Ife J. of Agric. 21 (2005) (104-115)

DEVELOPMENT AND DISSEMINATION OF AGRICULTURAL TECHNOLOGIES TO SOME COMMUNITIES IN NIGERIA

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Abstract

The Institute of Agricultural Research and Training (I. A. R. & T.), Obafemi Awolowo University, Ibadan has made tremendous achievements towards increasing food production and alleviating poverty within the farming communities by using a Unified Agricultural Extension System (UAES) and Training & Visit (T&V) approach. The T&V approach entails a renewed focus with emphasis on farm visits, regular field supervision, concentration of efforts and research extension-farmers-linkage system (REFILS). The Institute has been able to develop and disseminate improved agricultural technologies to many communities in the country. These developments have been in the area of organic-based fertiliser and breeding of new crop varieties that are resistance to diseases and adaptable to different ecological zones. Breakthroughs have also been recorded in improved conventional and unconventional livestock management. Of importance are snail breeding and cane rat domestication. Other improved technologies developed by the Institute are in the area of designing, fabrication and evaluation of agricultural equipment and gender specific technologies including food processing and utilisation. All these technologies have been successfully disseminated to many communities within the country.

INTRODUCTION

The Institute of Agricultural Research and Training (I. A. R. & T.), Obafemi Awolowo University with its three (3) Colleges of Agriculture was carved out of the old Research Division of the defunct Western Region Ministry of Agriculture and Natural Resources (MANR) in July 1969, by a charter signed by the Vice Chancellor of the then University of Ife and the then Governor of the former Western Region of Nigeria. Since its inception, it has been rendering valuable services to the Nigerian farmer through its integrated programmes in applied research, extension and middle - level manpower training. The institute which has adopted a developmental assistance strategy to effectively promote accelerated sustainable and economic agricultural production and processing with food security and poverty alleviation as its central goal is one of the five (5) Zonal Research Institutes in Nigeria with the following mandates:

National mandates for soils and water management.

National mandate for the genetic improvement of kenaf and jute.

National mandate for improvement of maize and joint co-ordination for the nationally co-ordinated Research Programme (NCRP) on maize for the forest and humid savanna agro-ecologies.

National joint co-ordination for livestock research with focus on large and small ruminants, trypano-tolerant indigenous cattle breeds, sheep and goats.

National joint co-ordination for soybean in humid agro ecology.

Mandate for farming systems for southwestern agricultural zone covering eight states of Lagos, Oyo, Osun, Ogun, Ondo, Edo, Ekiti and Delta.

Food no doubt, is the most important basic need of man. Apart from sustaining life through the provision of life's essential nutrients, it also supplies calories to carry out daily activities. The low rate of food production growth in Nigerian can be attributed to the neglect of the peasant farmer who is the major contributor to agricultural sector (Albrecht 1975). About 90% of the food consumed by Nigerians are produced by resource poor farmers out of which 60- 80% are women. The role of women in agriculture especially in Africa has been well documented (Olayide, 1982).

Recent efforts at raising the production and consequently the income of rural households have focused on the dissemination of improved production and agro-processing technologies. Such efforts had yielded appreciable dividends in increased output of some of the crops. Tremendous achievements have been recorded in the area of improved agricultural technology for rural development. Extensive work has also been done on adaptable technologies geared towards production and processing of food crops.

Post harvest handling of crops has not been without difficulties as some of the available technologies for storage, processing and utilisation are too expensive for the rural communities. For this reason, most farmers hurriedly dispose of their crops at ridiculously low price as a means of minimising post-harvest loss. Such occurrences have generated loss of enthusiasm in the production, processing and utilisation of most food crops.

In an effort to meet the need for available simple and sustainable food processing and utilisation technologies, and the bid to improve nutritional status of farming communities, the Institute of Agricultural Research and Training (I.A.R.& T.) embarked on extensive research on food crop processing and utilisation technologies activities which promote income generation of the communities. The Farming System Research and Extension Programme of the Institute is actively involved in this and also in conducting training courses at various levels including field level through the use of adopted villages and active collaboration with Agricultural Development Programme (ADPs) in southwestern zone of the country.

The idea of having institutional adopted villages was to pave way for research to have visible impacts on their immediate environs thereby disproving the general belief that research Institute are elitist organisations. They can be linked to the extension workstations established in the states in the post independence year. Specific objectives for adopted villages are:

to serve as validating bases for the technologies developed.

to ascertain that the technologies are socially acceptable and economically adaptable.

to serve as farm centres where clientele can receive innovations.

to train farmers and provide closer interaction between scientist on one hand and users of the developed technologies on the other hand.

The Institute has two adopted villages (Oniyo in the derived savanna zone and Moloko-Ashipa in the rain forest zone) where most technologies developed are tested before dissemination to larger community.

Development and dissemination of food processing and utilisation technologies

Through the aid of National and International funding, the Institute has been able to make some impact in the area of crop processing and utilisation. Training programs have been extensively used to strengthen crop utilisation in both the urban and rural areas. Of importance is the area of disseminating soybean processing and utilisation technologies. These achievements are summarised as follows:

(i)Documentation of status of crop utilisation

The major objective of documentation is to provide, a base for intervention and elucidate the agricultural related production and utilisation activities of the people. Results show that the major categories of respondents are women and industrialists. Cottage level food processing and retail trading are the prominent activities of the people. Some socio-economic factors that usually affect the development and adoption of processing and utilisation technologies are summarised in Table 1.

Table 1: Socio-Economic Characteristics of the three communities surveyed

Rural Community 1	Rural Community 2	Rural Community 3
1. Economic infrastructure: 1. Bore-hole with four serving points 2. Weekly market 3. Primary school and secondary schools 4. No electricity 5. Graded rural road 6. Cottage industry (cassava to lafun and gari) 7. No Town Hall 8. No Postal Agency 9. Health Centre	1. Pipe-borne water and stream water 2. Daily Market 3. Primary and secondary schools 4. No electricity 5. Graded rural road 6. Cottage industry (cassava to gari) 7. A Town Hall 8. A Postal Agency 9. Health Centre	1. Well and stream water 2. Daily market 3. Primary school 4. No electricity 5. Graded rural road 6. Cassava to gari 7. No Town Hall 8. No Postal Agency 9. Health Centre
2. Family size and age distribution: 1. Average family size is 11 2. Average age of respondent – 40 years.	1. Average family is 10 2. Average age of respondent – 40 years.	1. Average family [illegible] 2. Average age of [illegible]ndent – 48 years.
3. Educational level of respondents: 74% of respondents has no formal education	65% of respondents has no formal education	69% of respondents has no formal education
4. Household decision making in food production and utilisation: 1. Most decisions are undertaken by men	Men lead in decision-making	Most decisions made by men with the influence of wives
5. Farm size: Average farm size is 5.67ha	Average farm size is 6.15ha	Average farm size is 3.9ha

Field Survey, 1993.

(ii) Development of household processing and utilisation technologies for food crops (cassava, maize and soybean)

The comparative nutritional evaluation of some traditional homemade foods was to determine the nutritive properties of such food and level of fortification with other food crops. Soybean has been successfully used to fortify most of our traditional foods. Over 70 households processing technologies have been developed for soybean (Obatolu *et al.*, 1993).

Soybean-Milk: As a result of the soybean program conducted at villages, many beneficiaries now retail soybean milk in the community. Notably among this beneficiary is a woman with three children in one of the adopted villages who now retail soybean milk to her rural community as an income generating venture. A 200ml cup is sold for N1.00. The nutrient composition of soymilk processed in I.A.R.& T. kitchen laboratory is compared with those retails in the open market (Table 2).

Soybean-Gari: Cassava is a cheap source of energy in the diet but low and poor in quality protein. The consumption of cassava products with other food ingredients increases its nutritional value. The successful use of soybean in gari processing has increased the protein content of gari from less than 1 % in whole cassava to between 7.0 and 11.56 in soybean fortified gari (Table 3). Other popularised products are soy tofu (soycheese), soyvita, soyflour, soyiru, and soyvegatable soup to mention but a few.

(iii) Soybean Utilisation in Clinics/ Hospitals:

Malnutrition is evident in rural and urban areas. According to Martorell and Ho (1983) malnutrition may come about in one of four ways; (a) person may simply not get enough food (under nutrition), (b) his diet may lack one or more essential nutrient (deficiency) and thus give rise to such diseases as pellagra, scurry, kwashiorkor and marasmus, (c) a person may have more than enough food for the body (over nutrition) and (d) a person's condition or illness may prevent proper digestion or absorption of food nutrient (genetic or environmental factor). The Institute visits hospitals and set up means of helping the undernourished children through the use of soybean fortified food. Background history of such children is taken and growth monitoring is done on weekly bases. Soybean seeds and soymilk were given to the mothers of such children free for a period of 12 weeks. Improvement in the condition of such children spurred the Institute to conduct training programs on the use of soybean for mothers at the hospital premises and a recipe booklet (I.A.R. & T. 1988) in Yoruba of English language given to the mothers.

(iv) Dissemination of result of study

The introduction of soybean into the diets of Nigeria via household and small-scale level processing technologies of both rural and urban offers a practical approach to improving the diets of the people.

Training was used to educate people at rural and urban centres. Most training programmes were conducted in the local language of the people or English language depending on the educational level of the audience. Table 4 shows the training activities and number of people trained between 1997 and 2001. To facilitate training, some of the soybean based recipe booklets were given to groups or individual during visit or training. Rate of adoption of the utilisation technologies is shown in Table 5. The impact of soybean processing and utilisation technology research can be summarised as follows:

Soybean has been successfully used to increase the protein content of the low protein traditional foods without increasing the cost or the cooking time and without changing the colour or taste of foods.

Over 70 traditional and oriental soybean recipes have been developed.

A low-cost soybean stone removal have been fabricated and tested.

Soybean have been successfully used in the rehabilitation of protein energy malnourished children.

Several soybean products are now

Table 2: Nutrient Composition of Soybean Milk (%)

Nutrient	I.A.R. & T.	Retail
Protein	4.0	2.5
Carbohydrate	6.3	5.1
Fats	2.8	2.2
Phosphorous	0.43	0.34
Calcium	0.04	0.02
Magnesium	0.01	0.01
Potassium	1.05	0.92
Copper	6.77	7.86
Manganese (ppm)	13.09	12.01
Iron (ppm)	76.06	68.25
Zinc (ppm)	7.81	7.85
Calories (kcal)	150	135

Obatolu, *et al.*, 1993.

Table 3: **Nutrient Composition of Local Gari and Fortified Soybean Gari (%)**

Nutrient	Local Gari	Milk Residue Gari	Whole Soy Gari
Protein	0.89	7.0	11.7
Fat	0.76	2.2	5.6
Dry matter	91.53	89.23	85.4
Ca	0.29	0.34	1.6
Mg	0.18	0.19	0.26
K	0.37	0.62	0.96
Na (ppm)	35.4	241	261
Mn (ppm)	32.1	12	13
Fe (ppm)	18.9	123.3	269.0
Cu (ppm)	9.8	3.9	49.1
Zn (ppm)	7.3	4.4	4.0
I. A. R. & T. Tannin	-	-	0.10
(mg/g)	-	0.001	0.02
Phytic acid	-	0.03	0.06

T.I.A.: Trypsin Inhibitor Activities
Obatolu *et al.*, 1993

available in the market.

Voluntary organisations are now interested in soybean training (I.A.R&T, 1999).

Other achievements in different areas towards increasing the nation's food basket and eradicating hunger in the country are:

Soil and Water Management Research

(i) Development and on-farm evaluation of organic-based fertilisers

Under the unconventional agricultural practices, the inorganic fertilisers applied to soil impact negatively with reference to ecology and fertility of soils. Organic fertilisation tends to maintain soil structure, cause less disruption of the soil chemical environment encourage populations of beneficial soil fauna and contribute to the control of microbial pathogens. The advantage of organic over inorganic fertilizer informed the organic fertiliser research in Institute.

The objective was to improve on the existing method of compost production and fortification of organic materials to enhance their fertiliser value.

A new method of compost production called Passively Aerated Composting Technique (PACT) was developed. With this method, matured composts were obtained within six weeks as against five months in pit compo sting method. The nutrient status of composts obtained using PACT was higher than from pit method (Table 6).

The nutrient composition of compost is relatively low when compared with inorganic fertiliser. Fortifying compost increase the fertilizer value. A research-managed trial conducted in farmer's sites using fortified compost (organic - based fertilizer) indicated that organic - based fertilizers compared favourably in terms of maize yields with inorganic fertiliser (Table 7).

(ii) Development of cost effective water harvesting technique for small-scale farmers

Isoerodent map of S. W. Nigeria indicating potential areas of serious soil erosion has been produced in the Institute. The map is also useful in planning soil erosion control. Long duration data are also used to develop rainfall prediction techniques and these have been useful for providing information on climatological factors that affects crop yield. Appropriate techniques for soil and water conservation has also been developed. Some of these technologies include the use of vetiver grass (*Ventivoral nigritana*) for soil moisture conservation in Joga Orile, Ilaro, Imudike and Gidan Kaura. The use of broad-beds, furroes and reservoir for water management and water harvesting in vertisols (heavy soils) has been research into some dry areas (e.g. Mauduguri, Billori and Biu). Vetiver grass has been used for prevention of siltation of farm ponds in some areas in Ibadan, Ogbomosho and Ejigbo while Acacia albiada (*Faidlherbia albida*) has been used to conserve soil moisture in the arid and semi - arid areas of Sokoto and Katsina. This technology has been perfected in our adopted villages. Water harvesting in natural depressions for dry season have also been tested (e.g. in Kogi and Edo States). All these technologies on soil and water management have spread to cover most part of the country because of the Institute national mandate for soils. In the years ahead, areas of advancement in soil and water management in the adopted villages will be:

Evaluation of the potential of vetiver grass for moisture conservation in different soil types.

Development of more appropriate tillage methods for water conservation.

Evaluation of other indigenous local grasses to prevent situation of farm ponds and for soil moisture conservation in dry areas.

Evaluation of the effectiveness of natural depression for dry season farming in different agro-ecologies.

(iii) Soil Erosion Control

Extensive research has been carried out on measures of controlling soil erosion not only in the SW Nigeria but also in other areas prone to erosion. Some of the technologies that have been developed are:

Table 4: Number of People Trained on Soybean Utilization during the Year 1997-2001

Participants			
Year	**Male**	**Female**	**Total**
1997	127	580	707
1998	56	240	296
1999	240	670	910
2000	493	440	933
2001	752	692	1,444
Total	**1,668**	**2,622**	**4,290**

Field Survey, 2002

Table 5: Adoption Rate of Soybean Products

Technology	Adoption Rate %	Remarks
Soy vegetable soup	92	Easy to prepare, substitute to melon during season of scarcity, Tasty.
Milk	84	Available in the market to serve as substitute for milk. A health drink. Preparation is cumbersome; cannot keep long.
Soy Ogi	62	Easy to prepare and tasty. A healthy mix for children.
Soy flour	76	Available in markets. Can easily be incorporated into other foods.
Soy Iru	52	Easy to prepare and as good as locust bean (Iru).
Soy Tofu	58	Not easily available, processing time long. Good as scramble egg and fried cheese.
Soy Moinmoin	36	Cannot be used alone.
Soy Akara	28	Disperse in oil as for moinmoin.

KEY: 80% - Very high
60% - High
40% - Moderate
30-39% - Low
Below 30% - Very low

Field Survey, 2002

Table 6: Nutrient Composition of Composts produced using PACT and Pit Composting

Composting Technique	5C	%N	C/Nratio	%P	%K	Zn	Pb	Mn	Fe	Cu
PACT	27.7	1.90	15.0	0.80	1.77	0.70	0.06	1.00	47.00	0.23
Pit	35.2	1.00	35.0	0.30	1.20	0.50	0.02	0.75	27.4	0.21

Table 7: Effect of Organic-based Fertilizers on Yield of Maize (t/ha)

Fertilizer (type/rate)	Sites			
	1	2	3	4
Control	1.2a	0.8a	2.0a	1.0a
Organic based (5t/ha)	2.0b	1.2b	3.1b	2.0b
Inorganic	1.5a	1.4b	3.2b	2.1b
CV%	3.0	21	23	25

I.A.R. & T., 1999 (Unpublished Report)

The use of cover crops (mucuna, cowpea and melon) for soil control.
Inter-cropping of cereal/legume to control soil loss and run-off with emphasis on spatial arrangement have been extensively researched.
Strip-cropping for prevention of soil loss and run-off on farms. This include the use of multipurpose trees and leguminous shrubs as hedgerows for soils erosion control and integrated land use.
Crop rotation with the aim of a shortening the rotation period and minimising the risk of erosion on farms.
The use of tied ridges for erosion control, evaluating the height and width of ridges on erosion run off control.
The use of contour bonds for the control of soil loss and run off.
Construction of ridge and heaps for soil and water conservation with the aim of improving spatial arrangement of heaps.
The use of vetiver grasss hedges on very steep slopes
Stabilisation of gully channels using vetiver grass, bamboo and shrubs.
Control of erosion by minimum tillage system.

Development of maize varieties suitable for the Forest and humid Savannah ecologies

The Institute has been involved with maize research for a very long time. Western yellow I was developed as far back as 1974 while Western White I (also known as Kewesoke) was developed in 1985 (Anon, 1991). The Western white I is most suitable for inter-cropping because it has upright leaves and this reduces competition for light with component crops. White and yellow varieties of popcorn have also been developed (Iken and Olakojo, 2000). All these maize varieties are high yielding and pest/diseases tolerant (Olakojo and Ogunbodede, 2000). They have first been tried and found suitable in the adopted villages. Some open-pollinated Downy Mildew Resistant (DMR) varieties (Olakojo and Kogbe, 2000) have been released to farmers. Examples are:
i. Open-pollinated - SUWAN-ISR; DMR-LSR-Y; DMR-ESR- Y and DMR-LSR-W.
ii. Hybrid - DMR 8644-27.

High yielding and disease resistant hybrids such as 9701, 9602, 9611, green maize (ART- 98- SW, and SW_2) have been tried in the adopted villages. The maize has higher sucrose and protein contents in addition to high yields and disease resistance. Collection and characterisation of maize germplasm have also been carried out. About 425 lines of maize collected from all over the country were evaluated, characterised and described using certain quantitative and qualitative characters.

Identification and Production of soybean and cowpea varieties adapted to SW Nigeria

The Institute has developed some improved soybean varieties in collaboration with IITA. These include TGX 923-2E, TGX 1019-2EB, etc. These varieties have been tested throughout the SW zone (Anon., 1991) and more research is still going on to further improve other varieties. Soybean varieties are also being multiplied at Oniyo adopted village for distribution to farmers since it is usually difficult to get viable seeds. Research on inter-cropping soybean with other crops like cassava and maize is in progress. The majority of the small holder farmers practice inter-cropping and it is hoped that soybean will be more acceptable to farmers when it is known that it can be intercropped with other crops. Some soybean varieties (e.g TGX 1689 - IF, 1679- 3F and 1649 - 9F) with the ability to fix nitrogen in the presence of high inorganic nitrogen have been included in the cropping system of cereals - legumes mixtures and remarkable increase in crop yield over continuous cropping has been recorded (Adegbite *et al.*, 2001).

The research on cowpea also started being fruitful since 1970 with the development of a variety known as Ife brown. Others such as West, Ife Bimpe and IFH 101 have since been developed (Anon., 1991). The varieties have been tried in the adopted villages and distributed to the

local farmers.

Cowpea and other legumes such as groundnut and pigeon pea have been used in rotation systems and crop mixtures to improve and/or maintain soil fertility with appreciable increase in yield of component crops over continuous sole cropping. These technologies have been extended to local farmers in the adopted villages. This has reduced their fertiliser requirement. Some improved groundnut varieties (e.g. 3576-801) that can yield about 1.9t/ha in the southern guninea savanna areas of SW Nigeria have also been identified.

Development, Identification, and Production of Improved Kenaf and Jute Varieties

In the Institute, two new Kenaf lines have been developed by the use of gamma irradiation. These are Ife Ken-100 and Ife Ken - 400. The two high yielding varieties that have been identified and found suitable for cultivation throughout several agro-ecologies are Cuba 108 and Tiannung. Kenaf is produced mainly for its fibre and various trials are being carried out to improve the fibre yield. Probability of producing breeder seed as well as foundation seed is also a major concern. On-station and on-farm evaluations of improved production packages are also carried out in all I.A.R. & T. substations.

Investigation of the use of kenaf for human consumption, livestock feed and industries is being harnessed since it can be used for local production of building materials, pulp and paper. However the major problem in developing and popularising its homestead and industrial uses is in the limitation of funds.

Two promising varieties of jute have also been identified - IACUD-154 and ETC 5-5. The importance of jute for packaging foodstuffs can not be overemphasised.

Breakthroughs in livestock research

(i.) Conventional livestock

Scientists in the livestock improvement and management programme have been able to develop lines of pigs - 'Niger hyb which could utilise agricultural by-products and wastes effectively (Adebambo, 1986). Research has also been intensified on the formulation of least cost rations incorporating crop residues and agro-industrial by-products as well as the use of organic waste ash as alkali for breaking down lingnocellulosic poor quality roughage to small and large ruminants (Adebowale, 1985). A lot of work has been done on complete diet of ruminant crop residues especially sheep and goat (Adebowale and Taiwo, 1996). This has culminated in the establishment of the Sheep and Goats Farmers Association of Nigeria (SHEGOFAN) with headquarters in the Institute. Breakthroughs in ethno veterinary and traditional management practices in small ruminant production are being co-ordinated through this association.

Other areas in which research has been intensified include:

- Development of modified raised platform for sheep and goats.
- Use of local materials for mange treatment.
- Economic feed formulation for rabbit rearing using available ingredient.
- Simple housing design for rabbit.

All these technologies have been disseminated to farmers especially in the adopted villages.

(ii) Unconventional Livestock

Research into unconventional Livestock is also in progress. These include:

Appropriate technologies for domestic snails have been developed. Monthly training for prospective snail farmers are carried out and an extension guide for snail farming has been produced.

The Snail Farmers Association of Nigeria has been established and its headquarters is in the Institute. This has enabled scientists and farmers to interact regularly on all aspects of snail farming. Work is also progressing in developing appropriate management and nutritional requirements of cane rat (grass cutter) in captivity with a view to

producing a package of production to prospective cane rat farmers. Foundation stocks of both snails and cane rats are being distributed to farmers. Simple housing design for each and their prototypes are also available in the Institute.

Design, Fabrication and Evaluation of Agricultural Equipment

In order to remove or reduce the drudgery associated with farm operations, some labour saving agricultural equipment have been designed, fabricated and evaluated in the Institute. These include maize, cowpea and soybean planters, fertilizer applicator, feed mixer and 2-row rice drill. Motorised soybean thresher with the capacity of clean threshing an average of 250kg per hour has also been designed and fabricated. This has drastically reduced the drudgery associated with soybean threshing and there is improvement in the quality of soybean produced.

Other implement that have been designed and fabricated are maize, cowpea and rice sheller, pedal-operated grain cleaner, fruit harvester, cassava fryer, palm kernel cracker and feed grinder. Prototypes are available but cannot be produced in commercial quantity until they are patented.

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