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FARMING SYSTEMS RESEARCH AT THE NATIONAL ROOT CROPS RESEARCH INSTITUTE, UMUDIKE AND ITS IMPACT ON THE RURAL COMMUNITY

(Systèmes d'exploitation dans l'Agriculture nigériane à base de tubercules)

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SUMMARY

In Nigeria, small-scale farmers account for 70 per cent of domestic food supply. From a farming systems benchmark survey in 1982, major constraints to food production included lack of capital (92 per cent), unavailability of fertilizers and pesticides (42 per cent), weed infestation (38 per cent), poor transportation (36 per cent), diseases/pests (25 per cent), ineffective extension services (9 per cent). 88 per cent of the respondents practised mixed cropping (yam/maize/cassava/vegetables/egusi). Trials confirmed that the following per cent more land became available to the farmer from intercropping cassava/maize (40 per cent), cassava/maize/groundnuts (71 per cent), yam/maize (59 per cent), yam/egusi (63 per cent), cocoyam/egusi (59 per cent), cocoyam/sweet potato/maize (58 per cent). Weed control was most efficient when herbicide use was integrated with intercropping (egusi) and local manual hoeing practice. All the farmers in the sample frame accepted this technology.

RESUME

Au Nigéria, les petits exploitants assurent 70 pour cent de l'approvisionnement alimentaire. Une enquête de repérage des systèmes d'exploitation effectuée en 1982 a établi que les contraintes majeures dans la production alimentaire comportaient l'absence de capitaux (92 pour cent), l'indisponibilité de fertilisants et de pesticides (42 pour cent), les mauvaises herbes (38 pour cent), l'insuffisance des transports (36 pour cent), les attaques parasitaires (25 pour cent), l'inefficacité des services de vulgarisation (9 pour cent). Les réponses montrent que 88 pour cent des exploitants pratiquent les cultures associées (igname/maïs/manioc/plantes maraîchères/egusi). Les essais confirment que les associations suivantes manioc/igname (40 pour cent),

manioc/maïs/arachide (71 pour cent), igname/maïs (59 pour cent), igname/egusi (63 pour cent), taro/egusi (59 pour cent), taro/patate/maïs (58 pour cent) permettent un gain de surface aux exploitants. La lutte contre les mauvaises herbes étaient la plus efficace lorsque l'emploi de l'herbicide était intégré à la culture intercalaire (egusi) et aux pratiques locales de désherbage à la houe. Tous les exploitants de l'échantillon acceptaient cette technologie.

INTRODUCTION

The fourth National Development Plan in Nigeria expected the bulk of a projected 4 per cent agricultural incremental rate to come from small holder farmers who currently account for over 80 per cent of the domestic food supply (FMNAR, JPC 1974).

This projection is far from being realised due to, among other factors, limited adoption by small farmers, of a backlog of agricultural technologies developed in Nigeria (EZE, 1981). Therefore, agricultural productivity have remained low. The technologies were not adopted, principally because they were not tailored to the needs, capabilities and situations of the farmers. Instead, agricultural research in Nigeria has been organized along discipline and commodity lines ; an arrangement which has been criticised as presenting formidable management problems in evolving relevant and coherent research programmes without adequate reference to the farmers problems (OKIGBO, 1978 and 1982 ; ARIBISALA, 1982).

In order to increase the agricultural productivity of the apparently neglected majority of small farmers, the Federal Government of Nigeria set up a committee that reviewed agricultural research activities in Nigeria and advised on the re-orientation of research activities towards developing technologies that are within the farmers means to own, use, hire and repair and which are relevant to their needs and situations (OKIGBO, 1982). This required a reversal of an age long "Top to down" approach to agricultural research. Some of the National Research Institutes including NRCRI, have already started implementing the recommendations of the Committee. At the NRCRI, farming systems research efforts are geared towards :

(i) Identifying the major agricultural production constraints of rural root crops-based farmers.

(ii) Addressing the "small" farmers' problems by working with them under their conditions.

(iii) Incorporating into the traditional farming systems improved technologies from commodity root crops programmes of this Institute and other National and International Research Institutes.

(iv) Identifying more efficient and economic methods of managing root crops-based farming systems and land to produce good yields on a sustained basis.

MATERIALS AND METHODS

A benchmark survey of the Farming Systems of the eastern Agricultural Zone of Nigeria was carried out from March to December, 1982. The survey was a single general interview survey designed to provide quick information on the state of farm production in Anambra, Cross River, Imo and Rivers States on which further research and extension efforts could be based. Data were collected mainly on those phenomena that farmers could remember and describe, which changed slowly and that are characterised by infrequent occurences relating to the farmers knowledge, beliefs, attitudes and goals ; all of which facilitated identification of the major constraints to increased agricultural production by the small holder farmers in the zone.

Armed with knowledge of the later, the Institute in 1982/83 initiated a series of upstream, scale-neutral research, aimed at the development of component technologies for removing some of those constraints. In order to shorten the period needed for the development, transfer and final adoption of new technologies by farmers, the Institute is currently collaborating with the Federal Agricultural Co-ordinating Unit and the International Institute of Agricultural Research (IITA) to conduct downstream research in the Imo State Accellerated Development Area Project (ISADAP) locations, using a combination of "Researcher" and "Farmer"-managed trials.

Eighty (80) such trials were set up on 80 (eighty) farmers fields in Umuahia zone of ISADAP to test the practicability and farmer acceptance of the developed technologies.

Improved planting materials were obtained from relevant research institutes in Nigeria, and their respective optimum recommended planting densities were used. The yam and cassava were at 10,000 stands per hectare each, maize at 40,000, 'egusi' 20,000 cocoyam, 20,000, sweet potato, 33,000, groundnuts, 50,000 and ginger at 20,000.

In these trials emphasis was placed on development of easy-to-adopt row planting as a prelude to subsequently integrating other technologies with relative ease.

Table 1 : Distribution of Farmers by cropping systems in the Eastern Agricultural Zone of Nigeria, 1982.

Cropping System	Re Frequencies and Percentage*				
	Anambra	Cross River	Imo	Rivers	Mean (%)
Mixed Cropping	89 (100.00)	77 (82.80)	93 (100.00)	64 (68.810)	87.90
Relay planting	9 (10.11)	22 (23.70)	15 (16.10)	2 (2.15)	13.02
Land Rotation	35 (39.35)	38 (40.40)	20 (21.50)	6 (6.45)	27.05
Inter-cropping	7 (7.87)	23 (24.70)	5 (5.38)	22 (23.65)	15.40
Continuous cropping	10 (11.24)	13 (14.00)	20 (21.50)	1 (1.07)	11.95
Inter-culture	4 (4.49)	0 (0.00)	5 (5.20)	1 (1.07)	2.68
Mono-cropping	39 (43.49)	0 (0.00)	10 (10.80)	11 (11.82)	16.53
N	89	85	96	93	

* Numbers in parentheses indicate percentages.

Relevant and promising technologies developed on-station are selected and tested on the farmers' fields and conditions. The on-farm trial results are subjected to farmers' assessments for acceptability through the use of questionnaires.

RESULTS AND DISCUSSION

Bench mark Survey

The findings of the benchmark survey are contained in a publication of the Ministry of Education, Science and Technology, Lagos (Unamma et al, in press). Relevant aspects of it are included in this paper.

(a) Cropping Systems of the Rural Communities

Of seven main cropping systems identified in the zone, mixed cropping was practised by 88 per cent of the farmers surveyed (Table 1). 100 per cent of the respondents in Anambra and Imo practised mixed cropping. Generally, 2 to over 5 crops are found in a mixture (tree crops are excluded here) and the common crop combinations observed during the survey are as shown on Table 2. The predominant crop combinations varied from state to State but the most prevalent consisted of yam (*Dioscorea rotundata*) - maize (*Zea mays*) - Cassava (*Manihot esculenta*) vegetables - 'egusi' (*Colocynthis citrullus*) combination practised by 33 per cent of the total number of respondents covered by the survey. Vegetables included spinach (*Amaranthus* spp), Fluted pumpkin (*Telfairia occidentalis*), okra (*Hibiscus esculentus*), tomato (*Lycopersicum esculentus*), pepper (*Pipper nigrum*). The planting patterns for the various crop combinations were haphazard (without any definite row arrangement) and planting was generally done on mounds whose sizes varied with the soil type.

The planting arrangement allowed for 2,000 to 30,000 plant populations per hectare with the higher densities being achieved mainly by concentration of the plants per mound, leaving very wide margins (1m to 2.5 meters) between mounds or concentrations of the plants.

(b) Constraints to agricultural production

Table 3 shows some of the major constraints to increased agricultural production as cited by the rural farmers in Imo State. The majority (90 per cent), of the farmers in the area mentioned lack of capital as the major limiting factor to increased agricultural productivity. Lack or insufficiency of inputs such as planting materials (e.g. seed yams) fertilizers and pesticides were next (42 per cent) in importance among the constraints. Weed infestation (38 per cent) in addition to high cost of labour (25 per cent) were also cited by the farmers as major bottle-necks to increasing agricultural production.

Table 2 : Distribution of Farmers according to the Most Common Arable Crop-Mixtures in the Eastern Agricultural Zone of Nigeria, 1982.

Crops	Frequencies and Percentages*				
	Anambra	Cross River	Imo	Rivers	Mean (%)
1. Maize/Cassava/Egusi	2 (2.25)	10 (10.50)	0 (0.00)	32. (34.40)	4.00
2. Yam/maize/cassava/Veg/egusi	35 (39.30)	41 (43.20)	20 (20.83)	27 (29.03)	33.09
3. "/cocoyam/vegetable	0 (0.00)	28 (29.50)	0 (0.00)	7 (7.52)	9.26
4. Plantain/cocoyam	0 (0.00)	65 (68.40)	0 (0.00)	8 (8.60)	19.25
5. Banana/cocoyam	0 (0.00)	65 (68.40)	0 (0.00)	4 (4.30)	18.18
6. Yam/maize/vegetable	0 (0.00)	3 (3.16)	0 (0.00)	14 (15.05)	4.55
7. Cocoyam/maize	0 (0.00)	8 (8.42)	0 (0.00)	4 (4.30)	3.18
8. Cassava/maize/plantain	0 (0.00)	28 (29.40)	0 (0.00)	3 (3.22)	8.18
9. Plantain/pineapple	9 (0.00)	4 (4.21)	0 (0.00)	1 (1.07)	4.48
10. Cassava/sugarcane/pepper/plantain	0 (0.00)	3 (3.16)	0 (0.00)	5 (5.37)	2.13
11. Yam/cassava/cocoyam	0 (0.00)	10 (10.50)	0 (0.00)	1 (1.07)	2.89
12. Plantain/banana/cocoyam	0 (0.00)	19 (20.00)	0 (0.00)	9 (9.67)	7.42
13. Plantain/sugarcane	0 (0.00)	1 (1.05)	0 (0.00)	4 (4.30)	1.34
14. Yam/Cassava	0 (0.00)	0 (0.00)	0 (0.00)	1 (1.07)	0.27
15. Cassava/cocoyam/vegetable	0 (0.00)	5 (5.26)	0 (0.00)	4 (4.30)	2.39
16. Yam/maize/cassava	21 (23.60)	0 (0.00)	14 (14.58)	0 (0.00)	9.55
17. Yam/maize/cassava/veg.	40 (44.90)	2 (2.11)	22 (27.92)	0 (0.00)	18.73
18. Yam/cassava/cocoyam/veg.	6 (6.74)	10 (10.50)	4 (4.17)	0 (0.00)	5.35
19. Maize/cassava/cocoyam	2 (2.25)	12 (12.60)	10 (10.42)	0 (0.00)	6.32
20. Yam/maize/cassava/cocoyam	10 (11.20)	10 (10.50)	3 (3.13)	0 (0.00)	6.21
21. Yam/vegetable	2 (2.25)	0 (0.00)	4 (4.17)	0 (0.00)	1.61
N	89	95	96	93	

* Numbers in parentheses represent percentages.

Table 3 : Distribution of Farmers according to their assessment of the constraints to agricutural production in the Eastern agricultural zone of Nigeria

Constraints	Frequencies and Percentages				
	Anambra	Cross River	Imo	Rivers	Mean (%)
Lack of Capital	81 (91.01)	92 (97.87)	86 (89.58)	84 (90.32)	92.20
High Labour Costs	42 (47.19)	0 (0.00)	34 (35.42)	15 (16.13)	24.46
Inadequate supply of inputs (fertilizers and pesticides)	28 (31.46)	54 (57.45)	33 (34.37)	42 (45.16)	42.20
Poor transport facilities/access roads	25 (28.09)	43 (45.74)	28 (29.17)	38 (40.86)	36.02
Weed infestation	31 (34.83)	45 (47.87)	62 (64.58)	3 (3.23)	37.90
Diseases/Pests	31 (34.83)	14 (14.89)	49 (51.04)	0 (0.00)	25.27
Ineffective Extension Services	15 (16.85)	1 (1.06)	14 (14.58)	4 (4.30)	9.14
Lack of Government support	2 (2.25)	0 (0.00)	0 (0.00)	21 (22.58)	6.18
Lack of ready markets	0 (0.00)	5 (5.32)	6 (6.25)	0 (0.00)	2.96
Poor storage facilities	0 (0.00)	4 (4.25)	6 (6.25)	10 (10.75)	5.38
Lack of improved implets	0 (0.00)	0 (0.00)	9 (9.37)	2 (2.15)	2.96
Poor medical facilities	0 (0.00)	9 (9.57)	0 (0.00)	0 (0.00)	2.41
N	89	94	96	93	

* Numbers in parentheses represent percentages.

Table 4 : Land Equivalent Ratios (LERs) obtained from Intercropping some crops usually grown in mixture by peasant farmers - Umudike

INTERCROPS	LER
Yam/maize	1.84
Yam/egusi	2.80
Cassava/maize/groundnuts	3.41
Cassava/maize	1.60
Cocoyam/Sweet potato/Maize	2.08
Sweet potato/Maize	1.71
Cocoyam/egusi	2.75
Ginger/egusi	1.59

1. From Annual Reports for 1982, 1983 and 1984 of the National Root Crops Research Institute, Umudike.
2. Based on sole component crop populations for both the mixture and sole crops.

Efficiency of Lang Utilisation

In experiments designed to determine the optimum crop combinations that would enable the farmers obtain the same output as when sole cropping and still leave them with some substantial proportion of more land for other uses, a number of compatible and beneficial crop combinations were identified for confirmatory testing on-farm (Table 4). High Land Equivalent Ratios were obtained with the crop combinations.

Weed Management

Ninety-three major weed species commonly found in association with arable crops in the zone were identified and a manual was published to guide extension staff in problem weeds identifications (UNAMMA, 1982). Critical periods for weed removal in some of the crop mixtures have been identified. In cassava/maize the first 8 weeks after planting is

critical (UNAMA and ENE, 1984 ; in yam intercropped with maize the weeds should be kept away from the crop during the first 8 - 12 weeks from planting (NRCRI, 1984), in sweet potato/ cocoyam/maize, the critical time for weed interference is first 28 days after planting (UNAMMA et al, in press), whereas in sweet potato/maize it is first w 28 to 56 days after planting (UNAMMA and EMEZIE, 1985).

As shown in Table 5 under Uzuakoli and Bende conditions, integrated use of egusi + alachlor was as good as the use of egusi plus pre-emergence application of chloramben, both methods being better than integrated use of egusi + fluometuron or the cultural control by use of only egusi at 40,000/ha. At Olokoro/Oboro, best yields were obtained with integrated use of egusi + fluometuron and egusi + alachlor. The poor performance of the treatments relative to the control under Bende and Uzusakoli conditions may have been due to the sandy nature of the soils.

Inspite of the poor performance of the herbicides at Bende and Uzuakoli Blocks, the farmers response to herbicide use was generally favourable. Some of the reasons given for preference of herbicide were the alleviation of the dradgery of hand-weeding, lower labour costs and more time spared for relaxation for other farm operations.

Minisett technique for Accelerated Production of "Seed" yams

A minisett technique involving the use of 25 g yam sett sizes planted at 40,000 setts/ha for direct planting in the field instead of the normal 100 - 150 g sizes at 10,000/ha was evaluated on-farm. The result confirmed the practicability and economics of the technique under the farmers conditions (Table 6).

Weed management in intercrops on farmers fields

Results (Table 7) showed that it was practicale and beneficial to control weeds in yam/maize intercrop by relay intercropping high populations of 'egusi' (40,000 seeds/ha) with cowpea (40,000 seed/ha) at 8-10 weeks after planting yam/maize/'egusi' intercrop.

Impact of the Farming Systems Research Activities on the Rural Communities

A post-trial-harvest, single, interview survey of the farmers who participated in the on-farm tests showed that most of the farmers accepted the technologies tested (Table 8).

Table 5 : Crop Yields from Manual, Chemical and Integrated Weed Management Technique in Umuahia ISADAP Area 1984

	* Crop Yields (t/ha) in the Blocks								
	B e n d e			Olokoro/Oboro			Uzuakoli		
	Yam	Maize	Egusi	Yam	Maize	Egusi	Yam	Maize	Egusi
1. Egusi + alachlor	15.6b	2.03b	0.14b	7.3b	4.75b	0.14b	5.0b	5.59a	1.60a
2. Egusi + chloramben	16.6b	3.33b	0.13ab	3.4c	1.95b	0.25a	4.3b	3.10b	0.45b
3. Egusi + fluometuron	10.6c	2.47ab	0.09ab	8.4a	6.30a	0.04c	4.0c	3.74b	0.45b
4. Hand-hoeing 3+8+12 w.a.p.	25.8a	4.23a	-	4.4c	5.52a	-	6.9a	6.05a	-
5. Egusi 40,000/ha	0.6d	2.97ab	0.26a	4.3c	4.33a	0.07d	1.0d	2.49b	0.46b

Means in the same column not followed by a common letter are significantly different at the 0.05 level by D.M.R.T.

* The values are means of 5 replications

Table 6 : Cost and Benefit of Seed yam production using Minisett Technique under Farmers conditions, Umuahia ISADAP Area 1984

Inputs Items	Bende		Olokoro/Oboro		Uzuakoli	
	Costs	*Returns (3.39t/ha)	Costs	*Returns (5.76 t/ha)	Costs	*Returns (4.61 t/ha)
	----------N/ha----------					
Labour	1418.56	-	1566.60	-	1446.24	-
Seed yams -(t/ha)	690.00	-	690.00	-	690.00	-
Fertilizer (15:15:15, NPK)	48.00	-	48.00	-	48.00	-
Stakes	400.00	-	400.00	-	400.00	-
Herbicides : Primextra +	54.00		54.00	-	54.00	-
Paraquat	20.00	-	20.00	-	20.00	-
Aldrex T.	10.00	-	10.00	-	10.00	-
Sprayer (CP15): Depreciation 5 years	24.00	-	24.00	-	24.00	-
Drum (for water) Depreciation 5 years	8.00	-	8.00	-	8.00	-
Piassava heads (Twine)	300.00	-	300.00	-	300.00	-
Total	2972.50	3210.50	3120.60	5462.00	3000.24	4436.00
Net Benefit	-	247.94	-	2351.40	-	1445.76

*Means of 5 replications/location

Table 7 : Crop yields as affected by controlling weeds through relay intercropping egusi and cowpea in yam/maize intercrop - Umuahia Agric. zone 1984.

Weed Control Practice	Crop Yields																	
	Yam	Bende					Olokoro/Oboro						Uzuakoli					
	Yam	Maize[1]	Egusi[2]	Cow pea	Gross Marg. (GM) M/ha	Marg. Rate of Return (MMR)%	(Y)	(M)	(E) (t/ha)	(C)[3]	(GM) E/$_3$ha	MRR (%)	(Y) -	(M) -	(E) t/ha	(C) -	(CM) N/ha	MER (%)
Yam (Y) Maize (M)/Egusi (E) followed by 2 hand hoeings at 3+ 8 + w.a.p. local practice)	5.37	1.43	-	0.14	-	-	1.74	1.28	0.17	-	-	-	7.90	1.39	0.04	0.04	-	-
Yam/Maize/Egusi/40,000 seeds/ha followed by cowpea (c) 40,000 seeds/ha) 10 w.a.p.	7.12	1.54	-	0.23	-	-	3.66	1.73	0.38	-	-	-	11.51	2.31	0.08	0.06	-	-
Difference	1.8ns	0.2ns	-	0.09*	2250	1489	1.92*	0.45 ns	0.21ns	-	2667	795	3.62*	0.91**	0.04*	0.03*	5002	3789
Percent Improvement over local	33.5	7.7	-	64.3	-	-	110	35.2	124	-	-	-	45.8	65.5	100	75.00	-	-

1. Maize grain wt. at 14% Moisture content.

* t Test significant at 5% level

** " " " 19% level

2. Egusi had mainly vegetative growth

3. Unviable lot of cowpeas was mistakenly supplied from the store, the supply had lots of flower shortion leafing to insignificant yield.

Table 8 : Farmers response to introduced technologies in their fields - Umuahia 1984

Technology	No. of Respondents	% of Farmers Accepting technology
Minisett technique of seed yam production	60	100
Weed control by relay intercropping high populations of egusi followed by cowpea in yam intercropped with maize	60	98.33

1. Questionnaire was administered to only the on-farm-trials participants.

The success of the on-farm trials have generated an awareness among the communities about the potentialities of the research findings from the Institute and many of the neighbouring communities who did not participate have requested that the trials be extended to their areas. The National Roots Crops Research Institute, Extension Research and Liaison Services Wing is currently overstretched with requests for and inquiries about improved materials and technologies.

From March to May, scope of the On-farm trials was expanded to include multi-location trials, in collaboration with the ISADAP and FACU. A team has been set up to monitor the overall influence of the On-farm trials on the rural Community after a 2-year period of interactions with the on-farm research teams.

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Manual, chemical, cultural and integrated weed management methods involving the use of chemicals and a low growing crop for weed control in yam/maize intercrop developed upstream (UNAMMA et al, 1982) were evaluated on-farm at 3

different locations. BENDE, UZUAKOLI and OLOKORO all in Ikwuano/Umuahia Local Government Area of Imo State.

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