

Full Length Research Paper

Sources of damages and losses that affect productivity and livelihood of cocoa farmers in Western Nigeria

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This study reports possible sources of damages and losses that affect productivity and livelihood of cocoa farmers in Western Nigeria. Primary data were collected through the administration of structured questionnaire and collected data were analyzed. The results of 208 farmers showed that cocoa farming is the primary work of 86.5% in Ondo State and 75.8% in Osun State whilst the rest are either produce buyers or engaged in other businesses. Majority of the farmers are male, literacy level is high as only 2.7 and 3.5% of the farmers did not have formal education in Ondo and Osun States respectively and over 90% of the farmers are member of one association or the other. The losses of cocoa bean by farmers in Ondo and Osun States are significant as about 96% have one loss or the other ranging from 10 to 70 bags annually, out of which 40% of the losses were identified to be due to insect damage, 50% of the losses caused by disease infections, 3.4% jointly caused by insects and diseases and 6.6% of losses could be attributed to other factors. Most (93%) of the non-growers respondents' dealt with raw cocoa beans of which 43.5% of them export less than 250 tons of cocoa annually and 60% agreed that damages of cocoa beans are of multiple sources. The analysis of data showed negative linear correlation between gender and the level of education, size of farm, farmers' group and household size and also between size of farm and sex, age category and primary occupation. Significant correlation was observed between age category and age of farm, level of education and primary occupation as well as between size of farm and age of farm and household size and between age of farm and size of farm, age of farm and household size.

Key word: Cocoa, losses, value chain, damages, productivity, farmers, buying agents.

INTRODUCTION

Cocoa (*Theobroma cacao*) has a high yield potential, but it is frequently limited by environmental and cultivation factors to levels far below the genetic potentials. Africa alone accounts for 68% of the world's cocoa production, Asia and Oceania with 18% and the Americas with 4%

(ICCO, 2010). The cocoa consumption between 2000/01 and 2008/09 increased dramatically in Asia and Africa, with a 38% and 72% increase respectively, reflecting in part the standards of living increases, development of new products and advertising, and promotional campaigns (ICCO, 2010). Providing farmers with genetically improved planting materials is essential for sustainable production, although this alone will not significantly increase yields unless greater attention is given to reducing losses along the value chain. Cocoa

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value chain include different players; producers (farmers), researchers, extension agents, quality control experts, buyers (marketers), input suppliers, warehouse owners, local processors, exporters, transporters and foreign processing companies as well as eventual consumers of the cocoa products. The value chain analysis includes studies the sequence of processes of a good or service until the production of the final product (Talbot, 2002; Laven, 2005; Gilbert, 2006). The value chain analysis framework examines the nature of the commodity flows to and from each stage and the geographic distribution of the flows; and is complemented by more traditional industrial organization models in which questions of strategic behaviour and market power can be more satisfactorily addressed (Traoré, 2009).

The production rate about a decade ago was between 165,000 – 180,000 metric tons (Taylor, 2000, ICCO, 2003). The decline of yields in cocoa production was largely due to old age of trees, pests and disease attack and abandonment of productive holdings as a result of low price incentives (Fasina et al., 2001; Ndubuaku and Asogwa, 2006). However, there are lots of practices/inefficiencies which lead to damages and losses across the chain leading to significant reduction. These damages and losses warrant urgent attention from all participants in the cocoa value chain in order to improve sustainability of cocoa production. Disease infections and insect infestations are some of the major causes of lower cocoa production in the world. However, to effectively quantify the extent of damages and losses along cocoa value chain base line information is required, which informed the initiation of this study.

MATERIALS AND METHODS

The study covers three States, which were selected using a multistage random sampling technique and done within the South-western agro-ecological zones of Nigeria. The States selected are Ondo, Osun and Lagos. Among these, Ondo and Osun states were the main cocoa farm areas; Lagos was the point of cocoa export from Nigeria. Three cocoa growing Local Government Areas (LGAs) each in Ondo and Osun states were randomly selected and 208 cocoa farmers were interviewed across the LGAs using structured questionnaires and focus group discussions bordering on socio-economic characteristics, possible sources and areas of damages and losses along cocoa value chain, knowledge of best practices, recommended chemicals/responsible pesticide use, knowledge of pests and diseases and postharvest handling techniques practiced among others. The data collected were analyzed using statistical package for social sciences (SPSS) version 20. Inferential statistical tool such as correlation coefficient to determine the factors affecting cocoa productivity and descriptive tools such as frequencies and percentages were also used.

RESULTS AND DISCUSSION

Socio-economic characteristics

A total of 208 cocoa farmers comprising of 134 in Osun state and 74 farmers in Ondo state were interviewed along with 29 others who were either exporter, buying agent or processor across Osun, Ondo and Lagos states. The cocoa farmers' residence in Ondo State had 6.1% from Idanre LGA, 10.9% from Ondo East LGA and 16.1% from Oluji-Okegbo LGA. Osun state farmers residence was 21.7%, 12.2% and 33.0% from Atakumosa East LGA, Irewole LGA and Ife South LGA respectively. Across the two States, farming was the primary occupation of 79.3% of respondents, 7.9% were produce buyers, 8.8% traders and only 4% engage in other businesses. The age of farms vary, only 2.7% of the farms were established over 70 years ago, 54.5% of farms are between 10 and 30 years old and 10.3% of the farms were below 10 years. Only 3.2% of the farmers did not have formal education, 22.1% completed primary school, 30.4% completed secondary education and 19.8% have post-secondary education (Table 1). Majority of the farmers (75.2%) are male, 76.1% are married and only 19.8% are youth. Virtually all the farmers (94.0%) are member of either of Cocoa Association of Nigeria (CAN), Cocoa Farmers Association of Nigeria (CFAN), Farmers Business School (FBS), Farmers Development Union (FADU) among others and year of membership varied with only 5.8% having more than 21 years in the group. About 13% of the farmers have less than 5 people in their household, 58.3% have 5 to 10 people and only 2.8% have over 30 people. It was noted that only few farmers (8.5%) have more than 50 acres of cocoa farm, whilst 61.8% have between 1 and 10 acres (Table 1).

Table 1 also shows the demographic distribution of farmers in each of the study States. It was observed that 16.5% of Osun farmers are less than 30 years of age whilst only 9.6% are in the same age group in Ondo State. The level of literacy was higher in Ondo state as 34.2% completed post-secondary school while only 12.5% passed this level in Osun State. There are smaller holder farmers in Ondo State with 67.6% having 1 to 10 acres of farm as against 59% of farmers in Osun State with same area of farm. About 9.7% of the farms in Osun State have more than 50 acres of farm land against 5.9% in Ondo State. Across the study locations, only 3.6% were producers, 50% were exporters, 92.9% were warehouse agents whilst 46.4% were both exporters and warehouse agents. Lagos State had 21.4% of the exporters and 7.7% warehouse agents, Ondo had 57.1% exporters and 34.6% warehouse agents and Osun 21.4% exporters and 57.7% warehouse agents.

There are more young cocoa farms in Ondo than Osun States as 13.5% and 8.7% of farms are less than 10 years old in both States respectively. Also, the primary occupation of 86.5% of respondents in Ondo State is

Table 1. Socio-economic characteristics of farmers in Ondo and Osun States.

Parameter	Ondo State		Osun State		Both locations	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Gender						
Male	60	81.1	113	84.3	173	83.2
Female	14	18.9	21	15.7	35	16.8
Age of respondents						
< 30 years	7	9.6	22	16.5	29	14.1
30 – 60 years	50	68.5	106	79.7	156	75.7
> 60 years	16	21.9	5	3.8	21	10.2
Educational level						
No formal education	2	2.7	5	3.5	7	3.2
Incomplete primary	6	8.2	11	7.6	17	7.8
Complete primary	12	16.4	36	25	48	22.1
Incomplete secondary	6	8.2	22	15.3	28	12.9
Complete secondary	17	23.3	49	34	66	30.4
Incomplete post-secondary	5	6.8	3	2.1	8	3.7
Complete post-secondary	25	34.2	18	12.5	43	19.8
Farm size						
1 – 10acres	46	67.6	85	59	131	61.8
11 – 25 acres	16	23.5	28	19.4	44	20.8
26 – 50 acres	2	2.9	17	11.8	19	9.0
> 50 acres	4	5.9	14	9.7	18	8.5
Age of farm						
< 10 years	10	13.5	13	8.7	23	10.3
10 – 30 years	38	51.4	84	56	122	54.5
31 – 50 years	16	21.6	35	23.3	51	22.8
51 – 70 years	8	10.8	14	9.3	22	9.8
> 70 years	2	2.7	4	2.7	6	2.7
Primary occupation						
Farming	64	86.5	116	75.8	180	79.3
Produce buyer	2	2.7	16	10.5	18	7.9
Trading	7	9.5	13	8.5	20	8.8
Others	1	1.4	8	5.2	9	4.0
Farmers' group						
Yes	67	93.1	138	94.5	205	94
No	5	6.9	5.5		13	6
Household size						
< 5 people	15	21.7	11	7.7	26	12.3
5 – 10 people	42	60.9	81	57	123	58.3
11 – 20 people	10	14.5	37	26.1	47	22.3
21 – 30 people	2	2.9			9	4.3
> 30 people	0	0	6	4.2	6	2.8

farming as against 75.8% of respondents in Osun State. The household size of farmers is less in Ondo State as (21.7%) having less than 5 members against 7.7%

recorded in Osun State. However, it was noted that 4.2% of Osun farmers have more than 30 dependents but none in Ondo has this number of dependents. A higher number

Table 2. Assessment of farmers' knowledge of best practices in cocoa.

S/N	Knowledge of the farmers	Farmers' response (%)
1	Identify insect pests and diseases of cocoa	70.3
2	Chemical control methods	86.4
3	Identify chemicals that have been banned in cacao	79.4
4	Life cycle/vulnerable stage of pests	34.9
5	Biological method of control	30.9
6	Economic threshold of pest	60
7	Responsible pesticide use	87.3
8	Safety precaution in pesticide application	93.2
9	Land selection	83.3
10	Forestry management	76.7
11	Cultural/ physical method of control	94.1
12	Efficient irrigation facility	84.2
13	Timely pruning	91.1
14	Appropriate weed control	93.4

of farmers were accessed in Osun State. However, the level of literacy was higher in Ondo State and higher percentages of respondents in the State were primarily farmers.

Sources of planting materials

The sources of planting materials also varied as 43.1% are self-sourced, 26.7% from Ministry of Agric., ADP (6.7%) and 4.4% from Research Institute while some others had multiple sources. About 6% of the inputs are sourced from ADP, 14.9% from Ministry of Agric., 59% are self-sourced and only 1.4% are from Research Institute. The information source to cocoa farmers include; Extension agents (9.1%) friends and neighbours (10.5%), Cocoa Farmers' Association (41.3%), radio/TV (7.8%) and Research Institution (3.2%) among others.

The assessments of knowledge of the farmers on best practices in cocoa production are as stated in Table 2, indicating 86.4% of farmers are knowledgeable on chemical control, 87.3% are familiar with responsible pesticides use and 70.3% can identify pests and diseases of cocoa while 34.9% know about the life cycle of these pests.

Cocoa varieties planted

Generally, it was observed that 44% of the farmers planted local variety of cacao (Amelonado), 11.6% hybrid variety (CRIN Tc1-8) and 7.2% planted Agric. variety (F₃ Amazon) while some others have varieties from different sources mixed on their plot. Also, 38% of farmers have more than 25 years of cocoa farming experience and only 1.0% had less than 5 years' experience.

Losses of cocoa beans during harvesting

The yield in cocoa production showed that 44.3% of farmers had less than 10 bags, 35.03% had 10 to 25 bags and 9.67% had more than 70 bags per acre (Table 3). Most of these cocoa varieties are very susceptible to pod rot disease that cause great crop loss in cocoa plantations. The *Phytophthora* pod rot disease caused by *Phytophthora megakarya* and the cacao swollen shoot disease caused by Cacao Swollen Shoot Virus are the most important economic cacao diseases in Nigeria. Losses attributable to black pod disease of cacao range from 30-90% (Ndubuaku and Asogwa, 2006).

It was noted that 76% of farmers lost less than 10 bags of cocoa during harvesting while 3% lost 31 to 50 bags in the same process. The losses of cocoa experienced by farmers are significant as 95.9% have one loss or the other. It was also observed that 59% lost about 10 bags of cocoa, 32.8% lost 10 to 25 bags, 3.7% lost 26 to 50 bags, while a little above 4% lost more than 70 bags of cocoa annually. It was also noted that 39.6% of losses were identified to be due to insect attack, 50% of the losses caused by disease infestation. However, only 3.8% of farmers claimed that insect and disease caused their losses and 6.6% of losses, could be attributed to other factors (Table 3). The losses incur by insect pests are significant because the agro-ecosystem of cacao in Nigeria is inhabited by numerous species of insect pests, among which the most economically important and wide-spread species is the brown cacao mirid, *Sahlbergella singularis*, Hagi (Hemiptera, Miridae) accounting for 25-30% yield loss annually. Others include cacao pod borer, *Characoma stictigrapta* Hmps (Lepidoptera: Noctuidae), the shoot feeders, *Anomis Leona* Shaus, *Earias biplaga* Wlk (Lepidoptera: Noctuidae) and *Sylepta retractalis* Hmps (Lepidoptera:Pyralidae) and in areas where cacao

swollen shoot virus (CSSV) disease is prevalent, the mealybug vectors of the disease, *Planococcoides njalensis* Laing, *Planococcus citri* Risso and *Ferrisia virgata* Ckll (Homoptera: Pseudococcidae) could also be important (Ojo, 1980; Ndubuaku et al., 2003).

Damage of cocoa beans at the level of post-harvest handling

The incidences of damages of cocoa beans were frequently experienced by 17.9% of respondents while 75.0% affirmed rare incidence but 7.1% have most frequent incidence of cocoa bean damages. The damaging incidence were managed by warehouse fumigation, proper drying of beans, use of insect traps, appropriate jute bags, sorting and adequate processing of the beans. The sources of bean damages were identified as post-harvest handling and post fermentation activities by 18.5% of respondents, while 40.7% extended the damage sources to include harvesting techniques and poor storage facilities.

More than 87% of farmers experienced loss during harvesting with 75.8% of them losing 10 bags and 17% lost 10 to 30 bags annually. However, 13% of loss causes was ascribed to insect pests, 9.5% to diseases, while other sectors caused 77.6% losses of cocoa during harvesting.

All the farmers (100%) fermented their cocoa beans, however, only 37% of farmers fermented for 6 to 7 days, 56.6% (4 to 5 days) and 6.4% fermented for 2 to 3 days. It was noted that only 29.9% of farmers experienced losses during fermentation with 71.3% of them losing 10 bags, 25.7% lost 10 to 30 bags, 1% lost 51 to 70 bags and 2% lost 31 to 50 bags annually during fermentation. About 47% of farmers identified insect pest as responsible for losses during fermentation, 51.1% claimed other factors and only 2.3 % associated it with diseases.

Losses of cocoa bean during drying was also experienced by farmers, out of which 89% of them lost 10 bags while 8% lost 10 to 30 bags annually. It was observed that annually, 80.6% of farmers lost 10 bags of cocoa to disease infection, 13.7% lost 10 to 30 bags, 1.1% lost 31 to 50 bags and 0.6% lost 51 to 70 bags, whilst 4% lost over 70 bags to diseases on the farm. However, 97% of farmers lost about 10 bags of cocoa during processing, 2.7% lost 10 to 30 bags, but only 0.9% lost 31 to 50 bags to this activity yearly as affected by diseases. The losses of cocoa experienced during storage showed that 96.2% of farmers lost about 10 bags, 2.8% lost 10 to 30 bags and only 1.3% lost 31 to 50 bags of cocoa yearly in storage due to disease infection. Losses incurred on the farm due to insect pest showed that 85.5% of farmers lost about 10 bags, 10.1% of them lost 10 to 30 bags, and 3.6% lost more than 70% bags. Greater percentage (97.8%) of farmers lost about 10

bags of cocoa to insect pest attack during processing and 93.8% lost about 10 bags to insect during storage, while 6.3% lost 10 to 30 bags of cocoa in storage as a result of insect attack and 73% of the farmers lacked the technical knowledge and experience to reduce losses of cocoa on the farm, during processing and in storage.

Linear correlation of observed factors

Negative linear correlation was observed between gender and the level of education, size of farm, farmers' group and household size. Similar relationship between size of farm and sex, age category and primary occupation was observed depicting that increase in one factor brought about a decrease in the other. Significant correlation was observed between age category and age of farm, level of education and primary occupation. There is correlation also between size of farm and age of farm and household size and between age of farm and size of farm, age of farm and household size (Table 4).

Financial losses of cocoa from slaty beans

The result of losses incurred by farmers from damages/slaty bean for three consecutive years (2011 to 2013) showed that about ₦100,000 was lost by 78.9% of farmers annually, 16.4% lost ₦100,000 to ₦ 300,000, 3.6% lost more than ₦ 1,000,000 and only 1.2% lost between ₦300,000 and ₦500,000 in the first cropping season. Second year showed losses of about ₦100,000 by 87.2% of farmers, 7.6% lost ₦100,000 to ₦300,000, 2.3% lost more than ₦1 million and 1.7% of farmers lost ₦300,000 to ₦500,000. The losses incurred in third year showed that 0.6% of farmers lost ₦1 million, 1.7% lost ₦300,000 to ₦500,000 and another 1.7% lost ₦500,000 to ₦1,000,000 and 9.9% lost between ₦100,000 and ₦300,000.

Residue analysis of cocoa beans

About 48% of the exporters/warehouse agents/processor carried out residue analysis of the bean and 79.7% of them have partnership with farmers or farmers' association.

Damage of cocoa beans at the point of export

A high number (93.1%) of non-growers do business with raw cocoa beans, only 3.4% either dealt with both finished product and raw cocoa bean or either of each and 82.8% export cocoa beans. The export rate of 43.5% is less than 250 tons of cocoa annually while 21.7% export over 5000 tons. Damages of cocoa beans were

Table 3. Distribution of efforts and losses by farmers in the study locations.

Year of cocoa farming		Yield/acre (bags)		Cocoa losses during harvesting		Cocoa losses during fermentation		Cocoa losses during drying		Cause of cocoa beans losses	
1-5 years	1.0%	<10	44.37%	< 10bags	75.8%	< 10bags	71.3%	< 10bags	89.0%	Insect pest	39.6%
6-10 years	15.5%	10-25	35.03%	10-30bags	17.0%	10-30bags	25.7%	10-30bags	8.0%	Disease	50.0%
11-15 years	8.3%	26-50	8.93%	31-50bags	3.0%	31-50bags	2.0%	31-50 bags	0%	Others	6.6%
16-20 years	21.4%	51-70	1.97%	51-70bags	0.6%	51-70bags	1.0%	51-70bags	1.0%	Insect and disease	3.8%
21-25 years	16.0%	>70	9.67%	> 70bags	3.0%	> 70 bags	0%	> 70bags	2.0%		
>25 years	37.9%										

Table 4. Correlations analysis of growers responses.

		Sex	Age category	Level of education	Size of farm	Age of farm	Primary occupation	Membership of farmers' group	Household size
Gender	Pearson correlation	1	0.133	-0.089	-0.108	0.126	0.038	-0.112	-0.059
	Sig. (2-tailed)		0.064	0.212	0.139	0.074	0.589	0.114	0.414
	N	208	195	198	191	204	206	201	191
Age category	Pearson correlation	0.133	1	-0.104	-0.005	0.265**	-0.057	-0.017	0.001
	Sig. (2-tailed)	0.064		0.145	0.947	0.000	0.416	0.812	0.992
	N	195	206	199	190	202	204	197	190
Level of education	Pearson correlation	-0.089	-0.104	1	0.040	-0.049	0.153*	0.030	-0.084
	Sig. (2-tailed)	0.212	0.145		0.576	0.475	0.025	0.668	0.237
	N	198	199	217	200	213	215	208	200
Size of farm	Pearson correlation	-0.108	-0.005	0.040	1	0.237**	-0.047	0.094	0.248**
	Sig. (2-tailed)	0.139	0.947	0.576		0.001	0.495	0.182	0.000
	N	191	190	200	212	208	211	203	194
Age of farm	Pearson correlation	0.126	0.265**	-0.049	0.237**	1	-0.059	-0.115	0.193**
	Sig. (2-tailed)	0.074	0.000	0.475	0.001		0.385	0.093	0.005
	N	204	202	213	208	224	221	212	206
Primary occupation	Pearson correlation	0.038	-0.057	0.153*	-0.047	-0.059	1	0.002	-0.049
	Sig. (2-tailed)	0.589	0.416	0.025	0.495	0.385		0.982	0.479
	N	206	204	215	211	221	227	216	210
Membership of farmers' group	Pearson correlation	-0.112	-0.017	0.030	0.094	-0.115	0.002	1	-0.156*
	Sig. (2-tailed)	0.114	0.812	0.668	0.182	0.093	0.982		0.027
	N	201	197	208	203	212	216	218	201

Table 4. Contd.

Household size	Pearson correlation	-0.059	0.001	-0.084	0.248**	0.193**	-0.049	-0.156*	1
	Sig. (2-tailed)	0.414	0.992	0.237	0.000	0.005	0.479	0.027	
	N	191	190	200	194	206	210	201	211

** . Correlation is significant at the 0.01 level (2-tailed).

. Correlation is significant at the 0.05 level (2-tailed).

Table 5. Demographic characters of non-growers in study locations.

Variable	Frequency	Percentage
Type of business		
Finished product	1	3.4
Raw product	27	93.1
Finished/Raw product	1	3.4
Commodity exported		
Cashew	4	13.8
Cocoa	24	82.8
Others	1	3.4
Quantity of cocoa exported		
< 250t	10	43.5
250-1000t	4	17.4
1001-5000t	4	17.4
> 5000t	5	21.7
Damages of cocoa beans		
Rarely	21	72.4
Frequently	5	17.9
Most frequently	2	7.1
Sources of cocoa damage		
Harvesting techniques	1	3.7
Postharvest handling	1	3.7
Poor fermentation	2	7.5
Postharvest handling and poor fermentation	7	25.9
Harvesting tech., postharvest handling and poor fermentation	16	59.2

rarely experienced by 72.4% of respondents, 7.1% have most frequent damages of cocoa beans and about 60% agreed damages of cocoa beans are of multiple sources (Table 5). The losses experienced by farmers were enormous which translated to reduction of cash flow in cocoa sector. Some of the factors identified to reduce the menace ranged from employment of Agricultural officers to train farmers in cocoa communities, enforcement of best practices in cocoa production, inspection task force and monitoring agents, establishment of more seed gardens, capacity building and financing of research for development at the Cocoa Research Institute of Nigeria (CRIN). Other quick interventions are also needed to solve road and infrastructural problem in cocoa communities, loan facility and subsidized farm inputs to farmers to achieve the sustainable cocoa production in Nigeria.

Analysis of the non-growers responses showed 93.1% deal with raw cocoa beans, 82.8% export only cocoa, 43.5% export <250t and Harvesting techniques, postharvest handling and poor fermentation resulted into greatest damages and losses of 59.2% (Table 5).

CONCLUSION AND RECOMMENDATIONS

Cocoa farming was the primary occupation of majority of the respondents; level of farmers' illiteracy ranged from 2.7% to 3.5% and is mainly small holder cocoa farmers. Majority of the farmers are well acquainted with knowledge of best practices and familiar with responsible pesticides use. Losses of cocoa beans were experienced by stakeholders along the value chain through various activities on-farm and in storage though at varying degrees and such losses are of economic values to the livelihood of cocoa farmers and their household. These cocoa beans losses were attributed to insect attacks, disease infestations and other factors relating to farming practices. There is therefore the need for more capacity building of the farmers especially in pest management on farm and during storage. More research activities are required towards developing varieties that are resistant to major insect pests and diseases of cocoa. Infrastructural development regarding good road networks to the farms and provision of ventilated warehouses in the rural communities are also quick interventions to alleviating the farmers' losses.

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