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COWPEA (VIGNA UNGUICULATA (L.) WALP.) : TRADITIONAL AND IMPROVED CROPPING METHODS IN NORTHERN NIGERIA

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Current research deals with the physiology of Euphorbia tirucalli (a desert plant and possible source of bio-energy) and with the physiology and agronomy of tropical vegetables.

SUMMARY

The present article describes the traditional cowpea cropping system in Dambatta, Kano State, Nigeria. Through a baseline survey it becomes clear that traditionally cowpea is mostly intercropped with cereals, that the importance of land preparation is marginal, that yields are low and that, in general, the technical level of the cowpea grower is low (low inputs of fertilizer and pesticide). In a second part some data are given about a project that introduced a new

Figure 1: Vigna unguiculata (L.) Walp.; a: flowering stem, b: stem with a leaf and pods, c: leaf, d: pod with seeds (from BERHAUT, 1976)

cowpea variety, T.V.X.-3,236, and improved methods. It is shown that, although better yields are possible, the extension service does not succeed in motivating the farmers enough so that the outcome of the project intervention is uncertain.

KEYWORDS : Vigna unguiculata, cowpea, Nigeria, extension.

1. INTRODUCTION

Cowpea (see fig. 1) is a leguminous crop. It belongs to the same family (Leguminosae) as soybean, groundnut, acacia and many other species with economic value. Pulses (beans and peas s.l.) are highly appreciated by consumers because of the high protein content of their seeds, and the various, simple ways by which different other parts of the plant can be prepared. Cowpeas are typically grown for the dry seeds, which are cooked and eaten together with such staples as cereal grain and starchy foods (e.g. yam, cassava). In Africa and Asia people also consume the young leaves or leafy shoots. They are cooked and eaten with other ingredients in sauces. Peduncles are retted in northern Nigeria and Senegal. Other crop products are fed to animals. After harvesting dry plant material is used for animal feed.

About 4 million hectares are annually grown with cowpea in Nigeria (Table 1). Cowpea is a very popular crop amongst farmers, especially in the North, where it is well adapted to the climatic conditions. It is the fourth most important food crop in Nigeria, but people grow it, in the first place, as a cash crop.

Because of the short growing cycle cowpeas are often used as a second crop after, or together with, e.g. a cereal. In traditional agriculture in Nigeria cowpeas are thus usually

intercropped with sorghum and millet (Sorghum bicolor and Pennisetum americanum). This results in a relatively small number of plants per ha (definition of "stand density") : populations of 1,000 plants/ha, or less. This, together with the absence of fertilizer or pesticide applications, furthermore results in small yields : 120-160 kg/ha for the northern part of Nigeria. SLADE (1977) reports yield averages of only 88 kg/ha, for the lowland tropics of West Africa. Official figures for Nigeria are given in table 2.

Table 1. Area cultivated with pulses (esp. Vigna unguiculata) in Nigeria (x 1,000 ha ; F.A.O., 1980-1983)

Year	1978	1979	1980	1981	1982	1983
Area	4,110	4,115	4,116	4,125	4,318	4,120

Table 2. Yields (kg/ha) for pulses (esp. Vigna unguiculata) in Nigeria (F.A.O., 1980-1983)

Year	1978	1979	1980	1981	1982	1983
Yield	207	215	219	219	218	204

For several years the International Institute of Tropical Agriculture (Ibadan, Nigeria) has been developing new cowpea varieties for a number of different ecological zones. The vulgarization of these varieties has to be taken care of by local extension organizations.

In Kano, the northern state of Nigeria, the introduction in 1983 of a new cowpea variety, together with improved cropping patterns and modern technology was part of a World Bank project (1981-1986). This so-called "cowpea packet" was intended to enable the local farmer to rise above the subsistence farming level and to create the

possibility of having a marketable surplus, thus involving the farmer in modern, money based economy.

This article describes some technical aspects of the traditional and improved cropping methods. The first part elaborates on traditional cropping methods in Kano. Data were obtained from the FRADYS-survey (1) which was conducted by KNARDA (1) from May till November 1982. These data were processed by PEARSON and treated by the authors. The second part of the article describes the improved cropping methods proposed through the World Bank project, and their influence on yields. Data were obtained from research and a survey conducted by one of the authors from August till November 1983.

Both these studies are the technical and scientific basis for the last part where general conclusions are drawn, and where the cowpea packet approach is related to similar experiences in other countries.
Later on, a second article will describe some social and economic implications of the cowpea packet.

2. TRADITIONAL CROPPING METHODS

2.1. Sampling methodology

Kano State (figure 2) is divided into four zones (figure 3). The FRADYS-survey was conducted in Dambatta Zone II, which is divided in 7 regions. Each region is governed by a Local Government. A random sample of villages within each Local Government Area (L.G.A.) was taken, based on the village listing from January 1982. Within the selected villages, a random sample of houseboulds was taken. 217 households were selected from the Zone and a survey was carried out on the land cultivated by these households giving a total of 540 plots. A plot was defined as an area with a uniform cropping pattern.

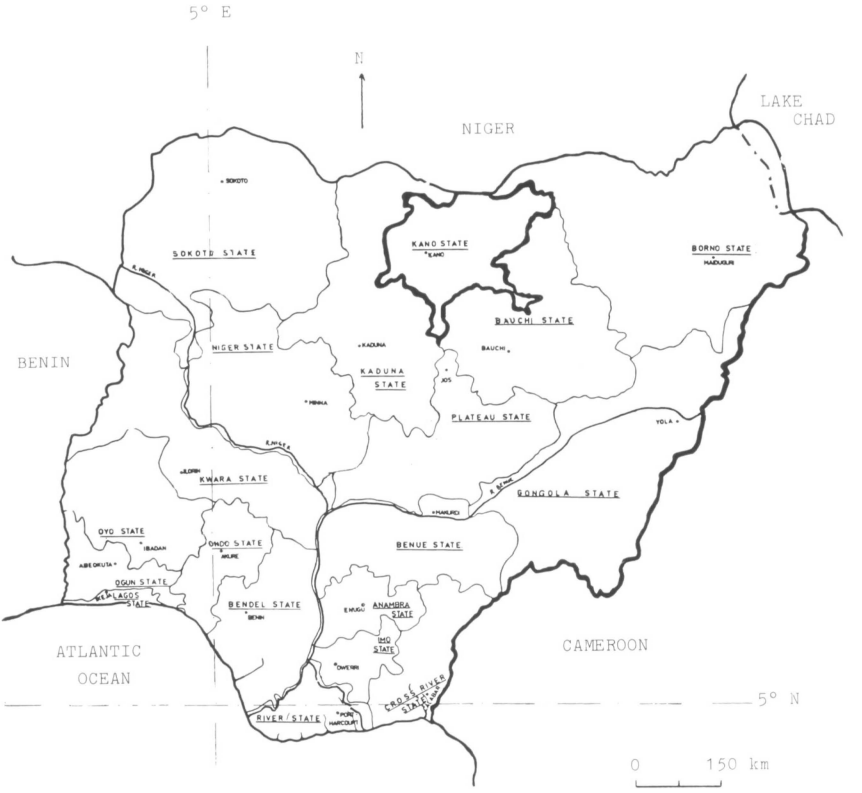

Figure 2: The 19 states of Nigeria

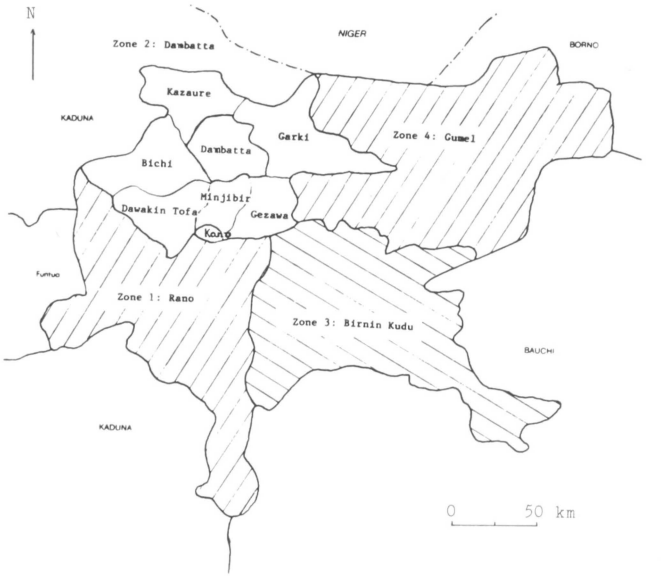

Figure 3: The 4 agro ecological zones of Kano State

2.2. Farm size per Local Government Area

The mean area cultivated by a household in Dambatta Zone II is 2.63 ha. The largest area per household is in Kazaure L.G.A., i.e. 7.83 ha. This can be explained on the one hand by the fact that Kazaure lies in the north of Kano State. This area has a majority of Fulani farmers (2a). These have larger farms than the Hausa farmers (2b) who make up the majority of the population in the rest of the State. On the other hand, there is the drought which is more of a problem in the northern parts of the Zone, and obliges farmers to cultivate a larger area of land to ensure self-sufficiency for their household.

The proximity of Kano City and the greater population in those areas explain why one can find the smallest land area per household in Minjibir and Dawakin Tofa : 1.45 and 1.59 ha, respectively (table 3).

Table 3. Farm size per Local Government Area (L.G.A.) in Dambatta (Kano State)

L.G.A.	Mean plot size (ha)	Mean Number of plots per household	Mean area farmed by a household (ha)
Bichi	0.473	3.75	1.77
Dambatta	0.587	4.85	2.85
Dawakin Tofa	0.413	3.85	1.59
Garki	0.769	2.48	1.91
Gezawa	0.441	4.42	1.92
Kazaure	1.720	4.55	7.83
Minjibir	0.446	3.25	1.45
Total for Zone II	0.678	3.88	2.63

Source : FRADYS-survey, 1982

2.3. Localization of the plots

67% of the fields are situated at a distance of less than 1 km of the farmer's dwelling ; 14 % lay further than 2 km. There is, however, a difference between Hausa and Fulani farms. Fulani farmers live scattered, each household having its fields near the house. The Hausa live together in settlements and their fields are at a distance of the house. This type of organization has another consequence as well : Fulani farms mostly consist of one large piece of land, near the house, whilst the plots making up one Hausa farm are scattered and small.

For 61 % of the plots, the distance to a road is less than 1 km, for 26 % of the plots, it is more than 2 km. A road was defined as a path on which a motorized vehicle can pass during the rainy season.

Normally, these percentages would vary according to the season during which the survey is done. But estimates of the distance from plot to road in the dry season have hardly any sense at all because land lies fallow during the dry season and this makes it difficult to ascertain whether it has been or will be used for agriculture.

2.4. Land preparation methods

One can distinguish several land preparation methods :
- planting ridges are made before sowing, by hand, oxen plough or, in a few cases, by using a tractor ;
- sometimes the furrows of the previous growing season are used and the new crop is sown in the furrows between the ridges ; after germination, the old ridges are broken up, and new ridges are made against the young plants ;
- another method consists in sowing the crop on the ridges from the previous year and to ridge up again after germination ;

- very often, farmers sow onto flat, unprepared land, leaving the soil as it is for the whole growing season.

The sowing is done by two persons. The first person makes a plant hole using a piece of wood. The second person throws two or three seeds in the hole and covers them with sand. Thinning is done three weeks after seedling emergence.

Table 4. Land preparation by plot area

Plot area (ha)	Parameter (1)	Land preparation: no preparation	hoe	oxen & plough	other methods	Total
< 0.5	a	44.9	17.1	25.9	3.6	91.5
	b	194	81	106	18	399
0.5-1.0	a	33.6	12.3	24.8	3.9	74.6
	b	49	19	32	6	106
1.0-1.5	a	7.6	4.9	6.7	2.2	21.4
	b	6	4	6	2	18
> 1.5	a	24.0	8.2	8.5	0	40.7
	b	9	4	4	0	17
Total	a	110.1	42.5	65.9	9.7	228.2
	b	258	108	148	026	540

(1) a: plot area in ha; b: number of plots
Source : FRADYS-survey, 1982

Table 4 shows that on 48 % of the plots in the survey no land preparation is done before sowing. On the other plots, land preparation is done in 53 % of the cases with oxen and plough and in 38 % of the cases with a hoe. It is interesting to mention that 74 % of the fields are smaller than 0.5 ha ; 49 %

Cowpea plants with flowers and young pods

Table 5. Yields (kg/ha) of the most important crops by Local Government Area

L.G.A.	Parameter (1)	Sorghum (*Sorghum bicolor* (L.)Moench)	Early millet (*Pennisetum americanum* (L.) Leeke)	Late millet (*Pennisetum americanum* (L.) Leeke)	Cowpea (*Vigna unguiculata* (L.) Walp)	Groundnut (*Arachis hypogaea* L.)
D. Tofa	a	709	- (2)	288	136	855
	b	74	46	63	70	28
Dambatta	a	825	1,055	291	161	300
	b	42	53	29	82	6
Garki	a	551	797	1,333	204	253
	b	73	76	4	84	10
Kazaure	a	222	639	0	27	221
	b	60	60	0	54	18
Gezawa	a	946	1,042	797	103	723
	b	66	43	15	84	15
Minjibir	a	867	828	286	209	680
	b	73	58	41	85	19
Bichi	a	956	785	409	50	1,168
	b	64	34	29	79	21
Weighted mean for Zone II	a	680	757	403	123	596
	b	64	51	29	77	18

(1) a : mean yield (kg/ha) ; b : % of the plots on which the crop is grown

(2) - : missing value

Source : FRADYS-survey, 1982

of these small plots receive no form of land preparation before sowing, indicating that plot size is not a determining factor as far as choice of land preparation form is concerned.

2.5. Crop yields by Local Government Area

Almost all crops are grown in a crop mixture.

Table 5 shows that cowpeas are grown on 77 % of the plots. Yields are very low : 123 kg dry beans per ha for Zone II (Standard deviation = 55 kg/ha).

When grown as a monocrop and in optimal conditions, a traditional variety yielded 548 kg per ha, while an improved variety, T.V.X.-3,236, yielded 1,958 kg per ha. Low yields are thus only partly explained by the habit of intercropping. A second reason is to be found in the fact that cowpeas are often grown for the hay, the dry beans thus being of no use or interest. This is surely the case in Kazaure (27kg/ha) where the majority of the population consists of cattle raising Fulani farmers.

It is remarkable that cowpeas are grown on such a large acreage, if one considers that cowpea is not a major staple food. Farmers, however, claim that they also grow cowpeas "to protect the other crops against insect damage".

2.6. Crop mixtures

The most frequent crop mixtures are :
1. Sorghum, cowpea
2. Early millet, cowpea
3. Late millet, cowpea
4. Sorghum, early millet, cowpea
5. Sorghum, early millet, late millet, cowpea

Table 6. Crop yields (kg/ha) by crop mixture (the figures in the first column refer to the numbering in the text under 2.6.)

Crop mixture	Sorghum	Early millet	Late millet	Cowpea	Groundnut	Acreage (ha)	nr. of plots
1.	948	-	-	97	-	19.51	51
2.	-	1,083	-	109	-	27.96	64
3.	-	-	935	87	-	8.93	23
4.	731	819	-	149	-	49.07	89
5.	776	491	183	138	-	10.92	33
6.	289	571	-	123	518	14.45	20
7.	770	-	250	177	1,171	4.10	12

Source : FRADYS-survey, 1982

6. Sorghum, early millet, cowpea, groundnut
7. Sorghum, late millet, cowpea, groundnut

These crop mixtures are representative for 57 % of the plots in the survey. Sorghum - early millet - cowpea is the most frequent crop mixture (16 % of the plots, and 21.5 % of the area under survey).

Table 6 gives an idea about the yields of the different crops when intercropped . In Table 7 yields and stand counts of the different crops are related to the number of crops in the mixture.

As could be expected, the mean stand count decreases as the number of crops in the mixture increases. At the bottom of each column in table 7 the correlation coefficient, r, for the regression of mean yield (a) on mean stand count (b) for a certain crop is given. For all crops but cowpea the r-value is positive. For sorghum and early millet the value of the correlation coefficient is high which suggests that, as can be expected, the yield per ha of a crop increases up to a certain level as stand density increases.

For cowpea however, the value of r is high and negative (-0.72). The reason could be that as stand density of traditional cowpea varieties increases, the possibility of pest damage increases likewise. Traditional varieties give spreading plant types. Some of the major insect pests (legume pod borers ; Maruca testulalis) can infest a whole plot through contact points between plants. Spreading types thus make infestation easier, and result in smaller crop yields. Sorghum and millet have an erect habitus. Even with a high stand density their foliage does hardly touch. Moreover, farmers cut away the lower overhanging leaves to feed their cattle as it is kept in an enclosure during the rainy season. Furthermore, most of the insect pests on sorghum and millet do not depend on touching plant parts for infestation, so that insect population dynamics are not influenced by plant architecture.

Table 7. Crop yields by number of crops in a crop mixture

Number of crops in the mixture	Parameter (1)	Sorghum	Early millet	Late millet	Cowpea	Groundnut
1.	a	975	768	600	-	408
	b	54	52	59	-	278
2.	a	866	993	880	102	415
	b	56	47	71	28	131
3.	a	700	794	338	138	657
	b	35	31	20	18	140
4.	a	533	507	215	142	582
	b	42	25	59	17	128
5.	a	383	301	345	64	589
	b	18	18	12	24	83
	r	0.88	0.83	0.58	-0.72	0.60

(1) a : mean yield (kg/ha) ; b : mean stand count (number of plants/0.01 ha) ;
r : regression coefficient of mean yield (a) on mean stand count (b) for the crops under survey.

Source : FRADYS-survey, 1982

Crop mixture in traditional farming consisting of cowpea, groundnut, peppers, and yam

Table 8. Crop yields for 5 major crops according to sowing date

Sowing date	Parameter (1)	Sorghum	Early millet	Late millet	Cowpea	Groundnut
Before 24 May	a	616	41	281	92	444
	b	47.96	45.96	12.28	48.28	17.71
	c	95	88	38	106	27
24 May - 6 June	a	840	921	456	153	734
	b	46.39	34.65	21.72	54.84	10.77
	c	120	76	54	134	37
7 June - 20 June	a	699	793	290	156	571
	b	34.03	38.31	6.99	47.29	6.77
	c	74	80	25	103	15
21 June - 4 July	a	581	481	551	73	843
	b	16.76	7.16	9.67	19.96	4.50
	c	43	22	30	57	12
After 5 July	a	290	772	324	33	1,108
	b	7.8	4.79	3.26	8.45	1.36
	c	17	8	10	16	92

(1) a : mean yield (kg/ha) ; b : total acreage (ha) ; c : number of plots

Source : FRADYS-survey, 1982

2.7. Sowing date

Table 8 shows that almost all crops give the highest yield when they are sown between 24 May and 6 June. Cowpeas, however, yield more when they are sown in the fortnight that follows.

The largest acreage of sorghum and millet is sown before 24 May although eventual yields are clearly low. Early millet is sown as early in the growing season as possible. The whole production cycle takes only 3 months. This enables farmers to harvest as early as by the end of July, or mid August, when the crop is sown before 24 May. The earlier they can harvest the better it is, as food stocks tend to deplete as the rainy season advances - the rainy season being a possible period of acute food shortage in a lot of traditional farming communities. Sowing early in the rainy season is rather risky, however, as the rains are unevenly distributed in time and intensity. This can result in a lot of plots not receiving enough water and, as a consequence, the drying out of plants. This influences the further development of the plants in a negative way. By sowing early the farmer takes some chances on the weather being good for plant development. If weather conditions are bad (uneven rain distribution) he will have to do some replanting later on. This will ensure better yields, but harvests will be later.

Sorghum is also sown with the onset of the rainy period, the reason being that farmers want to have a very long growing season. Local sorghum varieties are photosensitive and all start flowering at the same time in September. Thus, how earlier the sowing date, the longer the vegetative development can go on, the larger the plants will be and the better the yields will be. The final size of the panicle (represented particularly by the number of fertile florets) is closely related to the size of the plant and the rates of dry matter accumulation before flowering. Grain growth, representing the storage of material from current photosynthesis in the leaves and panicle, together with material remobilized from temporary storage sites in other

plant parts (upper leaves and stem internodes) is also related to earlier plant development (PEACOCK and WILSON, 1984). This physiological system is the same for late millet which has a total cycle of about 150 days.

From the reasoning about early millet it is clear that local farmers try to achieve risk minimalization rather than yield maximalization : they want to harvest as quickly as possible even if, by sowing early, yields are low. Minimizing the risks is also a major reason for the intercropping system they use.

2.8. Fertilizer application

69% of the plots received organic fertilizers (animal dung). Inorganic fertilizers had been applied on only 17% of the plots.

Table 9. Yields for sorghum, early millet and cowpea in relation to the application of organic fertilizers

Organic fertilizers	Parameter (1)	Sorghum	Early millet	Cowpea
no	a	637	611	110
	b	91	54	119
yes	a	693	792	129
	b	257	219	295

(1) a : mean yield (kg/ha)
b : number of plots

Source : FRADY-survey, 1982

Farmers who applied organic fertilizers obtained slightly higher yields for sorghum and early millet (table 9). There are no data available on the quantities of organic matter that were used.

3. IMPROVED COWPEA CROPPING METHODS

3.1. The new cowpea variety, T.V.X.-3,236

The new variety was obtained at I.I.T.A. (International Institute of Tropical Agriculture) at Ibadan, Nigeria. T.V.X.-3,236 is a high yielding variety, with a growing cycle of 90 days and synchronous flowering. The plant is half erect and the long peduncles lift the pods above the plant. This makes the spraying of pesticides more efficient and enables the farmer to harvest the pods more easily than with traditional varieties.
Up to this moment, T.V.X.-3,236 is the only variety which is said to be partly resistant against aphids. After several back crosses, this variety obtained some resistance against the cowpea seed beetle (Callosobruchus maculatus Fab.). This beetle can cause up to 60% damage during the storage of the beans. Furthermore, this variety is resistant against several plant diseases : web blight (Rhizoctonia solani), anthracnose (Colletotrichum lindemuthianum) and brown blotch (Colletotrichum capsici).

3.2. Organization and technical aspects of the cowpea packet

There are 976 farmers in Zone II growing the new cowpea variety in cooperation with the project. They are divided in

groups of 7 to 10 farmers, each group under the supervision of a village extension adviser.

The new variety and techniques are introduced during a first year, under the supervision of these extension advisers. From the second year onwards farmers are supposed to be able to use these methods on their own without further monitoring.

The farmers are asked to grow the new cowpea cultivars on a 0.5 hectare plot (3) which has been cultivated with cowpeas for two successive years.

Before land preparation starts, fertilizer (200 kg/ha, N.P.K. : 15-15-15) is broadcast by hand (4). If necessary, farmers can use herbicides to clear their land from weeds. Land preparation consists of harrowing and ridging, which is done with tractors from the project. Ploughing is not necessary because the soil is too sandy. Sowing is done on lines, by means of a handplanter from the project at a rate of 10 kg of seed per ha.

Application of pesticides is done with a new type of hand sprayer, the Electro-Dyn-sprayer. The use of the E.D.-sprayer is a recent introduction, the most widely used type in West Africa being the knapsack sprayer. The application of pesticides with the knapsack sprayer is a hard job though : the minimum quantity of water required is 200 l/ha, each row has to be treated separately ; the making of mixtures takes time and requires knowledge and training. SINNER et alii (1983) calculated that it takes 2 mandays to treat 1 ha of cowpea. For this reason knapsack sprayers are gradually replaced by Electro-Dyn-sprayers and even more widely by Ultra Low Volume sprayers. Using an E.D.-sprayer, two rows of cowpeas can be sprayed with each passage. The entomologists of I.I.T.A. advise two insecticide applications against aphids. The village extension advisers have to spray a first time 35 days after germination. A second spraying should follow after approximately 15 days. If necessary, a third spraying is done. The village extension advisers are supposed to learn the farmers how to handle the sprayer.

The pesticide, Cymbush E.D. (Cymbush Electro-Dyn) is sprayed at a dose of 500 ml per ha ; 500 ml of the liquid contains 15 g cypermethrine and 20 g dimethoate. Dimethoate is a systemic insecticide and kills aphids and bugs. Cypermethrine, a pyrethroid, kills thrips and legume pod borers.

If the farmers do not use herbicides, they are asked to weed three times.

Handbroadcasting of fertilizers, land preparation, sowing, spraying of pesticides and, if necessary, application of herbicides, are done by the project people during the first year of the execution of the cowpea packet. The farmers , however, are expected to do the weeding and harvesting of the crop. The village extension advisers are responsible for the execution of the complete production plan.

3.3. Evaluation of the intensive growing of cowpea

3.3.1. Sampling method

Five villages were selected ad random out of the 16 villages of the Dambatta Local Government Area where the cowpea packet was introduced. Two villages from the south of Kazaure L.G.A. were added. All farmers working with the packet were questioned, giving a total number of 65 (table 10). Through a survey (questionnaire) it was tried to get an idea about the adoption of new techniques and technology and about the financial implications of these introductions. The survey was done orally, in English, with a Hausa interpreter. Field measurements were done without previous notice. The area cultivated with cowpea was measured and the yield estimated through harvesting a triangular plot of 100 m2 within the cowpea field. The harvest was conducted by the village extension adviser. The figures that were obtained were used to calculate yield in kg dry cowpea beans per ha.

Table 10. Number of farmers questioned in each village

L.G.A.	Village	Number of farmers
Dambatta	Makoda	8
	Dambatta	9
	Kadandani	7
	Ajumawa	8
	Wailare	9
Kazaure	Kazaure	14
	Dansure	10
Total		65

3.3.2. Mean acreage of the cowpea plots (table 11)

Only in Kazaure, the mean acreage of the cowpea plots got near the 0.5 ha put forward by the project. In Ajumawa and Dansure, the mean acreage did not reach 0.25 ha.

Table 11. Mean acreage (in ha) of the cowpea plots in each village together with standard deviation (s) and coefficient of variation (c)

Village	Mean plot size	s	c
Makoda	0.30	0.13	43
Dambatta	0.37	0.11	30
Kadandani	0.35	0.13	37
Ajumawa	0.22	0.04	18
Wailare	0.28	0.07	25
Kazaure	0.44	0.12	27
Dansure	0.23	0.06	26
Mean	0.31		

This can be explained by the fact that the farmers are

rather distrustful and do not want to "sacrifice" more land to something which they are not familiar with. On the other hand, it is also possible that the village extension advisers intentionally mark out a smaller area, to lighten their work.

3.3.3. Yields and influences of different agricultural interventions

Table 12. Mean yields (kg dry beans/ha) for T.V.X.-3,236 cowpea fields in the surveyed villages

Village	Mean yield
Makoda	697.6
Dambatta	650.0
Kadandani	442.2
Ajumawa	377.0
Wailare	703.5
Kazaure	919.8
Dansure	1,072.2
Mean	694.6

The mean yields for each surveyed village are given in table 12. In the following paragraphs, the influences of different agricultural interventions and inputs on these yields are examined.

3.3.3.1. Land preparation

Land preparation consists of harrowing and ridging the soil.

As can be derived from table 13 slightly more plots have been prepared by animal traction than by tractor. This is rather strange because farmers do not have to pay for the use of a tractor during the first year of the execution of the cowpea packet.

Table 13. Form of land preparation of cowpea plots in each surveyed village and mean yield (kg/ha) for the two main methods for a total of 65 farmers

Village	Land preparation		
	with tractor	with oxen	
		owned	hired
Makoda	1	4	3
Dambatta	5	1	3
Kadandani	7	0	0
Ajumawa	0	3	5
Wailare	7	1	1
Kazaure	11	1	2
Dansure	0	3	7
		13	21
Total	31	34	
Mean yield	679	710	

There is no correlation at all between the distance from the village to the headquarters in Dambatta, where the tractors are stationed, and whether the farmers make use of a tractor or not : in the two villages that are nearest Dambatta - Makoda and Ajumawa - farmers have not used tractors at all (1 exception), whilst the highest number of tractors used is found in Kazaure and Kadandani, the two villages that are farthest away from Dambatta. In Dansure, farmers explained they were unable to get any tractors at all.

Some 20% of the 65 surveyed farmers have their own pair of oxen, whereas the overall mean for Dambatta Zone II is 12 %. This seems to indicate that the project has worked with the

more wealthy farmers, who are more willing to try out new introductions because of their greater income certainty. This approach is often the easier one for project people, but in the long run it increases social inequalities among the farmers.

There is no significant difference between the yields obtained from plots prepared by a tractor or by animal traction. This confirms findings of other authors that increasing productivity per ha is often not a matter of a "modern" machine but of intensive and careful farming (SHAW, 1970).

3.3.3.2. Weeding

Weeding was done by hand or with a hoe. In three cases, the farmers earthed up (5). This was done by animal traction. Herbicides were not used at all. This implied that farmers were expected to weed three times as stated before. But only two farmers weeded three times ; 22 % of the farmers weeded twice and the largest part (75 %) only weeded once. Weeding is done at approximately half the growing cycle of the cowpea crop, in order to collect as much weed as possible. The weeds are used as cattle feed.

Table 14. Yields (kg dry beans/ha) according to the number of weedings (1)

Number of weedings	1	2	3
Yields	701 a	656 a	1,688

(1) Duncan-test : figures followed by a letter in common are not significantly different at the 0.01 level

Table 14 shows how yields are influenced by the number of

weedings. It is remarkable that one passage gave a higher yield than two passages. Three weedings, however, give yields that are significantly higher than with one or two passages.

3.3.3.3. Thinning and transplanting

78 % of the farmers thinned the cowpeas a couple of weeks after germination (from 3 to 1 or 2 plants per planthole). No transplanting - to make up for the seeds that had not germinated - was done.

There is no significant difference between yields in stands that have been thinned and those that have not been thinned (724.2 kg and 665 kg dry cowpea beans per hectare, respectively).

3.3.3.4. Fertilizer application

The project advises to apply 200 kg N.P.K. (15-15-15) per hectare.

Several farmers applied N.P.K. (20-20-20) instead of N.P.K. (15-15-15). There are, however, no data available on the exact number of farmers who did so.

66 % of the farmers applied inorganic fertilizers. As can be seen from table 15, farmers from Makoda, Dambatta and Ajumawa used the recommended quantities (with the restriction that in the two first villages they used S.S.P. instead of N.P.K.). Farmers in Kazaure and Dansure applied more fertilizers than recommended. In Kadandani and Wailare farmers complained about the fact that fertilizers were not readily available. This is rather strange as Kadandani is near a fertilizer distribution centre (in Makoda). It could be that the local extension agent did not do what could be expected from him.

Table 15. Number of farmers applying N.P.K. and Single Super Phosphate (S.S.P.) and the amount (kg/ha) used in each village

Village	N.P.K.		S.S.P.	
	farmers	amount	farmers	amount
Makoda	0	-	7	166
Dambatta	0	-	7	180
Kadandani	0	-	0	-
Ajumawa *	5	225	2	238
Wailare	0	-	0	-
Kazaure **	8	240	13	250
Dansure ***	10	260	10	336
Total	23		39	

* 1 farmer uses N.P.K. as well as S.S.P., in total 450 kg fertilizers/ha
1 farmer does not apply any fertilizers

** 8 farmers use N.P.K. as well as S.S.P., in total 410 kg fertilizers/ha
1 farmer does not apply any fertilizers

*** All farmers use N.P.K. together with S.S.P., in total 600 kg fertilizers/ha

Fertilizers were broadcast by hand before land preparation, 38 % of the farmers also applied fertilizers afterwards on each plant separately (top dressing). This may be the reason why a lot of plants on these plots were burnt.

Table 16. Yields (kg dry beans/ha) according to the type and amount (kg/ha) of fertilizer used (1)

Type of fertilizer	N.P.K.			S.S.P.		
Amount	0	0-250	+250	0	0-250	+250
Yields	643 c	760 c	1,068	533 a	761 ab	1,057 b

(1) Duncan-test : a,b : no significant difference at the 0.01 level
c : no significant difference at the 0.05 level

3.3.3.5. Pesticides

As stated before, the entomologists of I.I.T.A. advised two sprayings with Cymbush E.D. On two plots of the project, however, four applications with Cymbush E.D. were made. Even then, the aphid infestation on these cowpeas was much higher than on non-sprayed traditional cultivars. This high aphid infestation can probably be explained by the fact that the aphid predators are killed by the non-systemic component of Cymbush E.D., i.e. cypermethrine. All project people, however, agree that the new variety T.V.X.-3,236 is not resistant against aphids as entomologists of I.I.T.A. claim. Apart from Cymbush E.D., Pirimor (systemic insecticide, pirimicarb, 1.5 l/ha) is also used (table 17).

In Makoda, Kadandani and Wailare, the spraying scheme has been followed to some extent. All farmers of Wailare sprayed three times with Cymbush E.D.. In Dambatta, however, all farmers sprayed only once with Cymbush E.D.

Table 17. Number of farmers doing 1, 2 or 3 sprayings in each village
(C : Cymbush E.D. ; P : Pirimor)

Village	Product	Number of sprayings		
		1	2	3
Makoda	C	0	7	1
	P	1	0	0
Dambatta	C	9	0	0
	P	0	0	0
Kadandani	C	2	5	0
	P	0	0	0
Ajumawa	C	5	3	0
	P	0	0	0
Wailare	C	0	0	9
	P	0	0	0
Kazaure	C	8	4	1
	P	3	0	0
Dansure	C	1	0	9
	P	7	0	0

In Dansure, there was an average of 3.8 sprayings per plot. In two cases, three sprayings with Cymbush E.D. were followed by one spraying with Decis Dimethoate, at a rate of 2.5 litre per hectare (Ultra Low Volume sprayer). One litre of the solution contains 5 g deltamethrine and 150 g dimethoate. The mean yields after one, two or three sprayings with Cymbush E.D. are 594,740 and 861 kg dry beans per hectare, respectively (no significant differences).

The application of Pirimor alone gives a significant yield difference at the 0.01 level. Cowpea plots sprayed with

Pirimor yield 1,052 kg per ha, against 652 kg per ha for non-sprayed plots.
39 out of the 64 farmers on whose plots insecticide was applied declared they had not done the treatment themselves. Amongst the 25 who had treated personally, only 14 said they thought they would be able to use the E.D.-sprayer in the future without assistance. This is a further proof of the fact that the extension agents do not always include the farmers in their work. This may be due to the fact that they want to reach the primary goals set by the project (introducing a new variety, planting x ha with this variety, ...) without paying attention to the secondary and, in the long run, more important goals (farmers' formation, adoption of new techniques).

3.3.3.6 Seed dressing

Only in Kazaure (9 farmers) and in Dansure (10 farmers) seed dressing has been used. The product that was used most frequently was Fernasan-D (fungicide, thiram). A Duncan-test on yields from treated and non-treated seeds shows a significant difference at the 0.01 level : mean yields being 1,008 and 615 kg dry beans/ha, respectively.

The price to be paid for seed dressing being rather low (0.15 Naira for two kg of seed to be treated) the farmer should be stimulated to use these products more frequently (6).

4. CONCLUSION

From the above it is clear that up till now, and this for a number of reasons, a lot of the instructions and recommendations of the project have not been followed.

The plots, on which the new cowpea variety was introduced and tested by the local farmers through the project, were

smaller than prescribed. This does not influence eventual yields in a negative way, but shows that local farmers are in doubt of the ultimate outcome of the new variety and methods, and will need more convincing by the project.

Land preparation was done either in the traditional way or with a tractor. There was no preference for either of both methods, even though the use of a tractor was free. Here again farmers are not at all convinced that the use of a tractor will give them better results (which, indeed, is not the case as yields from plots prepared by tractor do not differ from those obtained on plots prepared by animal traction). Part of their reticence might be explained by the fact that later on they will have to pay for the use of a tractor, and by the fact that tractors are not always available at the right moment (e.g. due to engine failures).

It is often very difficult to have careful weeding accepted by the local farmers as an agricultural intervention which is of the utmost importance to obtain good yields. On the one hand it is often difficult to show that yields are actually higher with careful weeding, and on the other hand it is a very labour intensive activity. Moreover, a lot of farmers find weeds interesting as they provide additional fodder for their cattle, sheep or goats. In this respect it is easy to understand that only a very small number of farmers weeded three times as suggested by the project. As a general rule weeding will be more readily accepted by larger production units (= families) as they have more labour force available. The introduction of labour saving practices in general will also promote weeding.

Thinning and transplanting are also labour intensive activities, and what has been said about weeding also applies here.

The use of inorganic fertilizers is another important intervention which can increase yields. Two thirds of the surveyed farmers used fertilizers. Very often farmers know about the beneficial properties of fertilizers, but the irregularities in availability and the initial buying costs are

very often a constraint. In general terms, fertilizers are more readily applied in cash crops than in food crops because of the monetary return of the first type of speculation which enables farmers to pay for further investments or to pay back borrowed money. In the project area cowpea is in the first place a cash crop which might explain the fact that farmers, who apply fertilizers, usually use the right amounts (or even more).

Getting the farmers to use fertilizers is one thing, learning them to use the fertilizers in the right way is another one. The fact that a lot of plants were burnt after a fertilizer application clearly indicates that farmers know that fertilizers have to be applied "to" the plant, but taking this consignment too literally leads to accidents, which can be overcome, however, by a good monitoring by the extension agents.

The need and frequency of insecticide applications in the proposed cowpea variety are clearly a research matter still, as the aphid resistance of T.V.X.-3,236 has been shown to be of hardly any value at all outside test field conditions. Farmers' practices often present other (ecological) conditions to pests and diseases than the conditions created in research institutes. The same phenomenon had already been seen with cowpea varieties which had been screened for resistance against pod sucking bugs (Riptortus dentipes, Acanthomia tomentosicollis and A. horrida, Anoplecnemis curvipes). Reportedly good results with a number of varieties in I.I.T.A. laboratory and field trials were later on not confirmed in trials with local farmers (LUKEFAHR, personal communication).

The results obtained with the few farmers who used seed dressing clearly indicate that this is a cheap and sure way to obtain higher yields, as plant losses through fungal diseases are considerably lowered. Therefore, efforts should be undertaken to promote the use of treated cowpea seeds.

It can be concluded that although the cowpea packet as a whole can be considered a technically sound introduction

(apart from the aphid resistance aspect), the bottleneck still is having the intended changes in (agricultural) practices accepted by the farmers. Stressing the need for more and better weeding, for instance, is a necessity but it is impossible for the farmer to comply with it if he has not enough labour force at his disposal to do so, or if there are no introductions of other labour saving interventions.

In a situation where a farmer grows different crops, a change in the growing methods of one crop influences the time and work devoted to other crops, and is influenced by the (subjective and/or economic) value he attaches to these other crops. If in this case, for instance, cowpea is only a secondary speculation, it is clear that any recommendations towards using new practices will only be met after the other crops have been taken care of. If cowpea comes first, however, these changes might lead to the neglect of other (food) crops. It is therefore clear that, even purely technical, interventions in one field must be integrated in a broader approach involving other fields of interest.

Furthermore, it is clear that a packet like this can not be introduced without proper knowledge of the socio-economic organization of the community for which it is intended. Hausa and Fulani farmers e.g. have different backgrounds, and will react differently when confronted with new techniques. This explains partly why projects which try to change long established methods and techniques very often have serious difficulties in doing so. A lot depends on the motivation and skill of the extension agents who have to "pass the message" to each and every individual farmer.

Moreover, the extension effort will often be a matter of "time and energy input". The agents often aim at short term successes (the introduction of a new variety, the obtaining of higher yields), whilst the long term effects are often forgotten, because they are more difficult to attain and consume a lot of time and effort. In this respect the question arises whether a one year extension effort with a group of farmers is enough to be able to induce everlasting changes in the cowpea growing habits of these farmers. The

answer is clearly negative ! Amongst others, experiences with the introduction of industrial tomato growing in Senegal (Région du Fleuve ; VAN DAMME, 1981 and 1982), or with the introduction of new sorghum varieties in Togo (Région des Savanes, F.E.D.-project ; MARECHAL, 1984) clearly show that it takes several years of very intensive monitoring before one is successful in changing traditional methods. Extension must try to show the long term, positive effects of new methods and introductions, but must also try to motivate the farmers as some of the interventions cost money (pesticide, fertilizers) or require more work (weeding). These last aspects - the economic implications of these interventions - will be treated in a second article.

NOTES

(1) FRADYS : Field Record for Agronomic Data, Yields and Stands
KNARDA : Kano Agricultural and Rural Development Authority

(2a.) Fulani : Peul or Fulbe ; traditionally chiefly occupied in nomadic and semi-nomadic pastoralism in the Sahel and Sudan

(2b.) Hausa : ethnic unit living in northern Nigeria, noted not only as cultivators and traders, but also as smiths, textile workers and dyers, tanners and leather workers.

(3) 0.5 ha = 1.23 acre ; 1 acre = 0.405 ha

(4) N.P.K. = Nitrogen, Phosphorus, Kalium fertilizer
15-15-15 : 100 kg of fertilizer contains 15 % N, 15 % P and 15 % K.

(5) To earth up : to cover the base of the young plants and the soil around it with earth and, by doing so, killing young weeds.

(6) 1 Naira = 100 Kobo = 1.30 US $ (1983)

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