Assessment of pre-harvest losses of banana and the social wellbeing of farmers in Boyo Division, North West Region of Cameroon

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Abstract: **The study assessed pre-harvest losses of banana and its effect on the social wellbeing of farmers in Boyo Division. It have as objectives to; assess banana production systems in Boyo division, examine the extent of pre-harvest losses of banana in Boyo division, and assess the effect of the losses on the social wellbeing of the farmers. The study employed multi-stage sampling techniques to select 380 respondents from three out of four Sub-divisions in Boyo Division. Data was obtained from the respondents with the aid of Questionnaire, Focus Group Discussions and Key Informant Interviews. The data obtained was analysed using descriptive statistics and relational content analysis. The results revealed that majority of banana farmers practiced banana-coffee intercrop with farm sizes ranging from 0.1-4 hectares. Majority of the producers (87%) were smallholders' farmers. The results further revealed that during the 2019/2020 cropping cycle, an estimated amount of 89,272 banana suckers were planted/maintained, 61,055 plants harvested, while 28,217 plants were lost at pre-harvest stage. Most of the losses (21-30%) were recorded in the banana-coffee intercrop system. These quantity lost subjected a significant proportion, 81% and 59% of the farmers' households to food shortages, inability to access good health facilities and societal commitments. The study therefore, concludes that pre-harvest losses of bananas significantly affect the social wellbeing of the farmers and recommend that intercropping should be reduced and improved cultivation practices provided to the farmers.**

Keywords**: Pre-harvest losses, Social Wellbeing, Production systems, Banana and Boyo Division**

I. INTRODUCTION

Pre-harvest losses of bananas affect the social wellbeing of farmers in Africa especially smallholders' farmers who form 90% of the producers [1]. *Musa sapientum* generally known as bananas or desert bananas are staple food crops to many people in Africa [2, 3]. According to [3], the per capita consumption of banana in Cameroon as well as Uganda and Rwanda is estimated at 200kg. This value is sometimes exceeded especially in rural areas where bananas are cultivated and consumed by almost all the households. Bananas are equally considered as cash crops in many producing countries [4, 5]. However, bananas are perennial crops which originated from Southeast Asia and New Guinea and were introduced in Africa before 2500 years ago [6]. In African continent, banana production is carried out predominantly in Sub-Sahara region. This region produces 25% of the World banana output with a significant quantity produced in Central Africa followed by West Africa. Cameroon is the major producer followed by Côte d'Ivoire [4]. In 2015, Cameroon produced an estimated amount of 278,450 tonnes [7].

In Cameroon, almost all what is produced in large scale plantations is intended for export. A significant proportion of what is consumed in the country comes from smallholder farmers who are distributed across the country. These smallholder farmers are constrained with several factors among which are poor inputs, artisanal farm tools, pests and diseases, inadequate experience and poor policies. These factors contribute to pre-harvest losses of bananas resulting in low yields. According to [8], pre-harvest losses of bananas and plantains in Cameroon, Nigeria and Ghana range from 30-50% and sometimes extend to 80%. These losses affect the social wellbeing of the farmers especially the food security status of many consumers in the country.

In Boyo Division in the North West Region of Cameroon, bananas are predominantly intercropped with coffee as a way of providing shade to the coffee as it grows. Farmers cultivate bananas with the intention of providing among others things food, education, clothing and healthcare to their households. Food items not produced by the farmers' households are equally obtained from banana output or proceeds. These items are never enough because farmers incur pre-harvest losses as most of the crops planted dry-off, topple, destroy by stray goats, sheep and cattle during transhumance period or burn by fire from bush burning or from farming activities during ploughing in the dry season. These traits only comes to cause a decrease in the farmers produce. This distort the ability of the local population to achieve their social needs. Over the past years, studies in the country have focused on the production and causes of pre-harvest losses of banana with little or no attention in addressing the effect of the losses on the social wellbeing of the farmers to inform stake holders. This study is therefore, aim to fill this gap with the objectives to:

1. Assess banana production systems in Boyo division
2. Examine the extent of pre-harvest losses of banana in Boyo division

3. Assess the effect of the losses on the social wellbeing of the farmers

1.1 Study Area And Method

1.1.1 Study area

Boyo Division is located between latitudes 6° 9' and 6° 17' N and between longitudes 10° 16' and 10° 20' E of the Greenwich meridian. It shares territorial limits with five out of the seven administrative Divisions (Menchum, Donga-Mantung, Bui, Ngoketunjia and Mezam divisions) that make up the North West Region of Cameroon (figure 1). The Division is made up of four administrative Sub-divisions (Fundong, Njinikom, Belo and Fonfuka Sub-division) and covers a total surface area of 1592 km^2 with 2020 population estimated at about 183,539 inhabitants based on 2.6 population growth rate in Cameroon. This population is unevenly distributed across the mountains, valleys and slopes. The choice of the Division stems from the diversity of banana varieties cultivated by the households. Almost all the varieties of bananas cultivated in the other six producing regions in the country are cultivated in this Division. A variety like the '*Achu*' banana: the main complement of the *achu* dish- a staple food in the entire nation is predominantly cultivated in the Western highlands (North West and West Regions) of Cameroon with Boyo Division being one of the major producers. Equally, the dominant volcanic and ferralitic soils as well as rainfall variability that starts from March and ends in November with an annual rainfall of 2400mm, a humidity of 82% and average temperatures varying between of 24.5 to 29.7°C favours the growth of bananas in the study area [9].

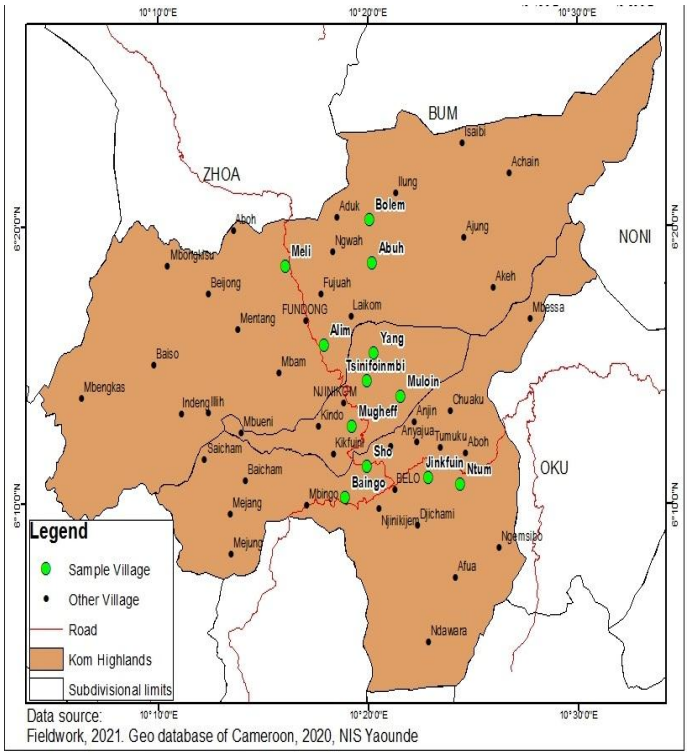

Figure 1: Location of the study area and sampled villages

1.2 Method of data collection

Questionnaire, Focus Group Discussions (FGDs) and Key Informant Interviews (KII) were used to obtain qualitative and quantitative data from the field. Triangulation was adopted to avoid biasness. Twelve villages (Baingo, Jinkfin, Sho, Ntum, Yang, Tinifoinbi, Wombong, Mugheff, Abuh, Alim, Bolem and Meli) were purposively selected from three Sub-divisions (Belo, Njinikom, and Fundong Sub-divisions) out of four Sub-divisions in Boyo Division. This selection was done with the aid of the reference farmers, Extension Agents and Sub-divisional Delegates of Agriculture based on the intensity and the various types of bananas cultivated in these Sub-divisions. A total of 380 banana farmers were selected using simple random sampling. Additionally, six focus groups (two per Sub-division each consisting of 6-10 persons) were organised and nine key informant interviews (three per sub-division) conducted. This was in a bit to gain an insight on pre-harvest losses of banana and its effect on the social wellbeing of the farmers in this Division. Key informant interviews per Sub-division composed of the Sub-divisional Delegate of Agriculture, an Extension Agent and a contact farmer.

1.3 Method of data analysis

Quantitative data obtained through questionnaire were analysed using descriptive statistics while relational content analysis was used to analysed qualitative data. Means were calculated using equation (1) and (2). The study area was designed using open source Geographical Information System-GIS (QGIS 2.18).

$$\text{Mean } (\tilde{x}) = \frac{\Sigma mf}{n} \qquad (1)$$

Pre-harvest losses (PrHL) = Mean quantity planted/maintained – Mean quantity harvested (2)

Where m is the midpoint, f is the frequency, ∑mf is the sum of the product of the midpoints and frequencies, and n is the total number of values.

II. RESULTS AND DISCUSSION

2.1 Characteristics of banana production in the study area

2.1.1 Banana farm sizes in the study area

Table 1: Banana farm sizes

Farm size (ha)	Frequency	Percentage
0.1-1	151	40
1.1-2	179	47
2.1-3	41	11
3.1-4	9	2
Total	**380**	**100**

Source: Field Survey, 2021

Table 1 revealed that an aggregate majority, 87% of the famers cultivated bananas on 0.1-2 hectares of land meanwhile only 13% were cultivating bananas on 2.1-4

hectares of land. This means that banana production in the study area is carried out predominantly by smallholders' farmers. Most of the farmers own more than one farm which were dotted across the villages and Sub-divisions. This was due to the inheritance system which permits males to inherit landed properties of their deceased maternal uncles and equally carter for that of their brothers. The cultivation of small farm sizes were triggered by the undulated landscape and drainage system of the study area which composed of hills, mountains, rivers and streams which delimits quarters, villages and Sub-divisions while hindering ownership of vast land. Similarly, [10] reported that *Musa spp*. farm sizes in the Western Highlands of Cameroon was 0.9ha.

2.1.2 Banana production systems practiced in the study area

Banana farmers in Boyo division practiced three production systems *viz*: compound production, banana-coffee intercrop and the bush banana production system as shown in Table 2.

Table 2: Distribution of banana production systems practiced in the study area

Production systems	Frequency (n=380)	Percentage
Compound system	304	80
Banana-coffee intercrop	350	92
Bush system	236	62

*Multiple responses recorded (n=380)

Source: Field Survey, 2021

The compound system of banana production was predominantly practiced by 80% of the farmers in zones with space settlements. Here, bananas, intercropped with few varieties of plantains were cultivated in the spaces around the compound. Banana plants in this system were fertilized with organic waste from the households. Output depended on the sizes of the cultivated area.

The banana-coffee intercrop production system was practiced by 92% of the farmers. In this system, bananas were intercropped primarily with coffee (*Coffea arabica* and *Coffea canephora*). Coffee seedlings were planted 30-50cm away from the banana plants or stools. Further inquiries revealed that this was for the banana plants to be providing shade to the coffee plants as they grow. It was equally revealed that because of the cool climate and the soils of the study area, banana stools stays for more than 10 years producing suckers and fruits. Therefore, the coffee continuous to strive with the bananas in the same piece of land. Nonviable and dead bananas as well as coffee plants were being replaced in the course of the cultivation. This system was predominantly practiced in the compound production system meanwhile, some farmers practiced it in distant farms. However, the banana-coffee intercrop system is gradually becoming banana coffee/cocoa intercrop. This is because farmers have started replacing less productive coffee stands with cocoa (*Theobromo cacao*) as well as the spaces in their farms. Equally, many farmers preferred intercropping bananas with cocoa in newly acquired landed properties. The rationale for this preference according to key informants' and focus group reports was that the yields and prices of coffee are low while the inputs are high compared to that of cocoa. Equally, coffee produces once a year while a cocoa plant produces throughout the year.

Equally, in the banana-coffee intercrop, traditional crops like kola nut (*Cola accuminata*) and raffia palms (*Raphia*) were cultivated. The raffia palms provided bamboos and ropes which were utilized to prop banana plants as well as fasten harvested bunches during transportation. It equally provided palm wine which was used as a reward for cooperate farm work as well as in traditional occasions and for entertainment. Meanwhile, kola nut was equally used for entertainment and to evoke the gods so too the palm wine. Equally economic crops like plumes (*Prunus domestica*), pears (*Pyrus communis*) and *Prumus africana* were interspersed in this system. The banana-coffee intercrop production system accounts for 60-70% of the total quantity of banana produced in the study area.

The bush banana production system was practiced by 62% of the farmers. In this system, bananas were intercropped mostly with several food crops like maize (*Zea mays*), cocoyam (*Colocasia esculentus*), beans (*Phaseolus vulgaris*), sweet potatoes (*Ipomoea batatas*) and sweet yams among others. The banana plants act as stakes for beans and sweet yams. When these crops are harvested, the banana plants continue to grow and produce fruits. Some tree crops were equally interspersed in this system and pruned alongside the banana plants during the food crop planting season. However, the tree crops in these stated banana production systems effect pre-harvest losses of bananas as they sometimes provide excessive shade as well as branches or the whole tree falling on banana crops during windy periods.

2.2 Extent of pre-harvest losses of banana in the study area

Banana farmers in the study area were maintaining and replacing banana plants with new suckers in existing farms by clearing, pruning and replacing nonviable plants as well as the spaces in the farm. Meanwhile, some were extending their farms or transplanting suckers to newly acquired pieces of land. Table 3 presents findings on quantity of bananas planted/maintained and harvested during 2019/2020 cropping cycle. This is in a bit to ascertain the quantity of banana plants that were not harvested by the farmers or lost in the course of cultivation.

Table 3: Distribution of the quantity of bananas planted/maintained and harvested

Quantity of banana planted/maintained	Quantity harvested (bunches)				Total
	Less 500	500-1000	1001-1500	1501-2000	
Less than 500	8	19	11	3	**41 (11)**
500-1000	29	40	10	0	**79 (21)**
1001-1500	56	48	18	9	**131 (34)**

1501-2000	42	33	36	1	**112 (29)**
2001 and above	5	9	3	1	**17 (5)**
Total	**140 (37)**	**149 (39)**	**78 (21)**	**13 (3)**	**380 (100)**

Source: Field Survey, 2021

Table 3 revealed that 34% of the farmers planted/maintained 1001-1500 banana plants while 5% planted/maintained 2001 banana plants and above. The results further showed that out of the quantity of banana suckers planted/maintained, 39% of the farmers harvested a total of 500-1000 bunches of banana, while only 3% harvested 1501-2000 bunches. These findings between the quantity of banana cultivated and the quantity harvested revealed that some of the banana suckers/plants cultivated were not harvested. This therefore, means that there were pre-harvest losses. The results showed that 68% of the farmers cultivated 1001-2001 plants, while only 24% of the farmers harvested bananas within this range which indicates that more bananas were cultivated and less were been harvested due to pre-harvest losses. The actual number of banana plants that were lost during cultivation was gotten by using mean ($\tilde{x}$) to calculate the mean quantity of banana suckers that were planted/maintained and the mean quantity that were harvested based on the data presented in Table 3 while employing equation (1) and (2). Table 4 present mean distribution for quantity of banana planted/maintained, quantity harvested and number of plants that were lost during 2019/2020 cropping cycle.

Table 4: Mean distribution for quantity of banana planted/maintained, harvested and lost

Total quantity of banana planted/maintained (stems)	Total quantity of banana harvested (bunches)	Total quantity of banana plants lost (stems)
89,272	61,055	28,217
100%	68.4%	31.6%

Source: Field Survey, 2021

Results in Table 4 revealed that an average of 89,272 banana suckers were planted or maintained in 2019/2020 cropping cycle in the study area. Out of this quantity, an average amount of 61,055 banana plants were harvested, while an estimated amount of 28,217 plants were lost as shown in figure 2. Table 4 further revealed that out of 100% suckers planted/maintained, 68.4% were harvested, while 31.6% were lost. Therefore, the extent of pre-harvest losses of bananas in the study area is high (31.6%). Focus groups and key informants' reports indicated that these quantity of banana plants lost were being destroyed by strong wind, pests and diseases, cattle, goats, sheep, and fierce fire as well as stolen before maturity and hence not harvested by the farmers. Equally, poor agronomic practices, planting of infected suckers, drought and limited extension services were some of the primary causes of the losses. This results obtained on quantity of plants lost is similar to the findings of [11] which reported that 100% of banana plants were lost to bacterial wilt in Rwanda while in Tanzania, close to 42,000 infected plants were destroyed. The proportion of banana plants (31.6%) reported to be lost at pre-harvest stage is similar to the findings of [8] who reported that 30-50% and sometimes up to 80% of bananas and plantains were lost during pre-harvest stages in Cameroon, Nigeria and Ghana caused by black sigatoka.

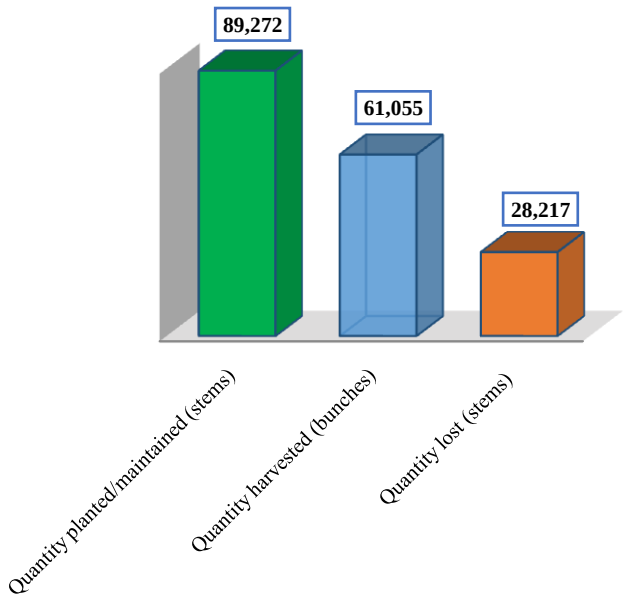

Figure 2: Distribution of the banana plants cultivated in the study area

Source: Field Survey, 2021

Extent of pre-harvest losses of bananas in the various production systems

Table 5: Pre-harvest losses of bananas in the various production systems

Extent of pre-harvest losses	Production systems		
	Compound	Banana-coffee intercrop	Bush production
1-10	29%(112)	20% (77)	27%(103)
11-20	52%(197)	34%(128)	55%(211)
21-30	16%(61)	44%(167)	17%(63)
31 and above	3%(10)	2%(8)	1%(3)
Total	**100(380)**	**100(380)**	**100(380)**

Source: Field Survey, 2021

Table 5 revealed that in the compound production system, 52% of the farmers recorded 11-20% pre-harvest losses, while in the banana-coffee intercrop production system, 44% of the farmers incurred 21-30% losses. Losses in both systems were primarily due to competition with other crops, shade, and wounding and shattering of fingers and the vegetative parts of bananas by branches and fruits from the tree crops as well as strong wind and pest and diseases. Further inquiries from key informants revealed that pests and diseases were common in these systems because of the continuous cultivation of the

crop on the same farms. Equally, the planting spacing was not respected resulting to overcrowding. In the bush production system, 55% of the farmers incurred 11-20% losses. According to focus groups report, apart from strong wind, the theft of suckers and fruits as well as fierce fire from hunters contribute to losses in this system.

Table 6: Effects of pre-harvest losses of bananas on the social wellbeing of the farmers

Effects	Frequency (n = 380)	Percentage
Inability to access good health facilities	224	59
Inability to perform traditional ceremonies	47	12
Inability to access quality education	52	14
Insufficient food/lack of access to other food types	310	81
Inability to meet commitments/belong to social groupings	22	6
Decrease level of payment in-kind	27	7

*Multiple responses recorded (n = 380)

Source: Field Survey, 2021

Table 5 revealed that, 81% of the farmers could not access the quantity of bananas needed for consumption as well as other food types because of pre-harvest losses. Banana production in the study area was not purely for income; it equally serves as a source of food especially during the lean seasons of other food crops. Focus groups and key informants' reports revealed that banana losses have caused a decrease in the quantity and quality of bananas needed for consumption. For instance, banana fruits especially *Achu*, Cavendish and Gros Michel were either pounded with corms of cocoyam, beans and irish potatoes (*Solanum tuberosum*) or boiled and eaten with vegetables like huckleberry (*Vaccinium*), bitter leaf (*Vernonia amygdalina*), garden egg (*Solanum melongena*) etc.) as well as cooked as *turning banana* (porridge banana) on daily bases especially from March to early June during the lean season of maize, beans, and potatoes. However, because of pre-harvest losses, farmers were unable to have a bunch of banana from their farms on daily or weekly bases to complement with these food items. Hence, they had to be consuming mostly these food items consequently exhausting them earlier before another harvesting season resulting to a reduction in the quantity of food consumed per person per day. It was equally revealed that bananas were being exchanged for other food types deficient or not produce by their households especially beans, potatoes and palm oil but the rate of exchange has drastically reduced because of insufficient and poor quality of the produce. Farmers were therefore, bound to be buying these food items for which income too was insufficient. This exchange practiced was predominantly carried out by women.

A 42 year old female farmer from Belo Sub-division has this to say:

> …I used to sustain my household with bananas especially after the food crop planting season in March while waiting to start harvesting beans and irish potatoes as from late May or early June. Even when these crops were harvested, I continue to complement them with bananas to economise their consumption so that they can sustain my household up to when maize will be harvested and also to reserve some for sale. This has not been the case for the past years because of pre-harvest losses of bananas which has led to shortages during this period. These shortages have translated to poor feeding as I try to minimise the consumption of the little I harvest so that I can sale some and patronise other household needs… (KII, June, 2021).

Similarly, [12] reported that Banana (*Xanthomonas)* wilt reduced the quantity of banana bunches harvested in Nshamba and Rubale Divisions in Tanzania causing households which depended on bananas as food to reduce their two to three meals per day to one meal per day in consequent, causing the food security situation of 53.8% of producers to be at risk and peace and harmony to disappear in many households.

Inability to access good health facilities was reported by 59% of the farmers. According to the views of focus group members and key informants, pre-harvest losses of bananas have resulted to insufficient income making farmers to be managing primarily roadside drug vendors and dispensaries which have limited facilities for effective healthcare. Additionally, the losses have resulted in farmers seeking medical attention from traditional herbalists which in some situations have led to loss of lives.

Responses in the course of the survey equally revealed that, 14% of farmers could not access quality education for their children especially in the past four years when the most affordable means of education (Government Schools) in the division were closed due to the socio-political crises (Anglophone crises). Farmers were not able to raise money and add to other sources and sponsored their children or relations in schools out of the Division or Region and this has led to school drop-outs.

Results in Table 5 equally showed that, 12% of the farmers were unable to perform traditional ceremonies like marriages and slaughtering of goats during funerals because of banana losses as they were not able to purchase the necessities. Meanwhile, 7% of the farmers complained of their inability to pay labourers in-kind because the quality and quantity of produce have reduced due to the losses. Other farmers, 6% expressed unhappiness for falling short of their commitments in their social groupings. The results on social interactions corroborate the views of [13] in Iran, who reported that the loss of plantains as well as other food stuffs as a result of drought contributed to conflicts, relinquishment of children education, poor health of households, and cut back on social interactions in most vulnerable families as people were unable to meet their social responsibilities.

The inability of the farmers to achieve their personal, households/family, group and community commitments from banana output as listed in Table 6 has resulted to low self-

esteem among farmers. Farmers feel unfulfilled and not belonging because they are unable to measure up with others in the Division as a result of low harvest caused by pre-harvest losses.

III. CONCLUSION AND RECOMMENDATIONS

The study has revealed that majority of banana producers in the study area are smallholders' farmers and that most farmers (92%) practiced banana-coffee intercrop. It has equally shown that not all the banana plants cultivated in the study area were harvested as more than one-quarter (¼) of the plants (28,217 plants) were lost during growth and maturation. The extent of the losses were high in the banana-coffee intercrop. These losses significantly affected the social wellbeing of the farmers' householders as it rendered them unable to fulfil their vital needs like food, education and health as well as societal commitments hence, contributing to low self-esteem. It is therefore, recommended that intercropping should be reduced and improved cultivation practices provided to the farmers.

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