

## Tree crop based agroforestry in Nigeria: a checklist of crops intercropped with cocoa

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**Key words.** agroforestry, cocoa belt, crop combination, food crops, medicinal plants, tree crops

**Abstract.** A survey of cocoa farmers in Bendel, Ogun, Ondo and Oyo States of Nigeria, carried out in 1985, showed that almost all the farmers intercropped other crops with cocoa. The intercrops included food crops such as plantain (92.3), cocoyam (85.7%), cassava (51.3%), yam (41.3%), maize (38.9%), melon (31.4%), cowpea (28.6%) and pineapple (26.0%) and tree crops such as oil palm (71.5%), kola (67.3%), coffee (41.0%), coconut (7.9%) and citrus (7.2%). Other crops are ewe-iran (*Sarcophrynium brachystachys*) and ewe-gbodogi (*Megaphrynium macrostachyum*) (45.2%), african walnut (*Tetracarpidium conophorum*) (42.2%), aligator pepper (*Aframomum melegueta*) (31.6%), and iyere (*Piper guinense*) (20.2%). Guava, mango, pawpaw and vegetables such as celosia, okra and solanum occur in cocoa plots at rather low frequencies. As many as six or more other crops can be intercropped with cocoa at the same time.

### 1. Introduction

Agroforestry is a land use system that judiciously utilises the available resources while at the same time sustains the system through the inbuilt recycling factor of the components. There are several types of agroforestry system [Nair, 1985]. Agroforestry with tree crop component is particularly suited to the humid tropical parts of the world. In Nigeria, it is practised in all parts of the rainforest belt of the country. Oladokun (unpublished) highlighted the system as one of the agroforestry systems that can be modernised for the purpose of adoption as an alternative to shifting cultivation and nomadism in Nigeria.

However, before the system can be modernised, it is necessary to know the extent of its practice, the crops involved and the nature of its practice. Thus the aim of this paper is to highlight the geographical spread of the practitioners of the tree crop based agroforestry, the crops involved and the degree of admixture.

## **2. Methodology and data collection**

### *Project area*

The survey covered Ondo, Oyo, Ogun and Bendel States of Nigeria. The four states together form what used to be the former Western Region of Nigeria (Fig. 1). The area has about 700,000 ha of planted cocoa and forms the major part of Nigerian cocoa belt providing about 93% of the total cocoa produced in Nigeria. The project area lies within the region of 1100 mm and 1800 mm annual rainfall with a temperature of 21°–32 °C. In the northern parts of Oyo, Ondo and Bendel States, there are some areas where soils have poor water retention capacity and annual rainfall is low. Such areas are demarcated as marginal and unsuitable for cocoa production.

### *Sampling procedure and sample size*

The number and distribution of the farmers interviewed were based on pre-existing records of cocoa plantings obtained from the respective Cocoa Development/Tree Crop Units (CDU/TCU) of the four states. In selecting the farmers, the multistage stratified random sampling technique was used. The sampling frame was the total population of the Cocoa Development Programme farmers in the respective states. The total list was made available at the various CDU/TCU offices. The stratifications used were by (i) circle within state and (ii) zone within circle. In all, 668 farmers were interviewed while a total of 108 farms were physically visited to verify the farmers' claims (Table 1).

### *Data collection*

Structured questionnaires were prepared purposely to find out from the farmers whether or not they intercrop cocoa with other crops, the types of the intercrops, the complexity/degree of intercropping and the period(s) of intercropping. The questionnaires were administered by the cocoa field assistants (CFA) of the various CDU/TCU's. All the CFA's were specially trained and test runs were carried out before the commencement of the survey. Few farms were randomly selected and visited in each circle for an on-the-spot assessment of the responses given by the farmers.

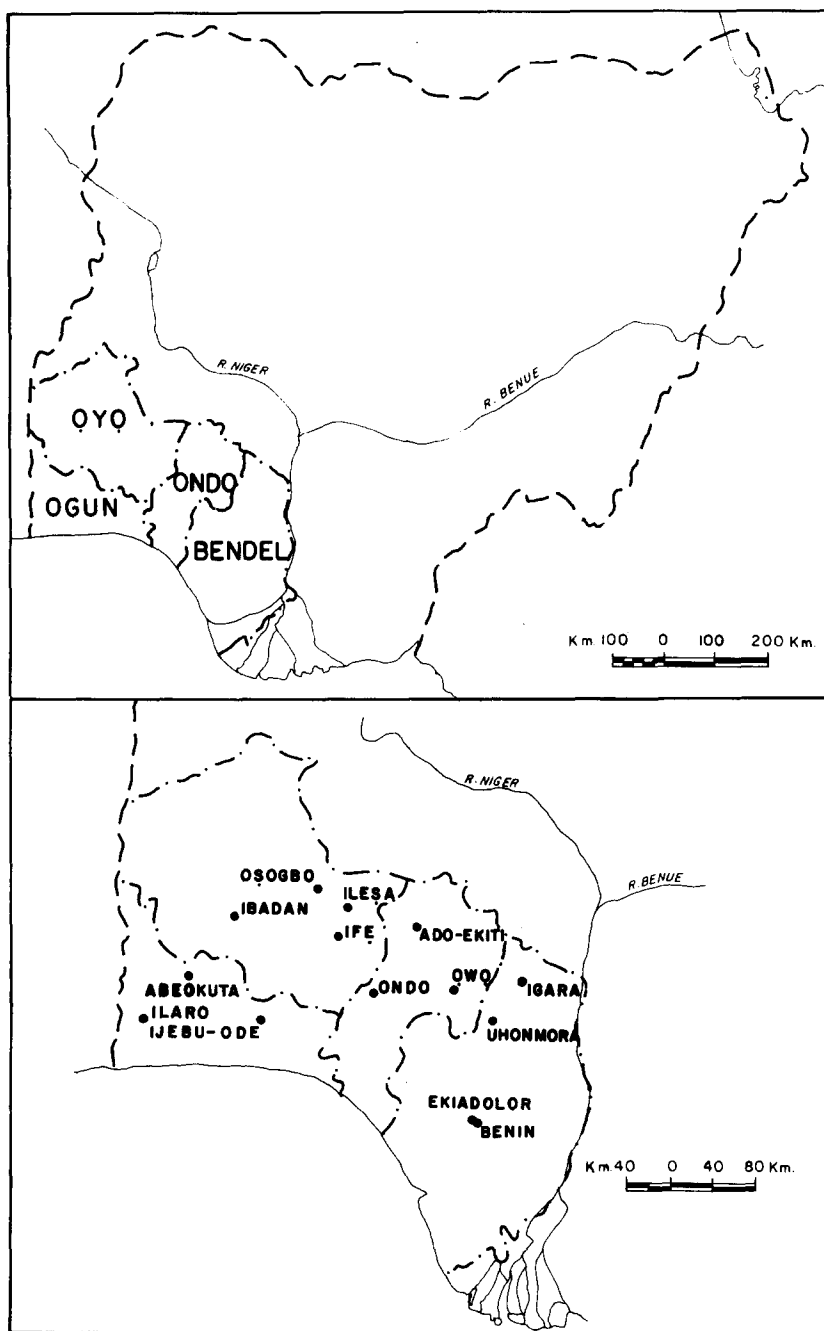


Fig. 1. Map of Nigeria showing the States and circles surveyed.

Table 1. Distribution of farmers (%) that intercropped food crops, tree crops and other plants with cocoa

State	Circle	No. of farmers interviewed	Yams	Cocoyam	Maize	Cassava	Pineapple	Cow pea	Melon	Plantain	Oil palm
Ondo	Ondo	85 (10)*	72	93	42	60	18	28	38	89	75
	Owo	116 (10)	65	90	34	63	25	30	33	95	82
	Ekiti	73 (10)	68	93	30	60	34	33	33	89	84
Oyo	Ibadan	61 (10)	31	85	29	56	8	38	36	97	80
	Ife	67 (10)	40	97	45	60	30	33	29	94	74
	Ilesha	53 (10)	45	92	40	49	17	28	23	90	77
Ogun	Osogbo	85 (12)	40	86	42	48	28	23	25	94	67
	Egba	39 (8)	23	69	51	59	33	36	31	79	62
	Egbado	53 (10)	21	79	60	45	24	38	28	94	74
Bendel	Ijebu	9 (4)	33	89	33	33	22	44	33	89	67
	Ekiadolor	10 (3)	30	90	30	40	30	20	40	100	60
	Igara	7 (4)	29	71	29	43	29	0	29	100	57
	Uhonmora	10 (7)	40	80	40	50	40	20	30	90	70
	Mean		41.3	85.7	38.9	51.2	26.0	28.6	31.4	92.3	71.5
	S.E.		4.1	2.4	2.8	2.5	2.3	3.1	1.3	1.6	2.3

State	Circle	No. of farmers interviewed	Kola	Coffee	Orange	African walnut	Coconut	Ewe Iran/Gbodogi	Aligator papper	Iyere
Ondo	Ondo	85 (10)*	68	41	6	46	12	55	35	15
	Owo	116 (10)	73	34	3	48	7	59	40	10
	Ekiti	73 (10)	72	38	8	59	10	64	30	10
Oyo	Ibadan	61 (10)	72	52	15	61	0	80	47	29
	Ife	67 (10)	65	48	16	55	6	64	55	34
	Ilesha	53 (10)	75	55	11	58	11	70	49	30
	Osogbo	85 (12)	67	53	11	59	8	60	45	28
Ogun	Egba	39 (8)	70	46	8	49	18	44	28	23
	Egbado	53 (10)	66	24	6	40	21	59	40	17
	Ijebu	9 (4)	78	33	0	44	0	33	22	22
Bendel	Ekiadolor	10 (3)	50	40	10	10	0	0	10	20
	Igara	7 (4)	59	29	0	0	0	0	0	14
	Uhonmora	10 (7)	60	40	0	20	10	0	10	10
	Mean		67.3	41.0	7.2	42.2	7.9	45.2	31.6	20.2
	S.E.		2.3	2.6	1.5	5.5	1.3	7.8	4.1	2.3

\* Figures in parenthesis represent the number of farms physically visited to verify the correctness of the claims by the farmers.

### 3. Results

The survey revealed that there are at least 18 principal crops usually interplanted with cocoa with plantain, cocoyam, oil palm and kola being the most prominent (Table 1). Other crops such as guava, mango, pawpaw and a few vegetables such as celosia, okra and solanum occur in very few cocoa farms. Among the food crops, plantain is the most commonly interplanted crop with cocoa followed by cocoyam and cassava in that order. Oil palm is the most popular intercrop among the tree crops followed by kola and coffee respectively. Among some other crops interplanted with cocoa there is no significant difference between the combination of ewe-iran and ewe-gbodogi combined and african walnut.

Almost all the farmers interviewed interplanted cocoa with other crops – less than 1% planted cocoa alone without any other crop (Table 2). Specifically, none of the farmers in seven out of the 13 circles in all the four states planted cocoa alone. A majority of the farmers interplanted as many as 5 to 6 other crops with cocoa while as high as 86.86% of all the farmers interviewed interplanted cocoa with at least three other crops. Figure 3 shows some of the various crops interplanted with cocoa.

Food crops are more popular as intercrops with cocoa than tree crops. However, the combination of both in cocoa plantations was the most popular practice (Table 3). It is rather rare to find other plants such as ewe-iran, ewe-gbodogi, african walnut and other medicinal plants alone or in combination with food crops. However, they are more likely to be found planted along with other tree crops in cocoa farms.

Intercropping in cocoa plantations take place in both young and old cocoa farms as over 90% of all the farmers interviewed admitted interplanting other crops in both young and old cocoa plantations (Table 4).

### 4. Discussion

The data from the present study show that mixed culture is a common practice among the Nigerian cocoa farmers. However, the mixed culture as practised is neither systematic nor based on any proportionate arrangement. In most cases, what one finds are seemingly monoculture cocoa plots with other crops interspersed within the cocoa trees (Fig. 4). The ratio of the other crops to cocoa can be small and this is why it is possible to find as many as six and even more other crops interplanted with cocoa on the same plot (Table 2) (Fig. 3). Exceptional cases are when the cocoa plantation is young and some food crops are planted to provide ready source of income

Table 2. Distribution of farmers (%) according to the degree of admixture of the intercropping

State	Circle	No. of farmers interviewed	Cocoa with		Cocoa with		Cocoa with		Cocoa with		Cocoa with	
			no other crop	other crops	1-2 other crops	3-4 other crops	5-6 other crops	more than 6 other crops				
Ondo	Ondo	85	3	12	26	46	19					
	Owo	116	2	10	20	58	10					
Oyo	Ekiti	73	2	14	21	56	7					
	Ibadan	61	0	15	30	48	7					
	Ife	67	0	18	27	45	10					
	Ilesha	53	2	14	24	47	13					
Ogun	Osogbo	85	1	12	29	48	10					
	Egba	39	0	13	33	41	13					
	Egbado	53	1	11	30	45	13					
	Ijebu	9	0	11	33	44	11					
Bendel	Ekiadolor	10	0	10	30	50	10					
	Igara	7	0	14	43	43	0					
	Uhonmora	10	0	10	40	40	10					
	Mean		0.9	12.6	29.6	47.0	10.2					
S.E.		0.2	0.7	1.8	1.5	1.2						

Table 3. Distribution of farmers (%) according to types of crops intercropped with cocoa

State	Circle	No. of farmers interviewed	Cocoa with food crops alone	Cocoa with tree crops alone	Cocoa with other plants alone	Cocoa with food and tree crops	Cocoa with food crops and other plants	Cocoa with tree crops and other plants	Cocoa with food crops and other plants
Ondo	Ondo	85	15	12	1	40	2	10	18
	Owo	116	18	10	2	42	3	15	10
	Ekiti	73	17	13	1	45	0	13	11
Oyo	Ibadan	61	14	12	0	40	0	14	20
	Ife	67	16	12	1	47	1	13	10
	Ilesha	53	14	15	0	48	1	13	9
Ogun	Osogbo	85	14	13	1	47	1	13	11
	Egba	39	13	13	0	48	0	13	13
	Egbado	53	14	14	0	50	0	14	8
	Ijebu	9	11	11	0	67	0	11	0
Bendel	Ekiatolor	10	10	10	0	50	0	20	10
	Igara	7	14	0	0	43	0	28	14
	Uhonmora	10	10	10	0	60	0	20	0
	Mean		13.9	11.2	0.5	48.2	0.6	15.2	10.3
	S.E.		1.0	1.0	0.2	2.1	0.3	1.4	1.5



Table 4. Distribution of farmers (%) according to the age of cocoa when intercropped

State	Circle	No. of farmers interviewed	Intercropping in young cocoa plots alone	Intercropping in old cocoa plots alone	Intercropping in both young and old cocoa plots
Ondo	Ondo	85	3	3	94
	Owo	116	4	3	93
	Ekiti	73	5	5	90
Oyo	Ibadan	61	8	5	87
	Ife	67	6	8	86
	Ilesha	53	3	5	92
Ogun	Osogbo	85	5	8	87
	Egba	39	0	5	95
	Egbado	53	2	2	96
Bendel	Ijebu	9	0	0	100
	Ekiadolor	10	0	0	100
	Igara	7	0	0	100
	Uhonmora	10	0	0	100
	Mean		2.8	3.4	93.9
	S.E.		0.8	0.8	1.5

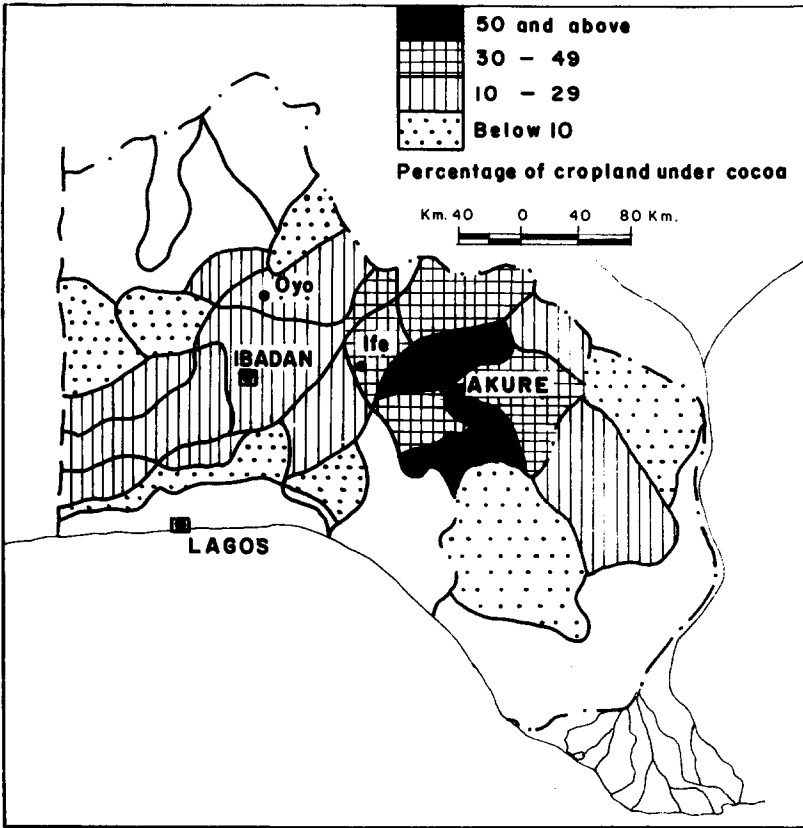


Fig. 2. Map of Western Nigeria showing land use under cocoa.

or plantains planted to provide shade for the young cocoa trees. In cocoa plantations where ewe-iran, ewe-gbodogi or aligator pepper are planted as intercrops, they spread through their rhizomes over a large area within the plantation under the shade of cocoa (Fig. 4B).

Plantain is the most popular crop planted with cocoa among the Nigerian farmers. This is because farmers are generally advised to use the crop as shade for the newly transplanted cocoa seedlings and also as a means of recovering the cost of establishment. Cocoyam came second because this is a shade tolerant crop which, apart from providing tubers for both consumption and sale, is well known for its weed growth suppressing ability.

Generally, food crops are more popular as intercrops than either tree or other crops partly because the soils of cocoa belt are particularly suitable for growing most staple food crops like plantain, cocoyam, yam, cassava, maize and melon. However, a limited amount of land is available for food production (Fig. 2; Table 5). Taungya system has been introduced to satisfy the

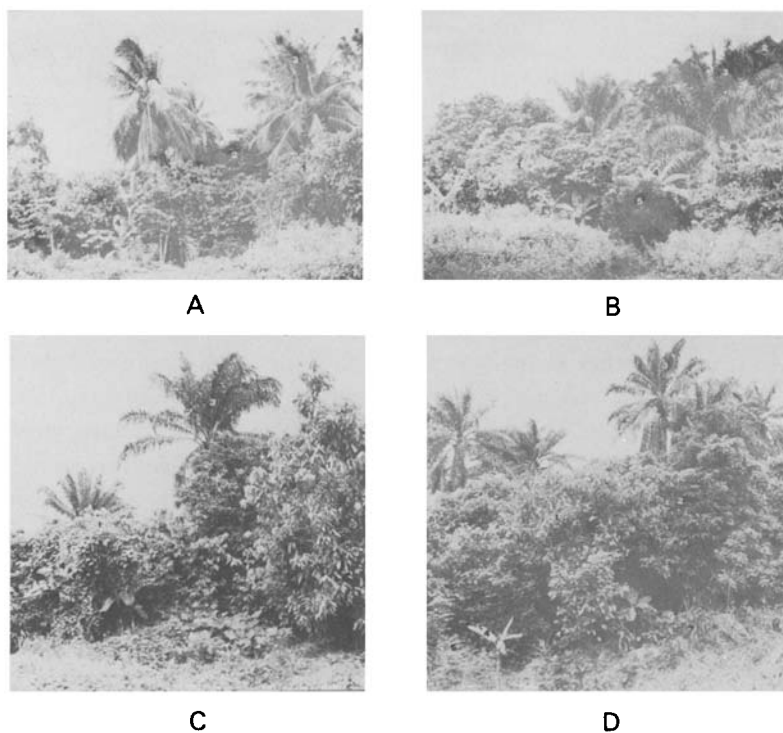


Fig. 3.

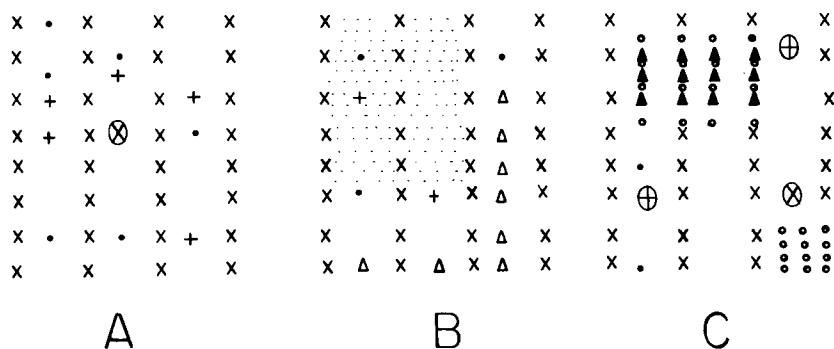


Fig. 4. Schematic presentation of some planting patterns of intercropping with cocoa.  $\times$  = Coca,  $\bullet$  = Plantain,  $+$  = Oil Palm,  $\otimes$  = *T. conophorum*/*P. guineense*,  $\cdot$  = *M. macrostachyum*/*S. brachystachys*/*A. melegueta*/Cocoyam/Pineapple,  $\Delta$  = Coffee,  $\blacktriangle$  = Cassava,  $\bullet$  = Maize,  $\oplus$  = Citrus.

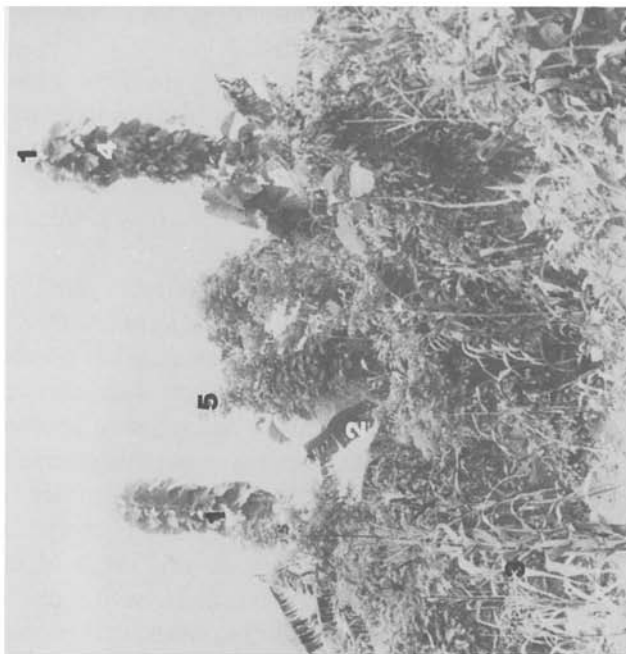
Table 5. Population growth in Ondo, Oyo, and Bendel States of Nigeria

States	1963 Census (million)	1984 Estimate (million)	Land Area (Thousand) (ha)
Ondo	2.728	4.573	2,096
Oyo	5.209	8.732	3,771
Ogun	1.551	2.600	1,676
Bendel	2.536	4.251	3,550

need for both tree and food crops production in areas close to the forest reserves (Fig. 5). Other farmers have had to resort to planting of food crops within cocoa plantations to produce at least part of the necessary food for their families. Thirdly, population density in cocoa producing areas of Nigeria has witnessed a phenomenal increase in the past twenty years (Table 5). This means a reduction of available hectareage per person for farming activities. Added to these factors is the astronomical rise in producer price of cocoa from N1,600.00 per tonne in 1985 to N8,000.00 per tonne in 1987. Thus all available lands, including marginal lands which have hitherto not been used for cocoa production, are now planted with cocoa. All these factors thus compel the farmers to plant food crops with cocoa during the establishment of the plantations as well as among pre-existing cocoa plantations especially on the vacant places created by missing stands and dead/aged trees (Fig. 4C).

The types of tree crops planted with cocoa are determined by a number of factors. Both the soil and climate of the Nigerian cocoa belt have been found suitable for the production of oil palm, kola and coffee. Thus, these tree crops have always been planted with cocoa to provide additional foreign exchange to that obtainable from cocoa exportation [Agboola, 1979]. Guava is not a popular fruit tree among the citizens but has been planted with cocoa in a few plantations, while mango is principally found in backyards and gardens as well as in dry savanna areas. The Nigerian cocoa belt is far removed from the coastal areas where coconut thrives well. Thus only in a few cocoa plantations are some scattered trees found with other intercrops (Fig. 3A).

African walnut are planted at the bases of some medium sized trees within the cocoa plantations and they use such trees for support. Its nuts are eaten after proper cooking. Both ewe-iran and ewe-gbodogi grow as understorey within the cocoa plantations. Their leaves are used to wrap foodstuffs both for preservative and aesthetic purposes. Before the introduction of zinc, aluminium or asbestos sheets for roofing, ewe-gbodogi was commonly used for roofing houses, especially, in the rural areas and it is one of the special



B



A

Fig. 5.

leaves used for wrapping kola nuts [Ibikunle, 1974]. Thus, these species serve as sources of extra income to the farmer.

Medicinal/spice plants such as aligator pepper and iyere are compatible with cocoa in that while the former grows as understory under cocoa plantation, the latter uses the remaining overhead trees within the cocoa plantation as support for its growth. Both produce fruits whose seeds are highly cherished by the traditional medicine practitioners. In some places, iyere is used for preparing soup and some dishes.

The comparative differences in popularity of intercropping among the four states are due to the relative amount of land left for other crops. An average Nigerian cocoa farmer does everything possible to maximise the use of available land by planting as many as six or even more other crops with cocoa. The level of complexity of the mixed culture may appear high but when it is realised that the fractional composition of these companion crops is low in most cases, one comes to the realisation that the primary aim of the farmer is cocoa production while other crops are sparingly included to maximise land use as well as satisfy socio-economic needs of the farmer.

The distribution of the farms on the basis of the types of crops interplanted with cocoa (Table 3) is a pointer to the needs of the farmers and apportionment of priorities. Food crops are the most popular followed by the tree crops. About 60% of all the cocoa farms interplanted with other crops contain food crops.

Intercropping in both young and old cocoa plots account for over 90% of all cocoa farms intercropped (Table 4) because some of the crops interplanted with cocoa in the earlier parts of its growth are still retained, in addition to others which may be added when the plantations are old. Typical examples are plantain, cocoyam, oil palm, kola, coffee and some other plants.

## **5. Conclusion**

It is a common practice among the Nigerian cocoa farmers to interplant cocoa with other crops. There are more than 18 different crops that are thus interplanted with cocoa. Such crops include food and tree crops, medicinal/spice plants and some other compatible and useful plants. The complexity of the admixture may be as many as six or more other crops coexisting on the same piece of land with cocoa. Intercropping occurs in both young and old cocoa plots. This is purposely to satisfy some other needs of the farmers in the face of high demand for limited land resources. However, the practice of intercropping is haphazard as most crops interplanted with cocoa are

invariably not subjected to proper layout, definite proportion/population and monitoring. Thus there is a need for agricultural scientists to devote more attention to research on tree crop based agroforestry in this part of the world. For example, more than ever, the need arises to know precisely the benefits accruable from the tree crop based farming systems, the timing and sequence of intercropping, the limitations of the practice, the most appropriate combination(s), complexity and proportion of the individual components.

From the findings of a few trials carried out at the Cocoa Research Institute of Nigeria (CRIN), Ibadan, it has been found that both cocoa and kola can be successfully and profitably intercropped [Oladokun and Egbe, 1989] while total yield obtainable from cocoa/oilpalm mixed culture recommends its practice to a willing farmer provided he uses hollow square planting [Onwubuya et al., 1982; Afolami and Ajobo, 1983; Kolade, 1986]. More of such findings are needed before one can embark on the campaign of rationalising the practice of intercropping in cocoa plantations in the country. The average farmer will need a rather substantial and convincing evidence before he can scale down the number of crops he interplants with cocoa from six or more to only one and in definite order and proportion for that matter.

## 6. Acknowledgement

The author is grateful to all the staff of the Cocoa Development Units of Ogun, Ondo and Oyo States and Tree Crop Unit of Bendel State, Nigeria, for their invaluable contribution to the success of the survey.

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