest resources and its implications for forest management in Ghana. They also look at the prospects of a community-based plantation using *Taungya* systems and indigenous trees as means to forest rehabilitation and livelihood improvement in Ghana; Osei et al. (2019) study the socio-economic determinants of smallholder plantation sizes in Ghana and how to encourage reafforestation in the country and also presents an analysis on the Joint Forest Management Project initiated by two timber companies in collaboration with local people in Gwira-Banso of Ghana, the conditions required for enhancing responsibility for and commitment to local forest management, and for an effective local participatory process were also analysed. This studies also contributes to forest faming in Ghana by focusing on what encourage local farmers to remain in forest farming.

This study therefore aims at investigating the factors that intrigue local famers to establish plantation forest within the Offinso North district and the extent of their contribution to forest cover change in the area.

Community Based Forest in Practice In Ghana

In Ghana, the Traditional Taungya System (TTS) began in the early 1950s as a reforestation scheme in replanting trees in poor forest reserves in the high forest zones (Tufuor, 2012). It continued until the 1980s where greater portions of the country's forest areas experienced wild fires (Asare-Kissiedu, 2014; Heist, 2001). Though most of these degradations were triggered by natural disasters, some were also from human induced activities such as bush fires, illegal logging and farming. It was after this disaster that several mechanisms were introduced to restore and conserve forest lands. Heist (2001) confirmed that, several agencies in Ghana in 1987, including both governmental and non-governmental organised workshops to know the appropriate forest schemes and projects to implement in the restoration of degraded lands. They then came up with the Collaborative Community Forestry Initiative (CCFI) which focused on environmental problems like desertification, decline in soil fertility and deforestation. It was also to improve the living conditions of small-scale farmers by the planting of trees as an alternate livelihood activity. There was also the implementation of the 1994 forest and wildlife policy aimed at protecting and sustainably managing the state's forest and wildlife resources (Asare-Kissiedu, 2014).

In 2001, the government launched the National Forest Plantation Development Programme (NFPDP) comprising the Modified Taungya System (MTS) and private timber tree plantations which occurred in state owned forest reserves and the off-reserves or on private lands respectively (Asare-Kissiedu, 2014). The modification of the Traditional Taungya System (TTS) is that of the MTS where the partnership between the state and the local people improved upon in terms of years. The local people were also allowed to cultivate crops in between the trees for at most three years and were also accompanied with incentives to increase the participation of the local people in forest management. The NFPDP programme was revived in 2009 to improve on the local people's participation (Tufuor, 2012). Plantation forests is mostly practiced in the forest zone regions in Ghana.

Plantation forest has facilitated the creation of an association called the Private Afforestation Developers Association (PADO). PADO was formed in 2010 as an economic sector-based organization to enhance individuals practicing afforestation in Ghana (Private Afforestation Developers Organisation, 2017). It seeks spearhead tree planting to reduce deforestation with its consequences on climate change and to meet wood product demands. The association with its motto, "Tree is life" comprises small scale farmers, private investors and companies (Private Afforestation Developers Organisation, 2017). Members of this association are located in Ashanti, the then Brong–Ahafo, Ahafo, Oti, Western North and Western region. On records, their membership is 97 with most of them being residents in the forest reserves (Private Afforestation Developers Organisation, 2017).

Socio-Ecological Systems (Ses), The Support Service Model and Community Based Forestry

The theoretical underpinning of this study is based on the socio-ecological systems and the support service model. Social and Ecological theories were propounded in the 1970's where the former was by Ludwig von Bertalanffy and the latter by Urie Bronfenbrenner (Friedman and Allen, 2006; Bronfenbrenner, 1999). Social theory focuses on the interdependence among systems, whereas the Ecological theory emphasizes on human development in relation to its environment. SES in this study can therefore be explained as the integration of Social and Ecological theory where human development and its forest are interdependent. That is, for an increase in forest cover, human beings have to plant and sustain trees. This directly provides human beings with timber, NTFPs, oxygen, mitigate climate change and protects water bodies/animals. Through this, human beings are able to improve upon their economic and physical standards resulting in sustainable development.

The relation between the Social and Ecological theories can be termed as "people–with–nature" in an ecosystem (Pérez-Soba & Dwyer, 2016). For this study, the concept is adapted as *human–with–forest* where man and forest are the systems. According to Redman, Grove and Kuby (2004), there should always be an interaction between the systems in a sustainable manner regulated by a system. Halliday and Glaser (2011) add that, SES is the assemblage of human, non-human (plants and animals) and geophysical elements (water, soil) where human activities affect the processes of the other elements. Hence, human activities affect other elements in an ecosystem both positively and negatively. For instance, tree planting improves the forest cover of an area with a positive effect on animals (as trees serves as a habitat) and other elements like water bodies whereas a negative action like deforestation affects all other elements because of the loss of forest cover. For the effectiveness of the relationship between forests cover and human's development, measures such as forest management and sustainability have to be ensured.

Plantation forest goes beyond the planting of trees to also the protective and other socio-economic functions of forest resources. The measures also sustain the purpose of plantation forest to bring about human development perpetually. The degree of forest management and sustainability are determined by the type of forestry being practiced. Various forms of forest management emerged from the community forestry in Nepal in 1978 where five models for community forestry were introduced. These models are 'Super Management Model', 'Non-Governmental Support Model', 'Partnership Model', 'Support Service Model' and the 'Leasehold Contract Model' (Singh, 1992).

Super Management Model' is characterized as very limited involvement of local peoples' in terms of decision- making, planning, development and utilization. It relies solely on Government for management. The exact opposite is seen in the 'Support Service Model'. This Model is made up of private foresters and promotes Private Planting and Forestry Programmes. Here, the Government's involvement is minimal and sometimes visible in areas like seedling provision, incentives and technical training. The 'Partnership and Leasehold Contract Model' involve a shared responsibility on decision making, development and management of forest resources between the Government and the local people (Singh, 1992).

The study combines the two concepts to explain how local people willingly indulge in tree planting because they see the usefulness of the forest resources to the protection of the environment and also acknowledge its benefits to the survival of human-kind.

Research Setting and Methodology

The study was conducted in the Offinso North Districtof the Ashanti Region of Ghana. This district is located in the extreme North-Western part of Ashanti Region and lies within longitude 1˚45W and 1˚65W and latitude 7˚.4N and 7˚24N. The District covers an area of about 946 km^2 with 73.76 km^2 and lies within the semi-equatorial region with a bi-modal rainfall regime (Ghana Statistical Service, 2014).

The natural vegetation of most parts of the district is moist semi-deciduous forest with thick vegetation cover and under growth. However, most of the forests have been converted to secondary forest because of the wildfires the nation experienced in 1983 (The Ghanaian Times, 2007, March 15). The district has nine state forest reserves with several off reserves (Ghana Statistical Service, 2014).

Mixed method approach involving quantitative and qualitative data was adopted in order to achieve the objective of this study. Purposive sampling technique was used in choosing communities where local people practice plantation forest. The communities selected were *Afrancho, Akumadan, Nkenkaasu* and *Nkwaakwaa*. The survey technique was used in obtaining data from all forest planation farmers in the study areas. Semi-structured questionnaires were administered to the farmers. At a confidence level of 95% (Z = 1.96) with 5% margin of error (d = 0.05) and an estimated proportion of 10% (p = 0.1) (Ajay & Micah, 2014), the sample size was approximately 135 respondents using the formula;

$$n = \frac{Z^2(p(1-p)}{d^2} = \frac{1.96^2(0.1(1-0.1)}{0.05^2} = 138.3.$$

This is because out of the 140 questionnaires obtained, 5 of them did not fall in the inclusion criteria of the study. For the data analysis, the Statistical Package for Social Sciences (SPSS) version 25.0 was used to derive bar graphs, percentages and frequencies were employed to provide the quantitative analysis, the data whereas qualitative data were analyzed using thematic analysis.

Forest Plantation in the Study Area

Reasons for the Establishment of Plantation Forest

One of the prime uses of trees is its production into timber to satisfy human needs (Mukesh, 2003). Therefore, owing to the increasing population, there has been an increase in the demand for timber for roofing, production of furniture, electricity/network poles, railway sleepers and fuelwood. Kanowski (1997) has asserted that across Africa, 90% of the plantation forests have been established mainly to produce industrial wood for economic benefits. This finding is in consonance with the findings of this study that majority of the respondents were into plantation forest mainly for the income obtained from the sales of trees. This is not different from a country like Italy where results have shown that local people practice community forestry purposely for the income from trees (Roberts and Gautam, 2003). Again, the economic values of trees have resulted in the growth of a nation's economy. For instance, the forestry and wood industry was the fourth contributor to the nation's Gross Domestic Product (Tufuor, 2012). The forest sector remained the third most important foreign exchange earner contributing to about 30% of export earnings and 12% of the GDP in Ghana (FOSA country report, retrieved 26-04-2021).

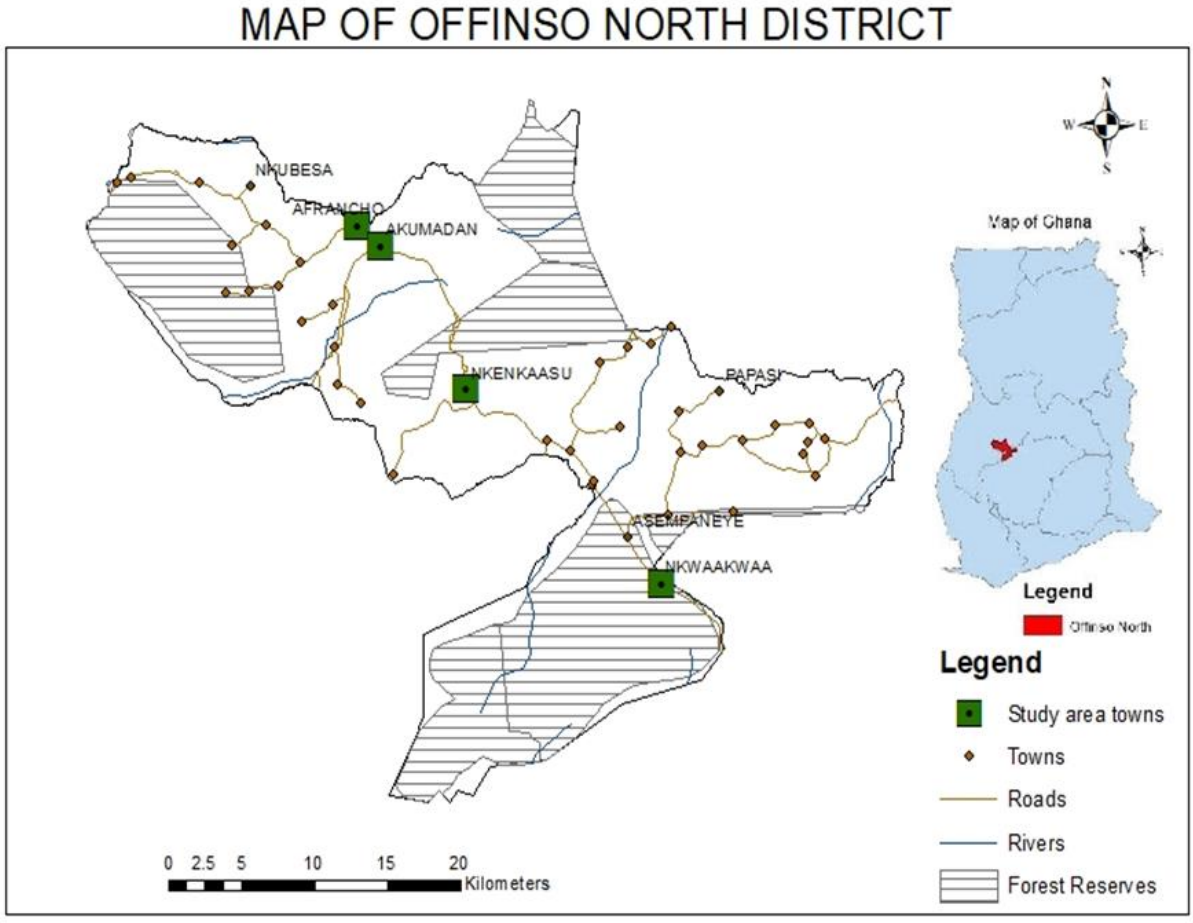

Figure_1: Map of Offinso North District
Source: Authors' construct of map from open-source Map, 2020

The study revealed that most of the local people plant trees mainly for their economic benefits. These benefits were the income from the sale of the trees often converted to logs. Also, other tree products such as charcoal, furniture and roof were seen to contribute to the economic benefits. Again, 20% of the respondents' said they plant trees to preserve water bodies and to protect the soil and crops. These farmers said that they rely on streams for domestic purposes, hence, they plant trees close to such water bodies. To some of these farmers, trees serve as a wind break and prevent crops especially, plantain from falling off. Meanwhile, 15.6% responded that they plant trees as a form of investment for their families and to secure their lands for future use. Table I gives a summary of why farmers in the study area practice afforestation.

Table I: Reasons for tree planting

Reasons	Frequency n (%)
Economic benefits	75 (55.6%)
Reduce deforestation	12(8.9%)
Preserve water bodies	27(20%)
Others	21(15.6%)
Total	**135 (100.0%)**

Land acquisition process

Land ownership is one of the most influential assets that influences the establishment of plantation forest in an area. Osei-Tutu (2018) postulated that forest management and sustainability is best analysed when there is a high degree of ownership. According to the results, lands used to establish plantation forest are often obtained through inheritance where more than two-thirds of the respondents (77.8%) affirmed that. In addition, 17.8% of the respondents purchased the land purposely for tree planting as indicated in Table 3. All the farmers in this category confirmed that they are in the tree planting for economic reasons. According to them, the price of land varies in relation to its closeness to human settlements. They further stated that between 2010 and 2015, an acre of land far away from the town was GHS 200[1] whereas, those close to the town was between GHS 600 and GHS 800. However, in 2018, the price of land in the same area was between GHS 1000 and GHS 1200 per acre. Again, 4.4% of the respondents indicated that they obtained their land through lease or partnership. As part of the contract, they shared the proceedings from the land equally with the land owners.

Other respondents, especially the women, claimed to have inherited their lands from their deceased husbands or relatives. All the respondents who practice afforestation in the study areas for ecological purpose, are part of those who inherited lands through the communal land ownership. Moreover, 17.8% of the farmers had bought lands to be used for tree planting, all these farmers have established plantation forest as an investment for their families. Nonetheless, 4.4% stated that they partner with farmers owning lands to establish plantation forest and equally sharing the profits that come thereof. The study revealed that such lands on partnership are given out for a maximum period of 50 years. A study by Mwihomeke et al. (2002) for instance, revealed that insecure possession of land has been a constrainon others desiring to establish plantation forest, but the farmers interviewed in this study who partner land owners had no problem with arrangement because of the 50 years contract period. With inherited and purchased lands, there is a high degree of ownership compared to lands obtained in a form of partnership with the land owners.

Tree planting systems practiced by the farmers

Majority (83.2%) of the respondents engage in mono cropping where only trees are planted on a piece of land. Such farmers explained that the nature of roots of trees especially, teak do not support the growth of other crops when they are in full maturity. But even for such farmers, for the first three years, they plant crops like maize, cassava and groundnut in between the young trees. This is confirmed by Baatuuwie et al. (2011) who opines that plantation forests established mainly for economic benefits is done as a monoculture practice in order to obtain a greater output regularly. The other respondents (16.8%) practice mixed cropping system throughout the tree maturity period. Their practice is also confirmed in the literature by Rai and Schmerbeck (2012) who also established that mixed cropping generates more forest products, hence, it is better than mono cropping.

Types of trees being planted

The most dominant tree species planted by the farmers was the teak. The farmers indicated that they planted teak because of its economic value and relatively shorter gestation period (mostly between 15 and 20 years). They also affirmed that teak is fire resistant compared to the other tree species. Other common species of trees planted were *Cedrela, Ceiba, Oframo, Emire, Kyenkyen, Nyamedua and Kokrodua*. A few of the respondents added indigenous species like Mahogany and Wawa to the teak as shown in Table 2. Most farmers said they do not want to plant local tree species because it takes over 40 years to mature.

Table 2: Types of trees planted by the farmers

Tree species	Frequency n (%)
Teak	110 (81.5%)
Teak & Cedrela	7 (5.2%)
Teak & Oframo	3 (2.2%)
Teak & Ceiba	1 (0.7%)
Teak, Mahogany &Wawa	2 (1.5%)
Others	11 (8.1%)
Total	**135 (100.0%)**

n: number of cases

Table 3: Number of years involved in tree planting

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
For how long have you engaged in the planting of trees?	135	1	74	18.00	10.478
How many acres of trees do you have?	135	1	250	14.94	29.862

The lands used for tree planting by farmers were measured with the least being one acre and most of them having 14 acres. Majority of the farmers said they began with crop farming and later added tree planting to it especially, in the year 2000. This is basically attributable to the rural electrification project the government had embarked on at that time, which created a high demand for teak t for that project. This could explain why the dominant number of years of respondents in tree planting was 18 years.

Teak has been the most central tree species among several plantation forests across the globe (Osumanu & Ayamga, 2017). This finding is in consonance with that of Tufour (2012) who also showed that among the plantation forest in Ghana, teak is the principal species. Some of the characteristics for it gaining grounds are that it is fiere resistant and has the ability to flourish on different soil types and geological formations (Oduro et al., 2015). Other exotic species found in the study area were Gmelina and Eucalyptus. Very few of the respondents (13.3%) planted in addition to some of the native tree species such as Ceiba, *Oframo, Mahogany, Wawa, Sapele and Kokrodua*. This was due to the longer years they take to mature.

For this study, the plantation forest has been practiced for a maximum number of 74 years with one year being the least among the respondents. The total acres of plantation forest by the respondents were 2,019 acres (817 ha) as at the time of the study with an average of 14.94 ha. According to the respondents, an acre of land had at least 600 trees. The size of plantation forest was determined by the acres of land at the farmers' disposal but not in the case of the years he has been in tree planting.

Extent of Land Cover and Change Analysis

Land cover distribution

Table 3 shows the distribution of land cover types in the study area which is grouped into five classes in the years under review (1990, 2015 and 2020). The classes are Forested areas, Farmlands, Bare areas, Built up areas and Water bodies. The study area has further been divided into two, Forest reserves and Off-reserves.

From Table 4, all the land cover classes except water bodies was consistent among the three years with a constant change either increasing or decreasing. From the study, farm lands covered greater portion of the land. Nevertheless, forested areas among the other class that increased significantly from 7643.34 ha to 34083.7 ha. This increase was influenced by the reforestation and afforestation activity practiced in the study area, especially, by plantation

[1] 1 USA dollar was equivalent to 5.74 GHS in March, 2021. This was much lower in 2015 (1 UAS dollar was equivalent to GHS 3.8 in 2015)

forests. Most of the local people gave up bare areas for tree planting. Water bodies covered very little portion in the study area. What remained are streams and constructed canals for irrigation. The area for the forest reserve helped in determining the area of the off-reserves by deducting that off-forest reserve from the total area in each land cover class in order to determine the percentage change in off-reserves.

Figure 2 shows the land cover changes over the period under review in the off-reserves in the study area. It is in these areas that local farmers in the study area practice plantation forest. In 1990, the dominant land cover feature was farmlands which covered 32831.2 ha (58.9%). It was followed by bare areas representing 12008.2 ha (21.6%). This might be the case because these lands were left to fallow or were prepared to be used for planting crops. Also, bush and wildfires had destroyed a greater portion of the lands before that year. These fires also occurred in forested areas recording the least of 3375.36 ha (6.1%).
In 2015, there was an increase in almost all the land cover type except in the built-up areas which drastically reduced from 7938.4 ha (14.3%) to 826.742 ha (1.5%). The buildings with local materials like mud have been replaced by concrete ones. Farmlands continued to cover greater portion of the off-reserves, specifically 34404.1ha (61.8%) with an increase of 2.9%. There was also a rise in forested areas to 5767.64 ha (from 6.1 to10.4%). The implementation of tree plantation programmes and the higher demand for trees products made farmers to plant more trees. Some of the farmers said during the interviews that they went into timber farming because they saw it in 2015 as a business which they could invest in and would get a better return.
As of 2020, forested areas occupied greater portion of the bare areas. There was a significant increase of forested areas from 6.1% in 1990 to 28.9% in 2020 representing 16115.1 ha (28.9%). The difference in forested areas between the forest reserves and off-reserves was insignificant, especially between 2015 and 2020 where forest reserve was 10.97% and off-reserve, 10.92%. The trend shows how plantation forest has helped in improving forest cover in the district, with some of the local people owning forest area almost being equal to that of the state reserves in the district.

Table 4: Land cover class distribution for 1990, 2015 and 2020

Land Cover Class	Total Area (ha)	Forest Reserve (ha)	Off-Reserve (ha)
1990			
Forested areas	7643.34	4267.98	3375.36
Farm lands	44411.7	11580.5	32831.2
Bare areas	23009.8	11001.6	12008.2
Built up areas	19831	11892.6	7938.4
2015			
Forested areas	13338.6	7570.96	5767.64
Farm lands	58852.1	24448	34404.1
Bare areas	21455.4	6754.01	14701.39
Built up areas	1082.05	255.308	826.742
2020			
Forested areas	34083.7	17968.6	16115.1
Farm lands	52879.9	18745.8	34134.1
Bare areas	1348.43	330.863	1017.567
Built up areas	4495.95	1318.03	3177.92
Water bodies	1920.24	665.01	1255.23

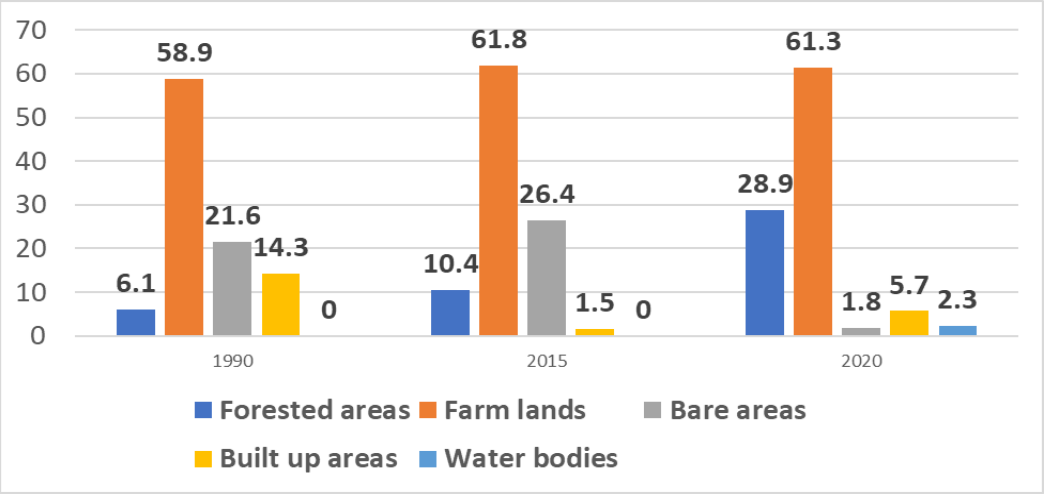

Figure 2: Land cover class percentage distribution of off-reserves for 1990, 2015 and 2020

In all, bare areas in the study area reduced by 21661.4 ha representing 22.8% (from 1990-2020). The change was significant between 2015 and 2020 by 21% (20107 ha) where majority of the farmers occupied their lands with crops and trees. A small portion of the bare land area was used for infrastructural development such as hospitals, schools, fuel stations and houses, similar to what is done in most towns in the country. In the case of built -up, the portion increased to 3177.92 ha (5.7%) in 2020 and farm lands had reduced slightly by 0.5% to 34134.1 ha (61.3%). This might be influenced by infrastructural development during that time, field observation by the lead researcher shows that some of the residents had shops, pharmacy and houses as the area open-up. The land cover maps of Offinso North district showing areas in forest reserves and off-reserves in 1990, 2015 and 2020 are shown below.

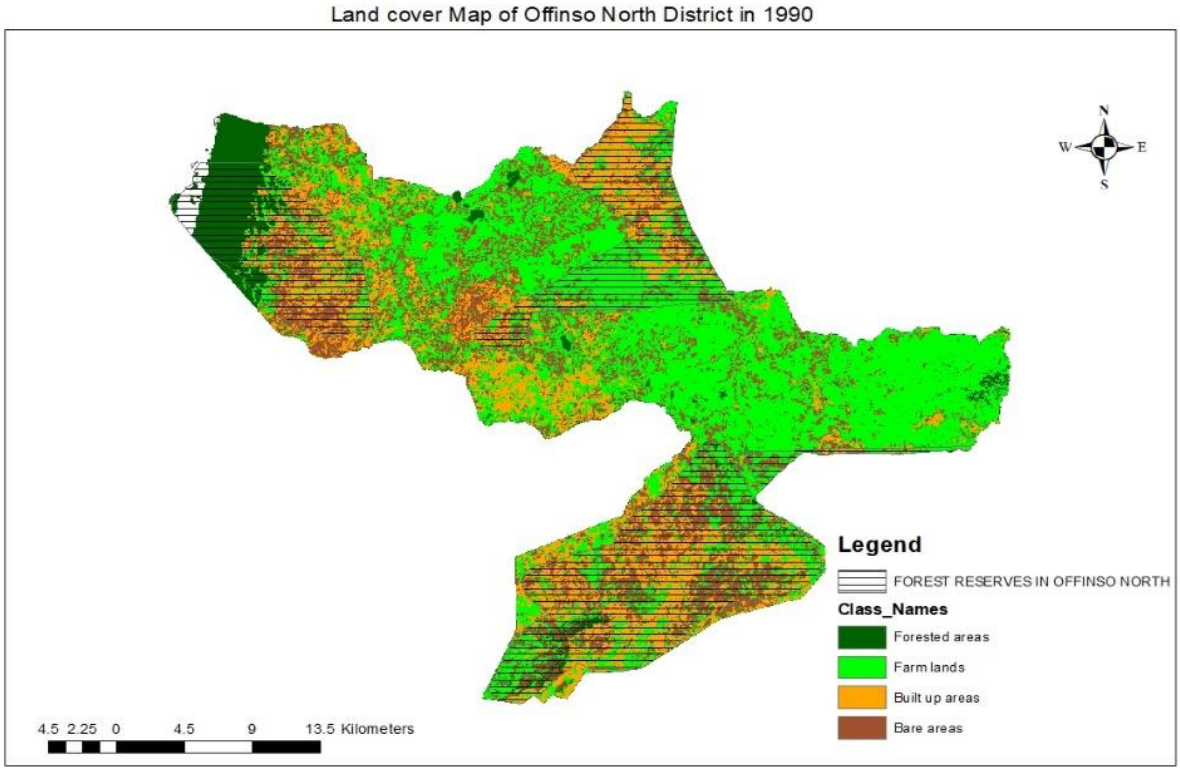

Figure 3: Land cover Maps for 1990
Source: Author's Construct from Landsat images

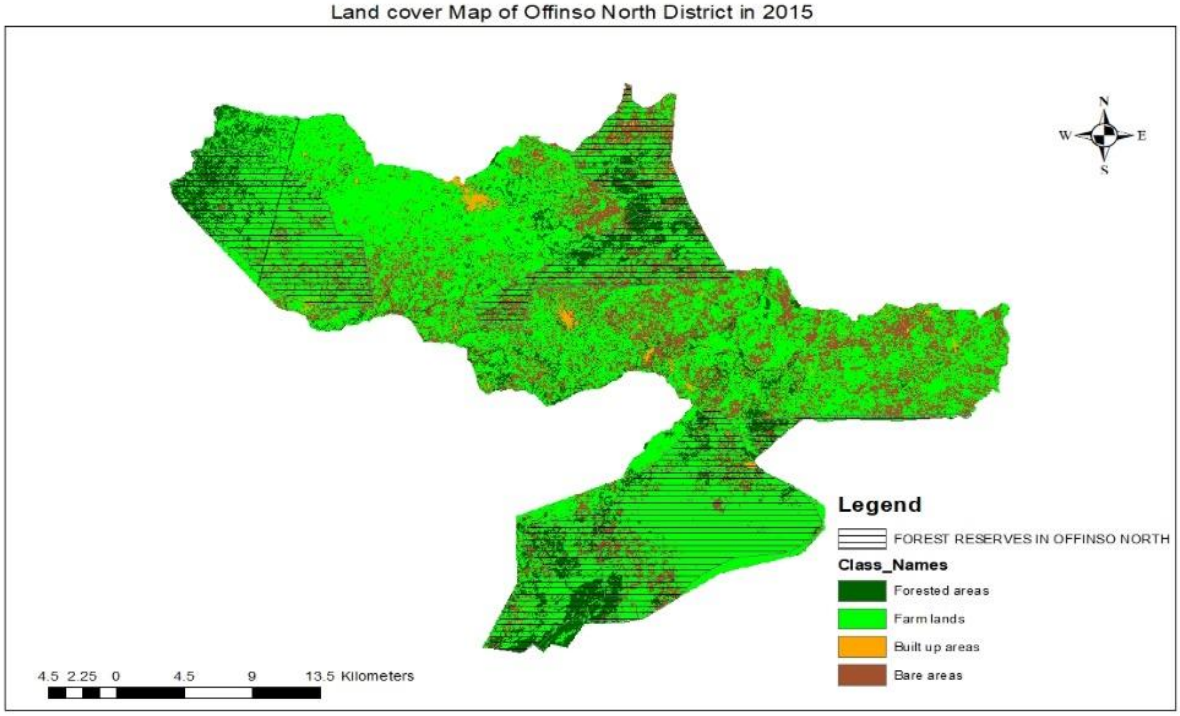

Figure 4: Land cover Maps for 2015
Source: Author's Construct from Landsat images

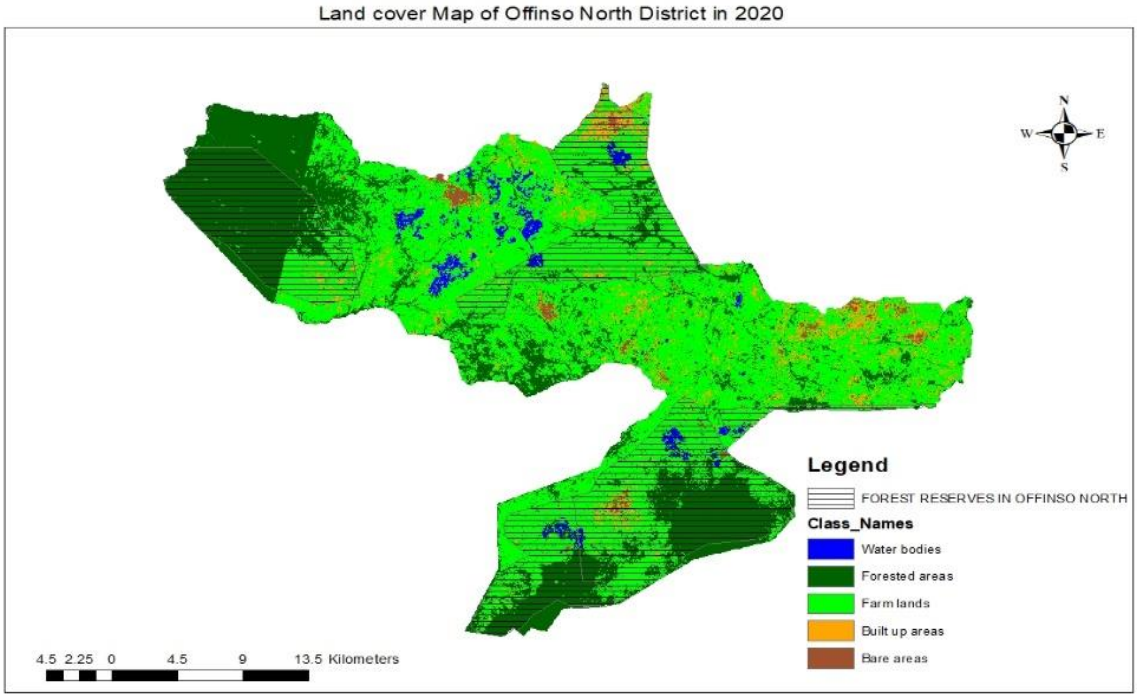

Figure 5: Land cover Maps for 2020
Source: Author's Construct from Landsat images

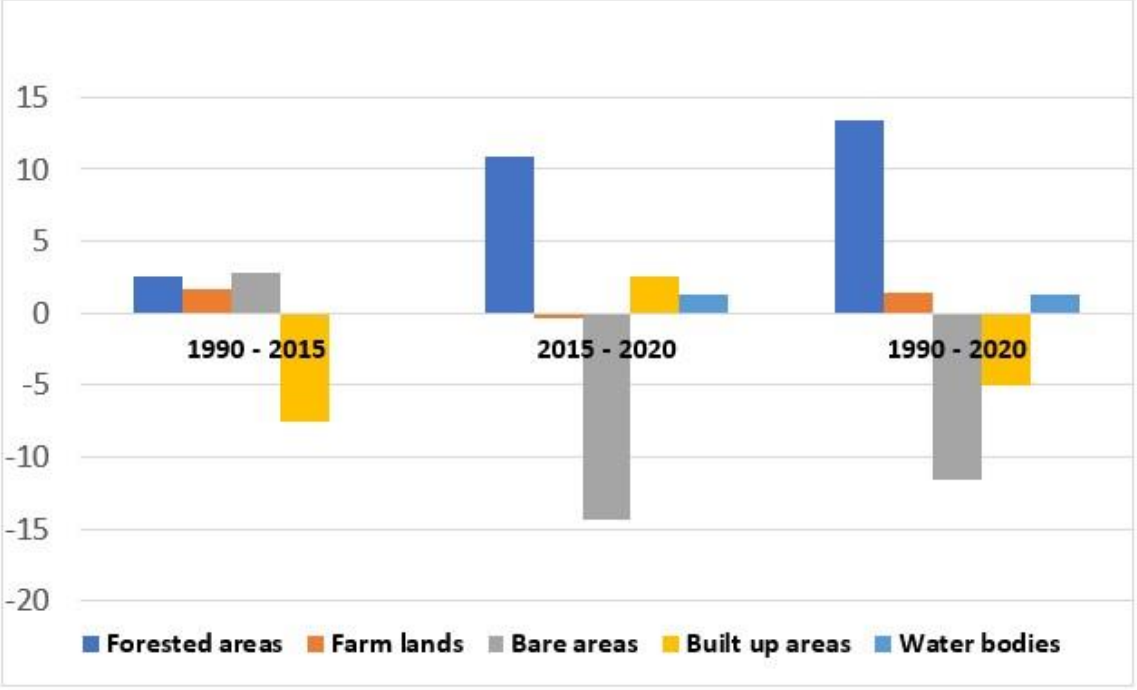

Figure 6: Net change in land cover class distribution of Off-reserve

Figure 6 displays land cover change distribution of the land cover classes in hectares from 1990 to 2020. It shows the net changes in terms of expansion and reduction in the land cover classes at the off-reserves in the study area. The findings indicate that throughout the period under review, bare areas and built-up areas lost almost all its areas to other land cover class especially, the forested areas.

The study showed major land conversions in the off-reserve in the study area within a period of 30 years (1990 – 2020). From Table 5, the highest conversion was farm lands of 12666.8 ha converted to forested areas between 2015 and 2020 with the least of 2272.14 ha recorded between 1990 and 2015. The area showed trees which had just been planted and were of the same height as the crops; hence they were in the same spectral band as that of the farm lands when Landsat images were taken.

Alternative Livelihood Activities Combined with the Tree Planting

Almost all the respondents have other livelihood activities mainly due to the long maturity span of trees. Majority of the farmers were into crop farming alongside tree planting. The main crops planted were cassava, maize, plantain and yam. All the farmers interviewed were also found to be engaged in vegetable farming especially, tomatoes. Also, a significant number (25.2%) of the famers were found to be engaged in cash crop farming, particularly, cocoa and cashew plantation in the study area. About (17%) of the respondents were in non-farming activities such as teaching, forestry, artisanry and health service. These groups of people also include retirees as shown in Table 6.

Table 5: Land conversions in the Off-reserves in Offinso North District from 1990 to 2020

Landcover class from	Landcover class To	1990 -2015 (Area in ha)	2015-2020 (Area in ha)	1990-2020 (Area in ha)
Forested areas				
	Farm lands	2456.42	3595.77	820.67
	Bare areas	178.94	7.86	233.26
	Built up areas	22.5	19.42	104.90
	Water bodies	-	164.93	22.12
Farm lands				
	Forested areas	2272.14	12666.8	6863.4
	Bare areas	2561.83	148.21	674.62
	Built up areas	82.96	688.82	2413.94
	Water bodies	-	388.46	748.76
Bare areas				
	Forested areas	1582.11	1464.57	3474.47
	Farm lands	7348.09	4504.16	7543.76
	Built up areas	60.59	563.94	514.51
	Water bodies	-	110.75	368.87
Built up areas				
	Forested areas	1886.56	54.27	3958.17
	Farm lands	7856.59	90.11	3682.06
	Bare areas	2035.98	64.19	9.408
	Water bodies	-	0.88	115.49

Table 6: Alternate livelihood activities

Livelihood activities	Frequency n (%)
crop farming	77 (57%)
livestock rearing	1 (0.7%)
cash crop farming	34 (25.2%)
Other	23 (17.0%)
Total	**135 (100%)**

According to the 2010 census, approximately 78.8% of the people in the study area were into agriculture especially, crop farming (Ghana Statistical Service, 2014). This confirms why majority of the respondents (82.9%) were into crop and cash crop farming. According to Oduro et al. (2015), the intensification of agricultural land use has resulted in a few of the rural folks such as health workers, teachers among others, venturing into non-farming activities (Oduro et al., 2015).. This assertion reflected in the study area where 17% of the respondents fell in this category.

Challenges faced by farmers in Plantation Forest in the Study Areas

From Table 6, majority of the farmers (24.4%) had 'no support or loans from the government'. From the survey, 12.6% stated that plantation forest is capital intensive, and for that matter, farmers have to buy their own nursery and farm inputs together with paying laborers regularly for pruning, clearing of weeds and protecting trees from bush fires. Some of the challenges are persistently reported in the literature. For example, a study conducted by Chala (2010) and Osei-Tutu (2018) reveal that farmers do not obtain assistance in the acquisition of seedlings and tools for their farming activities and that there are no incentives given to local farmers in tree planting. Another problem that the farmers face is the low prices that buyers pay for the trees. The problems farmers encounter in tree planting has been persistent as majority, that is (70.4%) of them complained that these challenges they encounter have been consistent for more than 10 years since they engaged in plantation forest. They said the chiefs, the media and their association are aware of their concerns, although the famers were yet not see any significant intervention initiated by these stakeholders. Challenges faced by the forest farmers discourage effective practicing of plantation forestry and for that matter, a continuous experience of these problems is detrimental to forest growth in the study area.

Another significant of the farmers, about (85.2%) also explained that after waiting for many years before the trees mature (at least 12 years for Teak), a tree could be sold for as low as GHS20. The longer years of maturity of trees coupled with high expenses in managing the farms have been a disincentive for some of the farmers resulting in their to giving up portions of their forest for cash crop farming. Most often the local farmers are vulnerable since they are unable to harvest the trees themselves. Thus, they lend them to timber companies at very low prices. Some of these companies even escape without settling their debts according to the farmers. This finding is similar to that of Osei-Tutu (2018), who established that lumber companies obtain community rights to trees at very minimal amounts. Other challenges face by the farmers are frequent bushfires, bureaucratic processes governing harvesting trees and the lack of incentives in the form of forest plantation fund or carbon credit.

Table 7: Challenges of local farmers in Plantation forest

Challenges	Frequency n (%)
Bush fires	5 (3.7)
Capital intensive	17 (12.6)
No support or loans from government	33 (24.4)
Low prices of trees	29 (21.5)
No support from gov't & low prices of trees	18 (13.3)
Capital intensive & low prices of trees	2 (1.5)
Bush fires & low prices of trees	7 (5.2)
Bureaucratic process in harvesting & low prices	4 (3.0)
Others	20 (14.8)
Total	**135 (100.0)**

Conclusion

This study particularly focused on plantation forest as an incentive measure in increasing the forest landcover in Offinso North District. The study revealed that the socio-economic and ecological benefits of wood intrigued the local people to establish plantation forest. Specifically, the economic benefits from investing in timber, growing of trees to safeguard family land for future use and protection of water bodies are motivations for their getting into forest farming. More than two-thirds of the farmers practiced plantation forest on inherited lands from family as part of the communal land ownership system, while some purchased lands for their plantation. Also, the study revealed that Teak is the commonest tree planted by the farmers.

As a result of the eagerness of the forest farmers to improve their economic fortunes through forest farming, the study revealed that from 1990 to 2020, there was an increase in almost all the land cover type except built up areas resulting in a drastic reduction from 7938.4 ha (14.3%) to 826.742 ha (1.5%). In addition, forested areas occupied greater portion of the bare areas. There was a significant increase of forested areas from 6.1% to 28.9% representing 16115.1 ha (28.9%). This finding obviously contradicts what most scholars have already established in the literature that built-up areas are quickly consuming most vegetation cover in the country. The study findings are very significant in forest restoration analyses, where private individuals have greatly contributed to forest land cover growth. Though the ultimate aim of the forest farmers is for economic gains, but they invariably help in improving the ecology of tree species in the country. Despite the laudable efforts put in by the farmers to help increase the forested land cover in the country, they face challenges in the pursuits of their aim. The main challenges faced by farmers in the study area are that they lack assistance from the state, especially in accessing soft loans, the low prices of trees paid by the buyer, frequent bush fires and long years of waiting for trees to mature. The state can act on the first two challenges by looking into the possibility of granting soft loans to the farmers and provide technical assistance and other incentives to the farmers.

The study therefore concludes that measures should be put in place to resolve the rapid depletion of the country's forest by encouraging local reforestation strategies such as what exists in Offinso. The state should therefore negotiate with the buyers to pay appreciable amount for the trees they buy. The authors therefore recommend that the prices of trees should be controlled by the government to motivate farmers in expanding their plantation forest.

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