

FARMER INDIGENOUS EXPERIMENTATION FOR PEST MANAGEMENT UNDER YAM CULTIVATION FARMING SYSTEM IN THE HUMID ECOLOGICAL ZONE OF NIGERIA.

OGBONNA, KALU IROHA

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ABSTRACT

In spite of major thrust by research to increase agricultural production through the introduction of and use of scientific agricultural technologies, it is evident that most practices used by peasant yam growers to control and manage natural enemies to yam production consist of indigenous techniques borne of farmers experimentation. Yet, little information is available in an easily understandable form, on these cultural practices of local farmers. In Nigeria, pest constitutes one of the most pressing constraints to crop production, but farmers have built up tremendous knowledge on indigenous ways of controlling pests. The result of the studies conducted among yam farmers in some selected states of Nigeria revealed that the farmers, through their indigenous knowledge had developed botanical pesticides, using extracts of seeds and fruit of trees, wood ashes and other materials to control pests. This paper presents some field results of farmers' experimentation with regard to pests' management under yam cultivation farming systems within the humid ecological zone of Nigeria.

INTRODUCTION:

Majority of farmers in Nigeria, to a large extent, operate farming systems based on the predominant use of indigenous knowledge and technologies. These farmers, for generations, have developed diverse indigenous agricultural technologies and techniques they adapted to local conditions and available resources through their innovative activities in their constant struggle for survival (Musa and Atala 2003; Titilola, 2003). These farming systems and practices of farmers believed to be sustainable in the farmers' unique environment have played very important roles in communities in providing solutions to local farming and food security and for the survival of culture.

Recent studies have clearly portrayed the active role that rural communities in Africa and other parts of the world have played in generating knowledge, based on a sophisticated understanding of their environment and in devising mechanisms to conserve and sustain their natural resources, and in identifying problems and dealing with them through local- level experimentation, innovation and exchange of information with other societies. Very little of this knowledge has been recorded, yet it represents an immensely valuable body of knowledge that provide indigenous people with insights on how numerous communities have interacted with their changing environment including its floral and fauna resources (Warren, 1992, Posey, 1995).

In many different ethnic communities in Africa, traditional knowledge is a potentially rich source of knowledge that

can contribute to sustainable agriculture and provides a theoretical framework within which it is easier to understand farmers' practices, and decision making (Thurston, 1990; Shankar and Hafeel, 1999). It is evident that most practices for pests' management used by traditional farmers in developing countries consist of indigenous cultural controls, yet little information is available in an easily accessible or understandable form, (Ashle, 2000).

Today, indigenous people face uncertainty in their quest to use, nurture and sustain the ecosystems in which they live and on which they depend. While there is growing evidence of deteriorating biodiversity and a decrease in cultural diversity due to the influence of globalization, there are tremendous efforts and initiatives on the part of the local people to provide alternatives based on their indigenous knowledge. In Nigeria, pests constitute one of the most pressing constraints to crop production and farmers have built up tremendous knowledge on indigenous ways of controlling pests, which include burning, timely planting and harvesting, cultivating resistant crop varieties, rousing, weeding, cropping pattern and botanical pesticides, (Ogbonna and Okoroafor, 2003).

Studies on pests' management under yam production system, conducted over the years, have focused on contemporary scientific knowledge system, (Singh and Rao, 1999; Chandler, 1999; Rajasekan, Warren and Babu 1991, and Rhoades, 1991). Until recently, discussions and documentation on indigenous knowledge of farmers in the management of pest under

Ogbonna, Kalu Iroha, Department of Agricultural Extension and Rural Sociology University of Calabar, Calabar, Nigeria.

yam cultivation has been scanty. In the humid ecological zone of Nigeria, indigenous knowledge of yam growers in managing problems of pests has not been systematically documented and as a result, the extent to which farmers used them in their various yam cultivation activities to ensure effective pest control has been difficult to determine and established.

This paper is therefore designed to provide descriptive information on indigenous experimentation of farmers pertaining to indigenous cultural practices and techniques for pest management. The specific objectives include to: identify categories of pest affecting yam cultivation, source of farmers' knowledge of indigenous cultural pests control techniques, identify farmers' innovative experimentation in the management of pests of yam; reasons for preference of the methods, variables influencing the use of indigenous methods in the control of pests affecting yam production.

THEORETICAL CONCEPTUALIZATION OF INDIGENOUS CULTURAL PRACTICES USED BY TRADITIONAL FARMERS IN PEST MANAGEMENT.

A number of researchers have conducted studies on the cultural practices utilized by farmers for management of pests, some of which have been found effective and sustainable. Studies conducted by *Ewell et al* (1990), *Ortiz* (1997) have shown that majority of farmers in Africa, Latin America and Asia still depended on indigenous methods for controlling pests, even though such farmers have been introduced to integrated pest management techniques.

In Peru, farmers of the Inca Empire were known for their use of fallow and rotation practices for management of potato cyst nematodes. Thus, the use of light, intercropping, crop rotation, and traps to control insects and rodents have been a long time traditional practices by farmers in different parts of Africa, particularly in Nigeria. *Ogbonna and Okoroafor*, 2003.

Balasubramanian et al (2001) reported that farmers in India controlled termites by soaking the leaves of *calotropis* plant in water for a day and then pouring the filtered liquid on the termite-infested soil. The treatment of pests by making use of these plant's insecticidal properties were based on indigenous knowledge of farmers which they found to be very cost effective and valuable option in the treatment of plant pests. *Shankar* (1999) observed the use of musical instrument made of wood by Ghat community in India, to create different sounds to drive away wild animals and birds from damaging crops. Similarly, *Ortiz* (1999) found that farmers in Peruvian Andes have traditionally made use of a number of cultural control practices to check pests such as potato weevils and potato tuber moth whose devastating effects have resulted in serious crop failures. Some of the specific indigenous practices adopted by farmers in this area to control major potato pests include: crop rotation, use of repellent plants, feeding the larvae to chicken, early harvesting, exposing damaged tubers to sunlight and the use of chilly juice, ash or lime.

Among the Sri Lanka rice farmers, it was reported that large trees and wooded uplands were traditionally left standing around the paddy tracts to provide nesting and resting places for birds which the farmers regarded as

the main agents of insect control. *Cosma and Raymond* (2001) found that traditional pest control measure which included growing colorful and aromatic flowers to attract predators that feed on the pests that infest vegetable plants were used to minimize incidence of pests in vegetable garden in Zimota Zimbabwe. Also, non-toxic herbicides which sometimes include solutions from specific flowers were used to spray on the plants to control pests. Thus, in the absence of pesticides, these traditional techniques of pest management were considered very valuable in protecting crops and promoting yields. *Erinle* (1999) reported that farmers in Rwanda, Burundi and Zaire controlled ladybird beetle in cassava by using local plants such as 'tephrosia', 'vagelli', 'veronica', 'amygdalina' (bitter leaf), *Iboza riparia*. By spraying the juice extract over cassava plants every week, the population of the parasite was reduced. Studies have revealed that Nigerian farmers through their indigenous knowledge have developed botanical pesticides using tree barks, wood ashes and extracts from the fruits of trees to control insect pest. *Musa and Atala* (2003) reported that farmers in Malumfashi (Katsina State) used the bark of the tree *Anogeissus Leicocarpus* ("Marke" in Hausa dialect) the fruit of the tree *Parkia biglobosa* (locust bean tree) known as "Dorowa", extracts from neem tree (*Aza discachta indica*) known as Dogoyaro and wood ashes known as "Toka" to control crickets, and sucking insects. The bark of *Anogeissus Leicocarpus* is ground with fruit of locust bean tree into powder form and then mixed with wood ashes to form a sticky solution. This mixture is placed around the holes of the crickets which infested their farms and as the crickets emerge from their holes to eat the sticky solution, they get trapped by the sticky solution. In the process of struggling to break free, the insects get covered up by the solution and later on die when the solution dries up on them.

Also in Mbamakem community of Tarka Local Government Area of Benue State, a farmer in Adede kindred, based on local knowledge and practice controlled the attack of beetles on yam by using biglobosa water which attract yam beetles (*Ogbonna and Okoroafor*, 2003). In Enjema community of Kogi state, farmers applied indigenous knowledge in pest management. Farmers boil striga leaves in water, filter out and applied as seed treatment against soil borne disease, birds, squirrel and mice which attack and destroy crops. These and other innovative experimentation of farmers were borne out of their knowledge, a considerable part of which were encoded and transmitted through oral communication.

METHODOLOGY

The population of this study constituted all men and women engaged in active yam cultivation and individuals who presided over socio-cultural activities associated with yam cultivation. Through a purposive sampling technique, three states (Benue, Cross River and Ebonyi) and six local government areas were selected. A random sampling technique was used to select 180 farmers from the three states, while a purposive sampling technique was employed to select fifty four (54) key informants.

Semi-structured questionnaires, focused group discussion, guided by checklist and oral interviews were

the main research methods used in data collection. Memory banking constituted the main research methods employed by farmers and key respondents to give information on indigenous pest management techniques, as local peoples rarely keep records. Descriptive statistics such as frequency distribution, percentages, and mean scores were used to analyze and interpret the responses of farmers.

RESULTS AND DISCUSSIONS

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

The result of the analysis showed that yam production in the area of study was dominated by males (92%) who were within the upper age limit of 41 years and above (67.22%), married (86.11%) with average family size of 11, 13 and 9 persons per household for Benue, Ebonyi

and Cross River states respectively, while polygamous marriages prevailed in all the communities studied. Most yam farmers were illiterate to semi-illiterate (80.55%), engaged in full-time yam cultivation (80%), with more than 20 years of experience in yam cultivation (67.77%).

More than 35% of the farmers belong to one form of social organization, with financial assistance (63.33%), farm advice (50.4%), procurement of input, and labour assistance in the form of exchange (80%), as the most important reasons for membership. Trekking and head postage (68.88%) remained the common prevailing mode of transport in the area, while lack of access road (90%) and non availability of motor vehicle in the rural communities were constraints influencing productivity and availability of yams.

Decisions about yam cultivation and other farm activities were made by the head of the household who was usually the male member of the family, confirming the notion of yam being man's crop, traditionally.

Categories of pest affecting yam cultivation in the study area.

Table 1: Common pests of yam in the study area

Common Pests	BENUE		EBONYI		CR, RIVER		TOTAL	
	No.	%	No.	%	No.	%	No.	%
Caterpillars	19	34.55	14	24.14	33	49.25	66	36.67
White Scaly ants	27	49.09	24	41.38	32	47.76	83	46.11
Guinea fowl	2	3.64	4	6.90	15	22.39	21	11.67
Monkey	2	3.64	36	62.07	34	50.75	72	40.00
Bush Rats	34	61.82	56	96.55	49	73.13	139	77.22
Crickets	50	90.91	32	55.17	37	55.22	119	66.11
Bettles	51	92.73	42	72.41	47	70.15	140	77.78
Rabbits	38	69.09	5	8.62	26	38.81	69	38.33
Grass-cutters	5	9.09	5	8.62	18	26.87	28	15.56
Termites	54	98.18	32	55.17	45	67.16	129	71.67
	n=55	n=58	n=67	N=180				

Source: Field Survey

According to the data on Table 1, yam beetle (77.78%), bush rats (77.22%) and termites (71.67%) constituted the major dangerous pests affecting yam cultivation in all the communities surveyed. Whereas cricket (90.91%) and termites (98.18%) appeared to be more serious pests in Benue as compared to their incidence in Ebonyi and Cross River States, bush rats and monkeys posed more serious threat to yam cultivation in Ebonyi and

Cross River. These categories of pest dig out either the planted seed yams, the growing or mature tubers from the ground. Ants (46.11%) and the caterpillars were found to be pests associated with yam cultivation in the area, especially in Ogoja and Yala communities of Cross River. Effects of pests attack on yams included: reduction in yield, market value and distortion in physical appearance of mature tubers.

Pests' Management Option Adopted by Farmers.

Table 2: Types of pest control technique options used

Management Option	BENUE		EBONYI		CR, RIVER		TOTAL	
	No.	%	No.	%	No.	%	No.	%
Indigenous methods only	39	70.91	40	68.97	43	64.18	122	67.78
Scientific methods only	5	9.09	6	10.34	8	11.94	19	10.55
Both scientific & Indigenous methods	11	20.00	12	20.69	16	23.88	39	21.67

Source: Field survey n=55 n=58 n=67 N=180

From data on Table 2, it was observed that 67.78% of the farmers adopted indigenous techniques alone, while 10.55% of the farmers employed scientific methods only. However, 21.67% of the farmers adopted a complementary use of both indigenous and scientific

techniques to check the effect of pests on their farms. From the result, it was established that majority of the farmers in the area relied on indigenous techniques for pests' management.

Table 3: Reasons for farmers' preference of Indigenous pest control methods.

Reasons for preference	BENUE		EBONYI		CR, RIVER		TOTAL	
	No.	%	No.	%	No.	%	No.	%
Community known method	12	21.82	-	-	-	-	12	6.67
Very effective/efficient	26	52.00	28	53.84	24	40.68	78	48.45
Simple to use	29	58.00	25	48.07	35	59.32	89	55.28
Less hazardous	26	52.00	31	59.62	35	59.32	92	57.14
Cheap (Less expensive)	41	82.00	50	96.15	47	79.66	138	85.71
Readily available	33	66.00	44	84.62	34	57.63	111	68.94
	n=55		n=58		n=67		N=180	

Source: Field survey.

Data on Table 3 indicated that farmers' preference of indigenous pest management techniques to scientific techniques were anchored on affordability (85.71%), availability (68.94%) and simplicity (55.28%). With farmers judging the traditional techniques cheaper, relative to the cost of modern methods, readily available and easy to use, without requiring any form of specialized training or technicalities, the study found adoption of indigenous techniques higher than the

improved scientific methods. Thus, majority of the farmers indicated their consistent use of these indigenous techniques over the years without abandoning them for any other alternatives. However, few farmers combined the use of modern techniques such as chemicals, without actually stopping the use of indigenous techniques, a proof that the farmers have found the various traditional techniques effective and successful.

INDIGENOUS PEST MANAGEMENT TECHNIQUES UTILIZED BY YAM FARMERS IN PESTS CONTROL.

Table 4: indigenous cultural practices applied by yam farmers to check pests attack

S/n	Indigenous Cultural Practices	Benue	Ebonyi	Cross River	Total	Ranking
		mean score.	mean score	mean score	mean score	
1	Spreading of wood ashes	2.22	2.53	2.09	2.27	7 th
2	Handpicking of pests	2.14	2.71	2.28	2.34	6 th
3	Trap setting	1.76	1.93	2.52	2.12	8 th
4	Weeding/clearing of farm	2.64	2.69	2.49	2.60	2 nd
5	Spreading of goat faeces	1.91	2.47	2.00	2.07	9 th
6	Bush burning	1.47	2.50	2.00	2.00	12 th
7	Use of musical instrument to create different sounds to drive away wild animals	1.38	1.57	1.57	1.51	17 th
8	Application of sap fluid from local herbs or plants	1.76	2.00	1.43	1.72	13 th
	Natural botanical pesticides					
9	Adjustment of planting dates	2.38	2.02	2.45	2.29	3 rd
10	Rotating fields for yam planting	2.16	2.02	1.84	2.06	10 th
11	Planting of resistant traditional cultivars	2.56	2.22	2.43	2.53	4 th
12	Planting of repellent plants	1.89	2.60	1.78	2.03	11 th
13	Intercropping	1.91	2.45	1.48	1.72	13 th
14	Early harvesting of yams	2.27	1.83	2.25	2.38	5 th
15	The use of chilli juice or limes	2.29	1.86	2.18	2.41	3 rd
16	Use of kerosene and soap/detergent solution	1.58	1.67	1.92	1.60	15 th
17		1.51	1.45	1.66	1.54	16 th
18	Weeding with traditional hoes					
19	Uprooting of attacked yam plant	2.65	2.69	2.58	2.64	1 st
20		1.56	1.90	1.54	1.66	14 th

Mean scores derived from a 3-point Likert rating scale.

Source: Field Survey.

Farmers in the three yam producing states were asked to indicate the techniques they apply against pests' attack in their farms that have proven effective and successful. On 3-point Likert scale, the mean scores were determined. A mean score of 2.00 was used as a basis to identify indigenous pests management techniques of farmers. Any management control technique with a cumulative average of 2 and above was accepted as proven indigenous techniques borne out of the farmers knowledge. The result of the analysis as shown on table 4 revealed the following indigenous techniques as utilized by yam farmers in checking pests in their yam farms: weeding, (2.64), bush burning(2.6), rotation of fields (2.53),early harvesting of yams(2.41), intercropping with other crops(2,38)handpicking of pests(2.34), natural botanical pesticides made locally(2.19), spreading of wood ashes(2.18) trap setting(2.12), spreading of ruminant animal faeces.

The farmers indicated that spreading of wood ashes, animal faeces and other natural pesticides were meant to control problems of crickets, beetles, white ants, termites and caterpillars, while trap setting was used to catch monkeys and rodents such as bush rats, rabbits and grass-cutters. Clearing of a nearby bush is an indigenous methods designed to prevent and scare pests away from entering the cultivated area to destroy yams. Most of the farmers stated that burning was employed when yam production activities involved the clearing of virgin forest, fallowed vegetation or when large debris are left on the farm from previous cropping period. Apart from paving way for easy mound making, burning was believed to help destroy seeds of weeds, larvae of insects, resting cells of plant/pathogenic

bacteria, fungal spores and expose the hide out of rodents. Although many studies have identified burning as a poor farming practice because of its negative effect on soil organic matter and soil structure, however, farmers in the study area perceived it sa an efficient indigenous technique in the management of weeds, insects, fungal and bacterial organism in yam cultivation. The farmers studied reported that techniques identified were very successful in the management of pests and the sanitation of the farmland. However, the number of years farmers had used the techniques varied from community to community, ranging between a minimum of 6years and a maximum of 31 years.

FARMERS' EXPERIMENTATION WITH THE FORMULATION OF BOTANICAL PESTICIDES (LOCAL MIXTURE)

The study investigated specifically farmers' creative and innovative abilities in the control of pests in yam cultivation. The field survey revealed farmers innovative experimentation techniques borne out of farmers' indigenous knowledge and they consisted mainly of derivatives from plant and household resources, formulated for the management of pests in the farm. According to the result of the survey, some farmers indicated formulating and using natural botanical pesticides (local mixture) in their yam farms. This implied that the use of natural botanical pesticides was not a practice commonly adopted by majority of the farmers in the management of pests in the area. However, most farmers found them very effective, hence adopted them in pests control.

Types of natural botanical pest management mixture

Table 5: Type of local botanical mixture used in Pests control

Indigenous local botanical mixture used in Pests control	BENUE		EBONYI		CR, RIVER		TOTAL	
	No	%	No	%	No	%	No	%
Mixture of Ash + water, used on leaves	18	75.00	17	94.44	22	95.65	57	87.69
Ash + Palm oil, rubbed on seed yams	20	83.33	16	88.89	21	82.61	57	87.69
Mixture of locust bean& Itemgbe fruit placed around the farm	20	83.33	4	22.22	9	39.13	33	50.76
Grounded neem seed mixed with wood ash and sprinkled around the farm	19	79.16	4	22.22	16	69.57	39	60.00
	n=24	n=18	n=23	N=65				

Source: Field Survey.

MIXTURE OF NEEM SEEDS AND LEAVES/WOOD ASHES .

According to data on table 5, farmers in Benue and Cross River State, utilized local mixtures of *Neem* powder (neem leaves and seeds grounded), wood ashes to control beetles, termites, crickets and white ants. The neem seeds and/or leaves were dried, grounded into powder and then mixed with wood ashes from the cooking chambers. Sometimes, dried, grounded goat faeces were mixed and added to the mixture of neem powder and wood ashes, which is subsequently spread around the farm and on the growing yam leaves to check the action of caterpillar, crickets, beetles, and termites. The effect of the mixtures according to the farmers kills the pests once they get in contact with it. However, one of its limitations as farmers

identified was that the mixture does not have permanent effect on the farm for longer time period, and this made it less effective against pests when the effect of each application disappeared.

MIXTURES OF WOOD ASHES AND PALM OIL

Another innovative indigenous botanical pesticide farmers in Benue, Ebonyi and Cross River used to prevent pests involved the mixture of wood ashes and palm oil. This mixture was usually rubbed on the seed yams before planting, to guide against termites destroying the seeds before they sprout, the mature tubers and vines. Residues of oil palm are also placed at strategic locations in the farm and this attracted ants to the farm, which in turn acted as predators to the termites.

MIXTURE OF LOCUST BEANS AND FRUIT OF ITEMBEGE TREE

Farmers in Benue State, used the fruit of a tree known in *Tiv* language as *Itembege* as well as extract from boiled or washed locust beans to control termites. The extracts of the locust beans were poured at strategic locations or at the centre of the farm, while the fruit of the '*Itembege*' were dropped in the farm and allowed to rot. The odor of the locust beans extracts or the rotten *itembege* fruit, both attract birds and other animals into the farm which in turn fed on termites instead of yams, thus reducing the attack of pests on yam cultivated.

The farmers claimed that they applied these local pesticides to ensure that they obtain viable yam sets for next planting seasons, as well as good and attractive tubers that would sale better in the market. It was found that these innovative techniques were practiced by few farmers and was yet to gain wide popularity and acceptance among the generality of the farmers in the different communities.

A MIXTURE OF WOOD ASHES AND WATER

The common natural pesticide applied by virtually all the farmers in the surveyed communities of the Benue,

Cross River and Ebonyi involved the mixture of wood ashes and water. This mixture was spread or sprinkled on the leaves of growing yam to stop caterpillar from eating the yam leaves. The farmers claimed that the sour taste left on the leaves due to the mixture made them unpalatable for the caterpillars.

These findings as shown in table 5 demonstrate the innovative potentials and experimental abilities of the traditional farmers which could be harnessed and developed by scientists for more sustainable techniques for pests' management, in the absence of the use of chemicals. The farmers indicated that spreading of mixture of neem powder, oil palm, wood ashes, animal faeces and other natural pesticides were used to control problems of crickets, beetles, white ants, termites and caterpillars, in yam farms. However, other indigenous methods such as trap-setting used to catch monkeys, rodents such as bush rat/rabbits, and grass-cutters, clearing of nearby bush to the yam area were adopted to prevent and scare pests away from entering the cultivated area to destroy yams. Farmers confirmed the usage and effectiveness of the identified techniques in the management of pests. These cultural practices have been used by farmers over the years, ranging between a minimum of 6 years and a maximum of 31 years.

REASONS FOR THE USE OF TRADITIONAL PESTICIDES MIXTURE

Table 6: reasons for the use of traditional mixture in controlling yam pests

Reasons for use	BENUE		EBONYI		CR, RIVER		TOTAL	
	No	%	No	%	No	%	No	%
Cheap	19	79.17	11	61.11	16	69.57	41	63.08
Easy to produce	14	58.33	13	72.22	15	65.22	42	64.62
Effective	16	66.67	11	61.11	18	78.26	45	69.23
Readily available	20	83.33	12	66.67	19	82.61	51	78.46
No side effect	17	70.83	14	77.78	17	73.91	48	73.85

Source: Field Survey.

From the views expressed, some of the farmers who adopted the use of natural botanical pesticides, commonly known as local mixtures found them very cheap (63.08%), effective (69.23%), with no side effect (73.85%) and easy to produce (64.62%) while resource materials for their preparation were readily available

locally (78.46%). The implication is that farmers with low capital who could not afford chemicals which are often very expensive, beyond the financial capabilities of farmers could rely on this local experimentation to control pests which are serious problems in yam cultivation.

VARIABLE ASSOCIATED WITH THE USE OF INDIGENOUS CULTURAL PEST CONTROL TECHNIQUES

Table 7: Problems associated with usage of traditional pest control method

CONSTRAINTS	BENUE		EBONYI		CR, RIVER		TOTAL	
	No	%	No	%	No	%	No.	%
Labour intensive	51	92.73	47	88.03	42	62.69	136	75.56
Difficult to practice	41	74.55	28	48.28	49	73.13	104	57.78
Time consuming	31	56.36	28	48.28	62	92.25	93	67.22

Source: Field Survey.

Despite the advantage inherent with the use of traditional pest control techniques, most of the farmers identified labour requirement (75.56%), difficulty in their preparation (57.78%) and the time requirement in their application (67.22%) as major problems associated with the techniques' utilization as shown on table 7. In some cases, farmers incurred additional costs to hire labour to procure and process the raw materials needed or to apply the mixture, and these posed serious limitations to the application of these indigenous pest management techniques.

SUMMARY OF FINDINGS:

The finding showed that the farmers who opt for indigenous pests management methods under yam production system used cultural practices borne out of their local knowledge or defined their peculiar cultural setting. There were some farmers in the various communities who demonstrated innovative potential through the formulation of natural botanical pesticides (local mixture) which consisted of neem powder (seeds and leaves grounded), wood ashes, palm oil and dried animal faces to control beetles, termites, crickets, white ants, and caterpillars which posed serious threat to yam cultivation. In Cross River State, it was found that some farmers control termites by placing residues of palm oil at strategic positions in the farm which attracted ants to the farm and these ants in turn acted as predators to the termites by feeding on them, while in Benue State, farmers used the fruit of a tree known as "Itembege" in Tiv language and the extract from boiled or washed locust beans to control termites. Also neem seeds/leaves or bitter leaves were grounded and rubbed on yam seeds before planting to produce bitter taste which scare pests such as termites and white ants away from destroying the sets.

It was also observed that only few farmers exhibited innovative potential capabilities and as a result, the practice was yet to gain wide popularity and acceptance among the generality of the farmers in the different communities. Farmers preference of indigenous pest management techniques was anchored on affordability, availability and easy to use. However, high labour requirement, difficulty in procuring the raw materials for their preparation and the amount of time required in their application were identified as some constraints or limitations to the use of indigenous techniques by farmers in the area of study area. Generally, majority of the farmers studied had been consistent in the use of indigenous techniques alone over the years without abandoning it for any other alternatives, a proof that the various indigenous techniques have been found successful and effective.

CONCLUSION

The result of the study has proved that local people in the area surveyed have consistently relied on their indigenous practices and techniques for the management of pests in their yam farms. It was found that the local people adopted practices and techniques that suited the changing social, economic and cultural needs of the local communities, and only techniques

and practices that were peculiar to each group of people were used by the farmers.

It was observed that the innovative potentials and experimental capabilities demonstrated by few farmers, was yet to gain wide popularity and acceptance among the generality of the farmers. However, most of the farmers had been consistent in the use of indigenous techniques alone over the year in managing pests problems, without considering other alternatives such as the use of chemicals which most farmers often found highly expensive, non-available and very poisonous, with tremendous side effects. These constituted major reasons why majority of the farmers shunned the use of chemicals or other scientific method.

RECOMMENDATION:

Given the indigenous innovative and experimental abilities demonstrated by farmers in the area studied in the designing and application of indigenous local botanical pesticides, using locally available materials for the control of termites, beetles, white ants, caterpillars, crickets in yam farms, it is therefore, recommended that research scientists and extension workers should collaborate with the local farmers in designing new farming systems and techniques for pest management. A proper understanding of the local people's knowledge systems employed in pest management is needed by research scientists as well as extension workers to facilitate the acquisition of both indigenous and modern knowledge system, without eroding farmers pre-existing indigenous knowledge. Thus, understanding people's indigenous technical knowledge and practices will help to address yam production and local ecological problems associated with pests management.

REFERENCES

- Ashley, T. D. 2000. "Why Agricultural Development Projects have failed in Sierra Leone: Local Farmers' Indigenous Knowledge the Missing Element". *Indigenous Knowledge Development Monitor Vol. 8 (2): 19 -20.*
- Balasubramanian, A. V., Vijayalashmi, S. S. and Arumugasamy, S. 2001. "Vrkshayurveda Experiments: Linking Ancient Texts and Farmers' Practices". *COMPAS*. March: 36-39.
- Chandler, P. 1991 The Indigenuos Knowledge of Ecological Processes among peasants in Fujian", *Agriculture and Human Values* 8(1/2): 59-66
- Cosmas, G. and Raymond, T. 2001. "Eco-cultural villages in Zimbabwe". *COMPAS* March: 26 – 29.
- Erinle, I.D. 1994: An overview of Indigenous Knowledge Systems of Pest Control in Nigeria, Paper Presented at the Farming Systems Research Methodology Training Workshop, IAR, A.B.U, Zaira, April 10-16.

- Ewell, P., Fano, H., Raman, K. O. Alcazai, J., Pallacios, M. and Carthumara, J. 1990. "Farmer Management of Potato Insects in Peru Lima: International Potato Institute Centre".
- Musa, M.W. and Atala, T. K. 2003. "Complementary use of Indigenous and Modern Technical Knowledge as Best Practices for Sustainable Agricultural Development: A Case Study", Paper presented on Indigenous Knowledge and Agriculture Conference at university of Agriculture, Makurdi, October 23rd – 25th.
- Ogbonna, K. I. and Okoroafor, E. 2003. "Indigenous Knowledge and Sustainable Pest Management and Control: Impact on Food Security at Household and National Levels". Paper presented on Indigenous Knowledge and Agriculture; University of Makurdi, Oct. 23-25.
- Okoroafor, E., Ukwela, M. U., Nwankiti, A. O. and Ogunwolu, E. O. 1999. "Natural Pest Control, Improved Farm Participation in Research and Extension in Benue Project IFPREB.
- Ortiz, O. 1997. "The Information System for Integrated Pest Management (IPM) in Subsistence Potato Production in Peru; Experience of Introducing Innovative Information in Cajamarca Province". Ph.D Thesis, Agricultural Extension and Rural Development, the University of Reading, UK.
- Ortiz, O. 1999. "Understanding Interactions between Indigenous Knowledge and Scientific Information". *Indigenous Knowledge and Development Monitor* 40 (2): 194 – 201.
- Posey, D. A. 1995 "Indigenous Management of Tropical Forest Ecosystems: The Case of the Kayap Indians of the Brazilian Amazon", *Agro Forestry Systems* (3) 139 – 158.
- Rajasekaran, B, D. M. Warren and S. C. Babu 1991 Indigenous Natural Resource Management Systems for Sustainable Agricultural Development- A Global Perspective", *Journal of International Development* 3(4): 387-402
- Rhoades, R. 1991 "The World's Food Supply at Risk". *National Geographic*, 179(4): 75-105
- Shankar, D. and Hafeel, A. 1990. "Revitalizing Indigenous Health Practices", *COMPAS*, February: 28-29.
- Shankar, G. 1999. "Cultural and Agro-Ecology in Tribal Areas", *COMPAS* February: 34 – 35.
- Singh, G. S. and K. S. Rao 1999 "Altering Indigenous Farming Practices in North Western Himalayas", Kosi-Katarmal, Almora: Plant Institute of Himalayan Environment and Development
- Thurston, H. D. 1990. "Plant Disease Management Practices of Traditional Farmers' *Plant Disease* 74: 96 – 102.
- Titilola, S . T. 2003 "Indigenous Knowledge within the Framework of Sustainable Agricultural Development in Nigeria'
- A Lead Paper at Indigenous Knowledge and Agriculture National Conference, University of Agriculture, Makurdi, October 22-25.
- Warren, D. M. 1992. "Indigenous Knowledge and Sustainable Development: A Review of Critical Research Areas and Policy Issues", Paper Presented at the International Symposium on Indigenous Knowledge and Sustainable Development, Silang Carite, The Philippines.