

Assessing the sustainability of forest plantations in Mezam Division of the North West Region, Cameroon

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Abstract:

Objectives: The study examined the sustainability of plantation forestry in Mezam Division of the North West Region.

Methodology and results: Respondents drawn from a cross-section of plantation owners in five (5) sub-divisions (i.e. Tubah, Bali, Bafut, Santa and Bemenda central) of Mezam Division. Fifty- (50) plantation owners selected through a system of random sampling. Data collected through the administered questionnaires were on social, economic, ecological, profitability, management strategies and constraints to plantation forestry in the study area. Structure questionnaires were instrument used for data collection. Analytical tools used were descriptive statistic including tables, means, and percentages to describe the socio-economic characteristic of respondents, while chi-square and Benefit Cost Ratio models were used to determined profitability and opinion of plantation owners respectively. The results reveal that majority of plantation owners were men 84.5% and widows make up 15.5% of the respondents. They all owned families. Benefit Cost Ratio B/C calculated was 0.7 ($B/C < 1$) this results implies that plantation business is not profitable compared to an alternative land use system, although they was a marginal profit of eight thousand five hundred francs 8500f (\$ 17 USD) for the sale of one acre of plantation. Chi-square test of equal probability showed that they were no significant difference at 0.05% probability level for private plantation owners. The main constraints confronting plantation forestry business in the study area are access to finance, followed by wildfires, unfavorable government policies and finally bad road networks leading to their plantation. The Benefit Cost Ratio B/C calculated ($B/C < 1$) mean plantation business is not profitable compared to an alternative land use system, although they were marginal benefits. The study therefore recommend that private plantation be encourage to ensure less dependence on natural forest and to also mitigation climate change and through this jobs created and livelihood improved to the rural communities

Key words: Management, Sustainability, Benefits and Priority species

I. INTRODUCTION

The forests are home to 350 million people and about 60 million indigenous people are almost wholly dependent on forests. More than 1.6 billion people depend to varying degrees on forests for their livelihoods, such as for fuel wood, medicinal plants and forest foods (World Bank, 2004). Over 90 per cent of those living on less, than \$1per day depend on forests to some extent for their livelihood. Forest ecosystems provide many and varied benefits from

their natural resources and processes (Millennium Ecosystem Assessment, 2005). Wood energy accounts for around 9 per cent of energy consumed worldwide, and up to 80 percent in some developing countries. Bush meat can account for up to 85 per cent of the protein intake of people living in or near forests (UNDP, UNDESA and World Energy Council, 2003).

In addition to the use of forests for subsistence food and fuel, community enterprises that generate income from trading sustainably harvested forest resources are on the increase in many countries. Global employment in the formal forestry sector is estimated to be around 13 million people (Sunderlin et al, 2008), and it has been estimated that for every one job in the formal sector there are another one or two jobs in the informal sector – up to 1 per cent of the global labour force (Lebedys, 2004). Around 3.5 billion cubic meters of wood are harvested each year from the world's forests and global trade in primary wood products was worth \$204 billion in 2006 (FAO, 2006). Forests are also an important supplier of other products including latex, handicrafts and medicines. Leisure time in forests has increased with economic development and urban living. This has led to a growth in social forest services such as recreation, sport and ecotourism (Millennium and Ecosystem Assessment, 2005). People value forests according to cultural, spiritual and historical factors. These amenities can range from intrinsic and aesthetic value to more geographically specific values relating to the traditional homelands of indigenous people. Forests provide a range of ecological services including flood protection, plant pollination, soil formation and erosion control. Forests stabilize their landscapes and offer protection from extreme events such as storms, floods and droughts forecast to become increasingly frequent and intense under future climate change (Macqueen and Vermeulen, 2006).

The total area covered by plantation in Africa as of year 2000 is about eight (8) million hectare with an annual planting rate of 194000ha (FAO, 2001a). Although the plantation area in Sub-Saharan Africa more than doubled during the last decade, the overall rate of increase is slow, particularly compared to the rapid global expansion of plantations (FAO, 2001a). Despite the rapid expansion of plantation forestry, there were also failures. Valuable plantations were neglect or abandoned in some countries (e.g. Cameroon, Gabon, Liberia and DR Congo) due to budget cutbacks and inability to maintain an expansive resource (Evans, 1992) and to political instability. Eucalyptus is the most widely planted genus covering 22.4% of all planted area, followed by Pinus (20.5%), Hevea (7.1%), Acacia (4.3%) and Tectona (2.6%). The area covered by other broadleaved and other conifers is

respectively 11.2% and 7.2%, while unspecified species cover 24.7%. Overall, the great majority of planted trees are exotic species chosen for their capability to grow rapidly to produce wood of desired quality (Tiarks et al., 1998). The study conducted in Mezam Division of the North West Region, Cameroon. Mezam division divided into five (5) sub-divisions, which are (Tubah, Bali, Bafut, Santa and Bemenda central). The objectives of the study were to identify and priority species, to survey and characterise the forest plantations and owners management strategies, identify the socio-economic and ecological factors driving the business and identify the constraints to sustainable management of forest plantations

II. METHODOLOGY

The study carried out in Mezam Division with a population of 800,000 inhabitants and a surface area of 17500Km² (Census, 2012). The area lies within latitude 5° 40' and 7° N and longitude 9°45 and 11°10'E at an altitude of 1614M above sea level (wekimedia, 2012). Data collected through the administration of fifty copies of well-structured questionnaire, which was careful, designed with view for providing information that certifies the study objectives. Forty-five questionnaires were retrieved represented 90% of the total private plantation owners in the study area. The obtained data analyzed as follows:

Chi-square, which is the test of equal probability of opinions was use to test the opinion of plantation owners on continuity

Chi-square is express as

$$X^2 = \sum_{i=1}^n \left(\frac{(X - M)^2}{M} \right)$$

Benefit cost ratio: it looks at profit at long term and analysis continuity of the plantation activities in the study area. It is express as follows:

$$\text{Benefit cost ratio } B/C = \sum Bt / \sum Ct$$

III. RESULTS AND DISCUSSION

A total of fifty (50) questionnaires were administered to plantation owners, NGO's, schools, Traditional and local councils in Mezam division of the North west Region. Forty- five (45) questionnaires retrieved after distribution; these represented 90% of the total respondents.

A. Socio-economic characteristics of the respondent

The data presented in this section identified the various interrelated components, such as social, economic, ecological factors and management strategies of respondent. Together, these components provided the information that led to the effective understanding of the sustainability of plantations in the study area

B. Sex distribution of respondents

The results in table 1 shows that more men than women are involved in private plantation business 84.5% since men other than women mostly own and inherit land. While the women counterparts (15.5%) either inherited their plantation from their late husbands or parents who do not have a son to inherit them after their death. WA Cameroon, 2011 reported that CAMEROON - Women produce 80% of food in rural

communities yet own only 2% of the land and benefit only 5% of the total agricultural inputs.

Women access to land depends on their relationship with men: either as husbands, fathers, brothers or male relatives. The inability of women to freely access and control productive resources, places them at a weaker position in terms of agricultural productivity and economic growth, food security, family income, multiple livelihood strategies and equal participation in governance. All these are set backs to an emerging economy like Cameroon. Cameroon - Gender Equality Advocacy Network (GEADNET, 2011)

Category	Frequency	Percentage
Male	38	84.5
Female	7	15.5
Total	45	100

Table 1: Distribution of respondents according to gender
Source: Field survey, 2013

C. Marital status of respondent

The results in table 2 show that majority of respondents 84.5% who have plantations are married and only 15.5% are widows. These results show that widows have inherited plantations from their death husbands and many other widows have been deprive of inheritance. This results is in line with the works of (HMR, 2003), reported that, the majority of evidence surrounding wealth dynamics at widowhood is based on qualitative research. For example, a Human Rights Watch brief on property rights discriminations in Kenya recounts stories of dozens of widows who were stripe of assets (including land and livestock) and in many cases forced to undergo ritual cleansing. Izumi (2007), defines asset disinheritance as a form of gender-based violence and documents stories of widows who are humiliated and robbed of self-esteem and others who literally die defending their property

Category	Frequency	Percentage
Married	38	84.5
Single	-	-
Widow	7	15.5
Total	45	100

Table 2: Distribution of respondents according to marital status

D. Motives for plantation establishment

Table 3 reveal that a larger proportion of respondents (42.2%) established plantation just to protect family land from been taken over by commercial investors and 33.3% owned plantation for economic reasons while 13.3% and 11.1% of respondents established plantation for self-employment and available market for their produce . This means that more of the unemployed educated youth have found their way in to the plantation business as a source of livelihood. This is a positive development as it has help to decongest the labour market, reduce land degradation, provide timber/ fuel wood and improve living standards of families. This has gone a long way to reduce destitution and crime in the communities. This study reveals that if private plantation business is well organized by the state through grants and subsidies, it provide employment opportunities and also reduce deforestation and hence mitigate the effects of climate change and land degradation. The results is

confirm by the study of Li, (2004) who reported that in recent decades; the area of forest in mid-latitudes has expanded due, in part, to an increase in Afforestation projects. China, for example, has been implementing an Afforestation scheme in order to reduce land degradation and provide timber.

Category	Frequency	Percentage
Source of employment	5	11.1
Ready market	6	13.3
Protect family land	19	42.2
Economic	15	33.3
Total	45	100

Table 3: Distribution of respondent according to motives
Source: Field survey, 2013

E. Respondents having permit

The results in table 4 shows that all of the respondents (100%) owning plantation do have an operation and exploitation permits and their activities are done under shadow as the state is unaware. Most of their plantations are exploiting illegally without the knowledge of the concern government agencies.

Category	Frequency	Percentage
Permit	00	0.00
No permit	45	100
Total		100

Table 4: Distribution of respondent according to those having a permit

Source: Field survey, 2013

F. Distribution of respondents according to support

Table 5 reveals that 100% of respondent have not gotten any form of support from Non Governmental organizations and the state. The owners struggle by their selves and plantations take between 15 – 20 years to mature and ready for exploitation. This long period discourage many youths to go into plantation business

Category	Frequency	Percentage
Support (yes)	00	0.00
No support (No)	45	100
Total	45	100

Table 5 Distribution of respondent according to support
Source: Field survey, 2013

G. Respondents according to their source of seedling

Table 6 shows that majority of respondents (84.5%) buy their seedlings from private nurseries while (15.5%) get their seedlings from the wild (wildlings). These planting stocks can also affect plantation productivity, as genotype of planting material is unknown.

Category	Frequency	Percentage
Wildlings	7	15.5
Private nurseries	38	84.5
ANAFOR	00	00
Total	45	100

Table 6: Distribution of respondent according to sources of seedling

Source: Field survey, 2013

H. Distribution of respondent according to produce

The results in table 7 show that majority of plantation owner (94.5%) sell their products as fuel wood while 31.1% and 24.4% sell their produce as poles and timber respectively. The study also reveals that during pole and timber harvest off cuts sold as fuel wood by plantation owners to increase their profits. This is in line with the studies of May and Ash, (2009) who reported that the fast growing nature of Eucalyptus species makes them ideally suited to the production of wood for pulp, timber (including poles) and fuel wood. These trees produce straight stems, which are suitable poles for carrying electric and telephone cables (Ndambi and Ndzerem, 2012)

Category	Frequency	Percentage
Poles	14	31.1
Timber	11	24.4
Fuel wood	20	44.5
Charcoal	00	00
Total	45	100

Table 7: Distribution of respondent according to produce
Source: Field survey, 2013

I. Shows tinning (prune) products

Table 8 shows majority (84.5%) of prune materials of a plantation is use as household energy while 8.8% and 6.7% of the tinning material sold and other left to decompose inside the plantation respectively. Respondent said the leave the material to decompose inside their plantation to improve soil fertility.

Category	Frequency	Percentage
Sale	4	8.8
Household use	38	84.4
Allow to decompose	3	6.7
Total	45	100

Table 8: Distribution of respondent according to the use of prune products

Source: Field survey, 2013

J. Ecological reasons for establishing a plantation

Table 9 reveals that respondent equality plant trees for environmental reasons with respective percentages of 26.7% for wind breaks, 8.8% for protection of watershed, 26.7% protection of soil erosion, 26.7% for protection of landslide and 11.1% as live fences respectively. The study also reveal that community water project plant water conserving trees in their catchment areas, while household located around steep slopes planted trees to protect their homes from landslide and soil erosion. Residence found in open areas also planted windbreak around their homes, trees planted as live fence over livestock farms, and vegetable gardens and when mature owners can sell as timber and fuel wood. This has gone a long way to reduce deforestation and protecting the environment. This is in line with the studies of Li, (2004) in recent decades; the area of forest in mid-latitudes has expanded due, in part, to an increase in Afforestation projects. China, for example, has been implementing an Afforestation scheme in order to reduce land degradation and provide timber.

Category	Frequency	Percentage
Wind breaks	12	26.7
Protection of watershed	4	8.9
Protection of soil erosion	12	26.7
Protection against landslide	12	26.7

Sacred site	00	00
Fodder	00	00
Live fences	5	11.1
Total	45	100

Table 9: Distribution of respondent according to environmental reasons for establishing plantations

Source: Field survey, 2013

K. Contingency table of equal probability

Chi-square is use here to test the response of plantation owner on a particular opinion, which equally shared by all respondent. The result interned at getting the opinion of the respondent on three responses. The results showed that X^2 tabulated with degree of freedom 2 (i.e. 3-1) = 5.99 at 0.05 probability is greater than X^2 calculated. The result indicates that there is no significantly different from equal probability. Thus, the option of plantation owners equally divided on the issue of continuity.

	Willing	Not willing	Indifferent
Observed	12	16	17
Expected	15	15	15

Table 10: Contingency table of observed and expected frequencies on plantation owner’s response

Source: Field survey, 2013

Chi- square test of equal probability given below

$$X^2 = \sum_{i=1}^n \left(\frac{(X - M)^2}{M} \right)$$

$$X^2 = (12 - 15)^2/15 + (16-15)^2 / 15 + (17 - 15)^2 / 15 = 9/15 + 1/15 + 4/15 = 0.6+ 0.07 + 0.3 = 0.97$$

L. Benefit cost ratio

This concept is usually defined to suit owner’s conception of the market. To the plantation owner efficiency may be to sell his produce at the high price. To the consumer it may be getting his forest product at the lower price. However, if forest products prices are high in turn it limits consumer’s purchases, which will in turn affect further plantation establishment.

Also using the benefit cost ratio valve obtained from the field survey, it indicate that benefit cost ration calculated 0.7 is less than 1. This implies that private plantation business in the study area yield less return compare to other forms of land uses such as agriculture. The result confirmed by the studies of Drigo, 1997, who started that the price of products grown on converted forestland is higher than the sales of timber and on contrary the derived revenues available are often unattractive compared with those available from land conversion to commercial agriculture. Colchester, (1998) reported that as populations grew with changes in farming methods such as livestock grazing, commercial cultivation and land clearance for infrastructural development had converted forestland.

Parameters	Products (cfa francs)
Total revenue (TV)	12500
Variable cost (VC)	
Permit	-
Weeding	2500
Manure	750
Fertilizer	-

Herbicide	-
Insecticide	-
Pruning	1750
Land preparation	1250
Felling/cross cutting	2500
Total cost (C)	8750
Total benefit (B)	3750
Number of years	5-10

Table 11: Showing benefit cost ratio per acre of forest plantation in the study area

Source: Field survey, 2013

$$\text{Benefit cost ratio } B/C = \sum Bt / \sum Ct$$

$$B/C = 8750/12500$$

$$= 0.7$$

M. Priority species

Table 11 reveals that majority of respondent (68.9%) have planted Eucalyptus species, 11.1% planted pruns, and 8.8% planted pine while 6.7% and 4.4% planted fruits trees and palm respectively. This study also reveal that eucalyptus species planted more by private plantation owners because grow faster and coppice. This species gives more profit to the businessperson than indigenous species, which takes a longer time to grow. This is in line with the studies of May and Ash, (2009) which reported that the fast growing nature of Eucalyptus species makes them ideally suited to the production of wood for pulp, timber (including poles) and fuel wood. These trees produce straight stems, which are suitable poles for carrying electric and telephone cables (Ndambi and Ndzerem, 2012)

Species	Frequency	Percentages (%)
Eucalyptus	31	68.9
Pruns	5	11.1
Cypress	4	8.8
Fruit trees	3	6.7
Palm	2	4.4
Total	45	100

Table 11: Showing the distribution of plantations according to priority species

Source: Field survey, 2013

N. Plantation distribution by ownership

Plantations forestry accounts for less than 1% of the surface area of the division. The area cover by plantations is 240 ha. The state has majority with 72ha followed by the local councils with 67ha and private owners with 57 ha as can been seen in table 12 below. Some of private plantation dates back to the 1970 with the state seriously engage in 2009. The regional delegation of forestry has since 2009- planted 8500 seedlings of eucalyptus species still plantation forestry only provide a little fraction of the forest products we need. This is in line with the studies of Sunderlin et al, (2008) further said that legal and policy frameworks have tended to favor industrial interests, timber production, agriculture and mineral extraction, over the interests of conservation and plantation activities.

Ownership	Productive		Protective		Total	
	No	Area (ha)	No	Area (ha)	No	Area (ha)
State	3	30	3	42	6	72
Local council	4	37	4	30	8	67
Traditional council	0	0	5	14	5	14
Private	25	57	0	0	25	57

NGO's	2	9	3	13	5	22
Schools	0	0	4	8	4	8
Total	34	133	19	107	532	240

Table 12: Plantation distribution by ownership and Management regime

Source: Field survey, 2013, ANAFOR, 2013

O. Plantation according to sizes

Table 13 shows that majority of the plantation (82%) are less 5ha with 12% less than 10ha while plantation greater than 10ha make up only 6%. This result implies that although private plantations are larger in terms of numbers but small in terms of hectares (sizes). This is due land tenure system where individual can only have little land to divide between subsistence agriculture and plantation forestry. Despite this expansion, forest plantations still account for less than 5 per cent of the total forest area in the world (FAO, 2006).

Size range(ha)	Frequency	Cumulative freq	Percentage (%)
0 – 5	41	41	82
6 -10	6	47	12
> 10	3	50	6

Table 13: Plantation distribution according to size (ha)

Source: Field survey, 2013

P. Survey of plantation in Mezam Division eucalyptus

The survey of Eucalyptus plantations in Mezam were the diameter at breast height (dbh) and total height of trees (TH) got with the aid of diameter tape and Hagar altimeter. See table 15 below.

Parameters	Dimension	Structure
Age of stand	Y	15-20
Dbh	Cm	20.4
TH	M	9.7
BA	M ²	3.2* 10 ⁶ m ²
BAT	M ²	1306
NTH	t/ha	2500
CCF		0.01
VTH	M ³	0.79m ³
Density	Tree/ M ²	0.25
Spacing	M	2*2

Table 15: Characterizing of *Eucalyptus grandis* stand in a plantation in Ntabang Nkwen with escapement 5 * 8m

Source: Field survey, 2013

Key

- DBH - diameter at breast height
- TH - total height
- BA - basal area per hectare
- BAT - basal area per tree
- NTH - number of trees per hectare
- CCF - crown competition factor
- VTH - volume of tree per hectare

IV. LAND PREPARATION METHOD

The results in table 16 shows that majority of plantation owner (66.7%) prepare their land by manual clearing follow by 20% who use chemical (herbicides) to prepare land for planting. Respondent who use fire to clear land make up 13.3% of the sample population.

Category	Frequency	Percentage %
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Manual clearing	30	66.7
Mechanical	00	00
Chemical	9	20
Fire	6	13.3
Total	45	100

Table 16: Showing the distribution of respondents according to land preparation

Source: Field survey, 2013

A. The type of manure use

Table 17 shows that majority (51.1%) of plantation owners do not use any form of manure. This is because fertilizers are very expensive. Trees can only use available nutrients in soil and this has contributed to slower growth of tree crops in private owned plantations.

Fertilizers rank second with 33.3% of respondent using fertilizer in areas where the soils have totally lost their nutrients so as to amendment soil nutrients.

Compost rank third with 15.6% forest Plantation who use compost manure to improve soil fertility. Compost got decomposed reduces of pruned materials. This has help increase productivity in terms of quality and quantity as a result improved standard of living of plantation owners.

Category	Frequency	Percentage %
Dug	0	00
Compost	7	15.6
Fertilizer	15	33.3
Non	23	51.1
Total	45	100

Table 17: Distribution of respondent according to type of manure

Source: Field survey, 2013

B. Plantation regeneration methods

The results in table 18 showed that majority of plantation owners 73.3% regenerate their plantation by coppicing and it is cheaper and needs little tending. This is follow by complete tilting 15.6% and replacing stocks with new planting materials. 6.7%, of respondents, use wildlings from neighboring plantations o regenerate their plantation and 4.4% of respondent were not willing to regenerate their plantations after harvest. This is because they are planning to put the land in to other uses. As urban centers expand toward suburbs, they are increasing demand for land to be use for housing estates, industrials and social services.

Category	Frequency	Percentage %
Coppice	33	73.3
Tiling and planting new stock	7	15.6
Wildling	3	6.7
Non	2	4.4
Total	45	100

Table 18: Distribution of respondent according to regeneration of plantation

Source: Field survey, 2013

C. Constrains to plantation forestry

The results in table 19 shows that access to finance ranked highest with 51.1% to plantation establishment, as needed material to establish and manage a plantation is expensive. Such materials include amongst others chemical fertilizers, planting stock and insecticides. In addition, seedling and manual labour are priced high leaving plantation owners only to the mercy of their family labour. Rations for

household food and education are sometime use to run plantation activities rendering families poorer as minimum harvest period range between seven to ten years after planting.

This is follow by wildfires with 31.1% Subsistence agriculture and subsequent bush fire end up burning young trees in a newly form plantation, this has lead to the lost of many established plantation where the perpetrators go unpunished

Policy and laws rank third with 17.8%. This problem has many dimensions. In some cases, even the agencies that are suppose to provide technical assistance fail to do so. land tenure is also problem for entrepreneurs who have capital and are willing to established large plantations for commercial purposes this is becomes it is difficult to obtain land couple with the difficult land laws and corruption in the part of the official responsible.

Roads ranked forth with 8.9% for instant there are no roads and where they exist, they might be seasonal feeder roads, which are usually few and in most cases, have to be constructed and maintain by communal efforts. These roads discourage timber and fuel wood distributors to buy from plantation that are not accessible as it will increase their own cost and hence the final price of the product.

Parameters	Frequency	percentages %
Access to seedling	00	00
Access to free market	00	00
Financial	23	51.1
Lack of roads	4	8.9
Policy	8	17.8
Wild fires	14	31.1
Land tenure	9	20
Destruction of trees during felling	00	00
Labour	4	8.9
Total	45	100

Table 19: Showing the constrains to plantation forestry

Source: Field survey, 2013

V. CONCLUSION

From this study, we can conclude that plantation business in Mezam is not sustainable in the near future despite the marginal profits made by plantation owners. The study showed that most of the plantation business is down by men and majority do this business just to protecting family land for their future generation. The results also proved that forest plantations contribute just a small portion of the household energy gotten from biomass. That most communities still depends on the natural forest and agro-forestry wood got from farms to complement household energy and timber for construction

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