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# Application of local knowledge to the development of Ecological Organic Agriculture in Nigeria

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## ABSTRACT

The survey was carried out in South West and North Central geo-political zones of Nigeria in the month of September and November 2014 to document the application of local knowledge in agricultural production in Nigeria especially the ones that could be called organic agricultural which are environmentally friendly and do not contribute to health hazards. Three states (Oyo, Osun and Ogun) from the South West and one state (Niger Sate) from the North Central were sampled. The tools employed for data collection were Focused Group Discussion (FGD) and Key Informant Interview (KII) using a developed research instrument as a guide. Farmers in the selected farm settlements and villages were interviewed in a participatory manner. The mean age of all respondents was 57 years. More males (89%) were involved in this traditional organic practices than females (11%) in South West while only male (100%) are documented to have been fully engaged in the indigenous organic farm practices in North Central Zone. There is variability in the number of years of farming experience of the respondents. The use of different application documented was highest for the crop pests and diseases management across the zones surveyed, which pinpoint importance of these biotic factors for productivity. The methods being used in various aspects of agriculture such as soil fertility management, seed dressing, weed control, field pest management, disease management, storage pest management, storage techniques, nutrition management, parturition management and fertility management range from methods that are scientific to the ones that are folklore and superstitious. However, this study is an eye opener to indigenous organic agricultural methods that can be improved and repackaged for moving organic agriculture forward in African and other regions of the world.

**Keywords:** Ecology, sustainability, organic agriculture, documentation, utilization.

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## INTRODUCTION

Organic Agriculture (OA) is a production system that sustains the health of soils, ecosystems, biodiversity and people. It relies on ecological processes and nutrient cycles adapted to local conditions, rather than the use of external inputs with adverse effects. Organic agriculture combines traditional knowledge, innovation and modern science to benefit the shared environment and promote fair relationships and a good quality of life for all involved as defined by International Federation of Organic Movement (IFOAM, 2004).

The history of environmental damage caused by modern agriculture is well documented; impacts include air pollution from greenhouse gases, land degradation as a result of clearing, cultivation of sloping land and salinity; water pollution from fertilizers, pesticides, overuse and wetland draining; and the loss of biological and ecological diversity (Norse and Tschirley, 2003). Adverse effects of modern agricultural practices are not only on the farm but also on the health of all living things (Meludu *et al.*, 2011).

United Nations Conference on Trade and Development (UNCTAD) and United Nations Environment Programme (2008) studies revealed that organic agriculture increased yields in Africa by over 100 % and that organic agriculture has higher yields under conditions of climatic extremes. Organic agriculture is highly suitable for increasing productivity of traditional small holder and agricultural systems. In the recent time, organic agriculture is developing rapidly and is now practiced in more than 160 countries of the world. IFOAM (2012) reported that as at the end of 2010, almost 37.0 million hectares of land were managed organically all over the world by about 1, 219 526 farmers, of which the majority (43.5 %) is in Africa.

The benefits of organic farming for Africa and Nigeria are numerous, from increasing yields and conserving water in semi-arid areas and combating desertification, to debt reduction for farmers, strengthening of

social systems and maximization of environmental services. Organic Agriculture, by its inherent multi-functionality, has the potential to both influence and address the factors that contribute to food insecurity and ensuring safe and adequate food, which is a basic human right. Promotion of organic agriculture in Nigeria is still less than 10 years. As of 2007, Nigeria had 3,154 hectares under organic agriculture, of which 50 ha were fully converted (Willer and Kilcher, 2009).

Presently, Nigerian farmers' interests are increasing in organic production, and are also eager to explore available opportunities to increase production and have premium on their produces. Most of the small scale farmers in Nigeria would be willing to convert to organic production because of their inability to purchase conventional inputs such as fertilizer, herbicides.

One of the major limitations to adoption of organic crop and animal production practices in many developing countries is the availability of technologies (practices) as well as inputs conformable to organic production practices (AdeOluwa and Adeogun, 2011). There are however some traditional practices among farmers which are in line with organic standards. This set of practices if puts together and at best revalidated through research could facilitate the adoption of organic farming in Africa. This activity of the Ecological Organic Agriculture (EOA) therefore documented the application of local knowledge to the development of Ecological Organic Agriculture in Nigeria.

Before the advent of modern agriculture, there had been practices which address several challenges that associated with agricultural production; weed pest and diseases infestations, soil fertility maintenance, storage, animal health and production etc. These methods are peculiar to different region of the world. Having realized the damages accompany the solutions offered by modern agriculture, it is necessary to re-consider all the abandoned traditional practices. The objectives of this activity were

therefore;

- To document the application of local knowledge in Agricultural production in Nigeria especially the ones that could be organic farming compliant.
- To promote ecological organic agriculture in Nigeria
- To contribute to the growing body of knowledge on organic agriculture in the country.

## MATERIALS AND METHODS

This survey covered Southwest and North central geo-political zones of Nigeria and was carried out between the month of September and November 2014. Three states (Oyo, Osun and Ogun) from the Southwest and one state (Niger) from the North Central. The tools employed for data collection were Focused Group Discussion (FGD) and Key Informant Interview (KII) using a developed research instrument as a guide.

The farmers group covered were four groups from Oyo, one group from Osun and one group from Ogun state. Their names respectively are; Farmer Field School (FFS) group (Ibadan), Arulogun-Aba Epo Farmers' group, Ilora Farm Settlement Farmers' group Oyo State, Akufo Farm Settlement farmers' groups, Oyo State, Ago Owu Farm Settlement Farmers' group Osun State and Odeda Farm Settlement farmers' group, Ogun State. In the North Central (Niger State), areas covered that involve focus group discussion are Chanchaga, Gwajigi and one key informant. Some prominent farmers were also interviewed. The information obtained were collated and documented. The study was carried out in the selected farm settlements and villages in a participatory manner. The focus group discussion (FGD) was carried out in the selected communities with the aid of open ended questionnaire that capture the socio-economic characteristics, demography, farming practices and level of awareness and practices of indigenous knowledge adopted in the communities. Data

collected were analyzed by descriptive analysis.

## RESULTS

### Personal characteristics of the farmers

**Age**: About 27% of the respondents were below 50 years old, while 73% were above 50 years of age in South western region and in the North central region reverse is the case because 71% of the respondents were below 50 years old, while 29% were above 50 years of age (shown in Table 1). This shows that indigenous Organic farm practices cut across all age groups. The older ones are there to impact expertise, which comes with experience, on the younger farmers. The mean age for all respondents was 57 years old.

**Sex**: More males (89%) were involved in indigenous Organic farm practices than female (11%) in Southwest, while only male (100%) are documented to have been fully engaged in the indigenous Organic farm practices in North central ( Table 1).This was in line with the findings of Oyesola *et al* (2011) that farmers in the Ekiti state, South Western Nigeria are mostly male with a mean age of 53.8 years

**Farming experience** : In the Southwest 20% of the respondents have less than 20 years of experience, while 80% has above 20 years of experience and in the north central region 80% of the respondents have less than 20 years of experience, while only 20% have above 20 years of experience. This shows that more farmers in Southwest have wealth of indigenous farming experience compared to those in the north central (Table 1).

## CROP PRODUCTION MANAGEMENT

**Soil Fertility Management:** Soil fertility refers the capacity of soil to supply sufficient quantities and adequate proportions of essential chemical elements i.e. nutrients and water required for optimal growth of specified plants as governed by the soil's chemical, physical and biological attributes.

The soil plays a major role in crop production management with reference to its degree of fertility. Series of challenges concerning soil losing its fertility over time were overcome via various indigenous agricultural practices such as shifting cultivation, bush fallowing, soil tillage and the use of both livestock and green manure. In North Central burning of rice shaft after harvesting and burying of house hold & kitchen waste on farmland helps to promote soil fertility. Shifting cultivation and the use of organic manures are the predominant practices that cut across both southwest and in the north central. These practices are organic in nature and are documented and highlighted in Table 2 and Table 3.

**Seed dressing:** A good quality seed with high viability status and germination vigor goes a long way to determine the success of a crop production management. Also important is the pre- sowing treatment which is applied as antimicrobial or fungicidal or few times insecticides. As a result of this, several indigenous agricultural practices of organic basis which were implored to treat seeds prior to planting include: the use of black residue from batteries and wood ash both in powdered form and solution, where the predominant practice is the use of wood ash. All practices were documented in the Table 2 and Table 3.

**Weed control:** Weeds are any kind of plants that are growing on undesirable location and therefore compete with crop plants for water, mineral nutrients and light which resulted in poor crop yields. Weeds constitute a larger percentage of the problems faced by farmers on the farmland and this necessitated an urgent attention by farmers to control them. Some of the practices are: covering the uncultivated areas on farmland with dry grasses or weeds, making ridges/beds on farmland, mulching, bush burning and regular weeding/hand weeding, the predominant practices are ridge/bed making on farmland, regular weeding and bush burning, while in North central inter cropping and

planting of cover crops are recorded. Shown in Table 2 and 3 below are the various indigenous agricultural practices of organic origin used to control weeds on farmlands.

**Field Pest Management:** Pests plays a devastating role in determining the yield and quality of seeds in crop production. It degrades the seeds and the resultant effect is poor production and promote field to storage pests. Different practices are used to checkmate all forms of pest attack experienced on farmlands. A huge number of information are gathered but just to mention few; use of extract of the following plants -Neem, Lemon grass, Tobacco, Baobab, Cocoa yam corms, Cassava tuber, Maize seeds, Devil beans, Pawpaw leaves, locust beans, *Tetraplura tetraptera,* Scent leaf and *Sida acuta*, spraying of the following on farmland; goat or human traces, wood ash, local black soap solution, kerosene, mixture of kerosene and detergent, powdered mixture of alligator pepper and head of grass cutter and small spicy pepper, construction of scarecrow, empty bottle & metal, shinning tapes and empty milk cans with stones to ward off birds and rodents on farmland, setting of traps and hunting of birds and rodents, regular hand picking of infected plants and burning them off, hanging of dead birds at different locations on farmland, burying of dead puppy/intestine of mole rats on farmland, tree felling, planting marigold flowers as boarder plant and employing bird scarier on farmland. Listed in Table 2 and 3 are the indigenous agricultural practices which are organic basis used in controlling insect and pest attack on farmlands. The utilization and efficacy of some of the listed plants in form of powder and extracts have been well researched as by several workers (Sambo and Okutu ,2010 ;Alamu, 1999).

**Disease Management:** The quality and yield in crop production are determined by the degree of disease incidences on farmlands and several indigenous agricultural practices such as robbing infected parts of livestock

with extracts/mixture of the following: Neem leave, tobacco and black coconut oil, pawpaw leaves, palm kernel, sulphur and palm oil, copper sulphate and engine oil, the following are administered in livestock feeds and water; Moringa leaves, dry pawpaw seeds, corn sap, salt, hot pepper solution and solution of *Lagenaria breviflorus*, construction of wooden stand for livestock to rest on and movement control by tying animals to a wooden pole, while in North central solution of Baobab leaves and solution of barks of karo, madaci, gamji and kirya plant are given to infected animals. All the aforementioned indigenous practices are organic in outlook which are used in disease management are documented in table 2.

**Storage Pest Management:** Farmers are faced with a great challenge of pest attack during post harvesting because most times after harvesting their produce there might not be immediate market for the harvested crop in question and such crops are prone to pest attack. The respondents highlighted several indigenous agricultural practices related to organic practices which are implore to confer lasting solution to the above problem such as; keeping stored seeds closed to smoke source, covering stored seeds with leaves of *Ficus esalspirata* and application of either dried or powdered pepper and yellow lime in stored seeds, while in North central grains are stored in bark of gamji tree. The aforementioned indigenous practices are highlighted in Table 2 and Table 3.

**Storage techniques:** Several storage challenges were addressed and several techniques used by the respondents to confer lasting solution to storage problems which are organic in nature were discussed as follows; storing seeds closed to smoke source, storing seeds in air tight bags on wooden stand, wooden barns, sacks and baskets, plastic bottles, covered plastic with ash, gourd and bottles, seeds are stored with pods and stored seeds are air dried. In North Central grains are stored in airtight tins, plastics container, sacks, silo, mud house, barn stakes and rhombus store, stored seeds are sun

dried (Table 2 and 3).

**ANIMAL PRODUCTION MANAGEMENT**

**Disease Management**: Several infectious diseases affect the growth and quality of several livestock in animal production management, some of which the respondents manage to address and they are listed in table 2 and table3.

**Nutrition Management.** The types of feeds given to livestock by farmers plays a vital role in growth/ developmental, productivity and quality of animals in animal production management. The respondents highlighted several natural feeds with reference to the role they play in livestock management. They are: beans shaft, cassava peel, corn sap and feeding livestock during the early hours of the morning, while in the North central maize stalk, rice bran, cowpea haulm, bark of Gamji, madaci, alum and cow plant are used to feeding livestock. The practices are documented in the tables below.

**Parturition management:** The act of reproduction is a crucial issue that calls for urgent attention by farmers, because it is a major key which determines the success in animal production management. The increase in production rate and the achievement recorded in livestock production marks the success of a farmer. Several challenges experienced in parturition management, alongside with the various indigenous agricultural practices used in conferring lasting solutions to these problems are: using palm oil &black as aseptic measure during delivery, feeding pregnant livestock with corn, corn shaft & salt and administering solution of *Spondia mombin* in to pregnant livestock for easy delivery, while in North central boiled extract of Geza leaf are given to pregnant animals for strength, Tsansagi and kalgo leaves/Yadiga leaves are given to livestock for milk production,ash

solution are applied to private parts of animals for easy delivery.

**Fertility Management:** During the course of this study, it was observed that the aspect of fertility management has been neglected over the years due to the fact that there have been no proven relevant indigenous agricultural practices that addressed this area of animal production management. It is hereby advised that further research/study should be embarked on, to ascertain the best practices in fertility management. However, the few methods recommended by the respondent are burying of umbilical cud of animals with pegs with multiple branches and tying multiple knots with raffia palm on the neck of female animals immediately after having sex.

**Environmental management:** In animal production management, the environment goes a long way to determine the health status and the productivity of the various animals. According to a popular saying "health is wealth". How healthy the livestock are, determine the rate of income generated from the sales. Some indigenous agricultural practices which are highlighted are: regular sanitation and wetting the surrounding with hot water.

**Inventory of plant used at different locations:** The inventory of plant species used in different locations as applications revealed Thirty-eight (38) plant species from twenty-four (24) plant families used for various crop and animal management in both geo-political zones (Table 4). Fabaceae and Arecaceae family were the highest with 4 entries. Thus, emphasized importance and the richness of agro biodiversity available in different Nigeria agro ecology and potentials for their utilization as enumerated by FAO (2008).

**Table 1: Personal Characteristics of the Respondents in Southwest (Oyo, Ogun, Osun State) and North Central (Niger State), Nigeria.**

| **Personal Characteristics of the respondents in the Southwest (Oyo, Ogun and Osun State), Nigeria** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age(Yrs) | Male | Female | Frequency | Percentage (%) | Farming Experience (Yrs) | Male | Female | Frequency | Percentage (%) | |
| <30 | 2 | | 2 | 3.6 | 0-9 | 3 | 2 | 5 | 9.1 | |
| 30-39 | 5 | 1 | 6 | 10.9 | 10 19 | 6 | | 6 | 10.9 | |
| 40-49 | 5 | 2 | 7 | 12.7 | 20-29 | 12 | 2 | 14 | 25.5 | |
| 50-59 | 17 | | 17 | 30.9 | 30-39 | 13 | 1 | 14 | 25.5 | |
| 60 above | 20 | 3 | 23 | 41.8 | 40-49 | 12 | 1 | 13 | 23.6 | |
| | | | | | 50 above | 3 | | 3 | 5.5 | |
| **Personal Characteristics of the respondents in the North Central (Niger State), Nigeria** | | | | | | | | | | |
| Age(Yrs) | Male | Female | Frequency | Percentage (%) | Farming Experience (Yrs) | Male | Female | Frequency | Percentage (%) | |
| <30 | 16 | | 16 | 53.3 | 0-9 | 15 | | 15 | 50 | |
| 30-39 | 10 | | 10 | 33.3 | 10 19 | 9 | | 9 | 30 | |
| 40-49 | 1 | | 1 | 3.3 | 20-29 | 3 | | 3 | 10 | |
| 50-59 | 2 | | 2 | 6.7 | 30-39 | 3 | | 3 | 10 | |
| 60 above | 1 | | 1 | 3.3 | 40-49 | | | | | |

Table 2: Inventory of plant species used for different applications

| S/N | SCIENTIFIC NAME | FAMILY | COMMON NAME | LOCAL NAME | |
|---|---|---|---|---|---|
| | | | | Hausa | Yoruba |
| 1 | *Moringa Olifera* | Asclepiadaceae | Drum Stick | Zogale | |
| 2 | *Prosopis Africana* | Fabaceae | Iron Wood, Axdewood | Kirya | |
| 3 | *Piliostigma Reticulatum* | Leguminosae/ Caesalpiniaceae | Camel Foot | Kalgo | |
| 4 | *Azadirachta Indica* | Maliaceae | Neem Tree, Nimba, Nimb | Dongo Yaro | |
| 5 | *Carica Papaya* | Caricaceae | Paw Paw | Ibepe | |
| 6 | *Ficus Platyphylla* | Moraceae | Flake/Red Kano ,Rubber Tree | Gamji | |
| 7 | *Khaya Senegalensis* | Meliaceae | African Mahogany | Madaci | |
| 8 | *Cymnema Sylvestris* | Asclepiadaceae | Miracle Fruit, Australian Cow-plant | Kashe Zaki | |
| 9 | *Adansonia Digitata* | Bombacaceae | Baobab Tree, Judas Fruit | Ose | |
| 10 | *Glypheae brevis monachino* | Tiliaceae | | | Atori |
| 11 | *Parkia biglobosa* | Fabaceae | African Locust Beans | | Iru |
| 12 | *Zea maize* | Poaceae | Maize | | Agbado |
| 13 | *Tagetes erecta* | Asteraceae | Marigold Flower | | |
| 14 | *Tetrapleura tetraptera* | Fabaceae | | | Aidan, Aridan |
| 15 | *Ocimum balsilicum L.* | Lamiaceae | Scent leave | | Effirin |
| 16 | *Spondias mombin* | Aanacardiaceae | Hug plum | | Iyeye |
| 17 | *Sida acuta* | Malvaceae | Wire weed | | Osekotu |
| 18 | *Cymbopogon citralis* | Poaceae | Lemon grass | | Ewetil |
| 19 | *Citrics limon* | Rutaceae | Yellow lime | | Osan Wewe |
| 20 | *Capsicum frutescens L.* | Solanaceae | Spicy pepper | | Ata Wewe |

| | | | | | |
|---|---|---|---|---|---|
| 21 | *Nicotiana tabacum L.* | Solanaceae | Tobacco | | Taba |
| 22 | *Corchorus olitorius L.* | Tiliaceae | Jute mallow | | Ewedu |
| 23 | *Aframomum melegueta* | Zingiberaceae | Alligator pepper | | Atare |
| 24 | *Manihot esculenta* | Euphorbiaceae | Cassava | | Ege |
| 25 | *Colocasia esculentum L .* | Arecaceae | Cocoyam | | Isu Koko |
| 26 | *Mucuna pruriens* | Fabaceae | Devil beans | | Werepe |
| 27 | *Jatropha Gossypifolia* | Euphorbiaceae | Wild cassava | | Lapa Pupa |
| 28 | *Cocos nucifera* | Arecaceae | Cocount | | Agbon |
| 29 | *Elacis guineensis* | Arecaceae | Palm kernel | | Eyin |
| 30 | *Laganaria breviflorus* | Cucurbitaceae | Pseudclocyth | | Tagiri |
| 31 | *Ficus Esalspirata* | Moraceae | Forest sandpaper | | Ewe Epin |
| 32 | *Lagenaria siceraria* | Cucurbitaceae | Gourds | | Ado Or Akeegbe |
| 33 | *Raphia africana* | Arecaceae | Raffia palm | | Iru |
| 34 | *Acacia polyacantha Spp.* | - | - | Karo | |
| 35 | *Combretum micranthum* | - | - | Geza Geeza | |
| 36 | *Bauhinia rufescens* | - | - | Tsansagi | |

**Table 3: Documentation of Application of local knowledge to the development of EOA in South West (Oyo, Osun and Ogun), Nigeria.**

| ACTIVE INGREDIENTS | MODE OF APPLICATION | USES | TARGET PLANTS/ ANIMALS | PEST/ DISEASE | LOCAL NAME |
|---|---|---|---|---|---|
| SOIL FERTILITY MANAGEMENT | | | | | |
| Shifting Cultivation | After farming on a land for a period of 3 to 5 years, one move to a virgin land to farm& allow the former land to fallow | Promote Soil fertility | | | |
| Bush fallowing | After farming on a land for a period of time, one abandon the land to fallow | Promote soil fertility | | | |
| Green manure | Application of green manure for 3 years | Promote soil fertility | | | |
| Livestock manure | Application of livestock manure o n farmland | Promote soil fertility | | | |
| Soil Tillage | After land clearing, till the soil(i.e. turning the soil) | Promote soil fertility | | | |
| Moringa | Application of Moringa leaves into a barren Land | Soil fertility | | | Ewe igbale/ Zogale |
| Crop rotation | Constant prac tice of crop rotation on farmland | Promotes Soil fertility | | | |
| Dry weeds | After cutting the weeds on farmland, allow it to decay then bury it underground | Promotes Soil fertility | | | Koriko gbigbe |
| Leguminous plants | Establishment of leguminous plants on farmland | Promotes Soil fertility | | | |
| Bush burning | Setting bushy farmland on fire | Promotes Soil fertility | | | Oko sisun |
| | | | | | |
| SEED DRESSING | | | | | |
| Black residue from batteries | Application of black residue from batteries on seeds before planting | Seed dressing | Maize | | |

| | | | | | |
|---|---|---|---|---|---|
| Wood ash | Application of wood ash over seed before planting | Seed dressing | Cocoa | | Eeru |
| Wood ash and water | Application of wood ash over seeds and sprinkle little water before planting | Seed dressing | All seeds | | Eeru ati omi |
| Corchorus seeds | Seeds af ter being stored away are either boiled in hot water before planting or are planted on bushy farmland afterwards the farmland are set ablaze | Promotes Seed dressing | Amaranths | | Omo ooyo |
| WEED CONTROL | | | | | |
| Dry weeds/grasses | After weeding/clearing the farmlan d, make ridges & placed the dry weeds/grasses in between the ridges made | Weed control | | | Eweko tabi koriko gbigbe |
| Ridges/Beds | After land clearing making ridges/beds | Weed control | | | Ebe ati |
| Hand weeding | After planting, one can hand pick the weeds on the farmland and exposed the roots | Weed control | | | |
| Mulching | After land clearing, one should gather all the weeds and use it to cover the uncultivated areas | Weed control | | | |
| Regular Weeding | Regular weeding either by hands or hoes on farmland | Weed control | All crops | | |
| Fire | Setting the farmland on fire to clear it | Weed control | | | |
| | | | | | |
| FIELD PEST MANAGEMENT | | | | | |
| Goat feaces | Goat feaces are sun -dried, burnt into ashes & sprinkled over Okra & Vegetables | Insecticides/ Pesticides | Okra &Vegetables | | Igbe Ewure |
| Neem | Leave extracts are sprayed over Crops | Insecticides/Pesticides | Crops &Vegetables | | Dongoyaro |
| | Put wood ashes into a perforated Clay - pot filled with dry grass & placed inside a bigger clay -pot, then add water. Then place a heavy object on | | | | |

| Wood ash | the perf orated pot to its extract contents and spray on affected farmland | Insecticides/Pesticides | Crops &Vegetables | | Eeru abaaje |
|---|---|---|---|---|---|
| Lemon grass | Leave extracts of lemon grass are used to spray seeds of Maize before planting, so as to prevent attacks from birds & insect-pest. | Insecticides/Pesticides | Maize | Birds | Ewe Tea |
| Alligator pepper & Grass cutter | Dried head of Grass cutter is powdered with seeds of Alligator pepper & sprinkled over Crops &Vegetables | Insecticides/Pesticides | Crops & Vegetables | | Atare ati ori oya |
| Tobacco | Tobacco leaves are soaked in water for 24 hours & the solution is sprayed on the field | Insecticides/Pesticides | Crops &Vegetables | | Ewe Taba |
| Baobab | Leaves or back extracts of Baobab are used to spray farmland | Insecticides/Pesticides | Crops &Vegetables | | |
| Wood ash | Sprinkling of ash over the crops on the farmland | Pests and insects control | All types of crops | All insects and pests | Eeru |
| Local black soap and water | Sprinkling the mixture of black soap and water on crops on the farmland | Pests and insects control | All types of crops | All insects and pests | Ose dudu anti omi |
| Cocoa yam corms | Application of cocoa yam corms extracts on the farmland | Pests and insects control | All types of crops | All insects and pests | Gbogiran koko |
| Kerosene | Sprinkling of kerosene ov er the crops on the farmland | Pests and insects control | All types of crops | All insects and pests | |
| Sap from cassava tubers | Sprinkling of cassava tuber sap over crops on the farmland. It should be applied under extenuating condition but with low dosage | Pests and insects control | All types of crops | All insects and pests | Omi ege |
| Dead Puppy | Burying a dead puppy in the middle of a farmland | Pests and insects control | All types of crops | Termites and Soldier ant | Oku omo aja |
| Hot sand | Application of hot sand inside dug hole after planting | Pests and insects control | All types of crops | All insects and pests | Eruku |
| Intestine of (Asin) rats | Burying of (Asin) rats intestine in crops surroundings | Pests and insects control | All types of crops | All insects and pests | Ifun eku asin |
| Enuopire plant | Planting enuopire as boarder plants on farmland | Pests and insects control | All types of crops | Termites | Enuopire |

| | | | | | |
|---|---|---|---|---|---|
| **Small spicy pepper** | **Sprinkling of small spicy pepper over the crops on the farmland** | **Pests and insects control** | **Maize** | **All insects and pests** | **Ata ijosi** |
| **Scarecrow** | **Establishment of scarecrow on farmland, which must be relocated on daily basis** | **Birds and rodents control** | **Rice and Maize** | **Birds and rodents** | |
| **Empty bottle and metal** | **Establishment of suspending empty bottle and metals wh ich gives a giggling sound on farmland to scare birds and rodents** | **Birds and rodents control** | **Rice and Maize** | **Birds and rodents** | **Igo ati irin** |
| **Net traps** | **Setting of net traps on farmland and keeping the trapped birds in the net to scare other birds away** | **Birds** | **Rice and Maize** | **Birds** | |
| **Human feaces** | **Dropping human feaces inside ant or termite hills** | **Pests and insects control** | | **Termites** | **Igbe eniyan** |
| **Maize seeds** | **Dropping maize seeds inside hills of termites, before germination ward off termites** | **Pests and insects control** | | **Termites** | **Koro agbado** |
| **Dried Devil beans** | **Spraying the mixture of powdered dried devil beans and water on farmland** | **Pests and insects control** | **All crops** | **All insects and pests** | **Ewe yerepe gbigbe** |
| **Dried Tobacco leaves** | **Spraying the mixture of powdered dried To bacco leaves and water on farmland** | **Pests and insects control** | **All crops** | **All insects and pests** | **Ewe taba gbigbe** |
| **Dried pawpaw leaves** | **Spraying a solution of powdered dried pawpaw leaves on farmland** | **Insects and Pests control** | **All crops** | **All insects and pests** | **Ewe popo gbigbe** |
| **Marigold flower** | **Planting Marigold flowers in rows in between plants on farmland** | **Pests and Insects control** | **Vegetables and other crops** | **All insects and pests** | |
| **Neem seeds extract** | **Spraying farmlands with Neem seeds extract** | **Pests and Insects control** | **All crops** | **All insects and pests** | **Omi eso dongoyaro** |

| Neem extract | Spraying farmlands with Neem leaves extract | Pests and Insects control | All crops | All pests and insects | Omi ewe/eso dongoyaro |
|---|---|---|---|---|---|
| Locust-beans extract | Spraying the extract of locust -beans on farmland | Pests and Insects control | All grains | All pests and Insects | Omi iru |
| Hot sand | Hot sand are sprayed across farmlands | Insecticides/Pesticides | Maize | Stem borer | Iyepe gbigbona |
| Hunting and Trap setting | Hunting and setting traps on farmland for rodents, birds and wild animals | Birds and rodents control | Maize, Rice etc. | Birds, rodents and wild animals | Ima dode ati takute ninu oko |
| Bird scarer | Employing the service of people to scare birds on farmland | Birds and rodents control | Maize, Rice etc. | Birds and rodents | A won ti won man le eye loko |
| Bottle and Metal | Hanging of bottles and metals together on ropes at different locations on farmland | Birds and Rodents control | Maize, Rice and other grains | Birds and rodents | Igo ati irin |
| Shinning Tapes | Making barricades o n farmland with shinning tapes which glitters and gives sound when blown by wind to scare birds and rodent | Birds and rodents control | Maize, Rice and other grains | Birds and rodents | |
| Empty milk cans and stones | Empty milk cans are filled with stones and are suspended on ropes at different locations on farmland and are shook at regular interval | Birds and rodents control | Maize, Rice and other grains | Birds and rodents | Agolo milliki ati okuta weeree |
| Hand picking | Hand picking of infected/affected plants and burning them off | Insects/Pests and Disease control | All crops | All forms of Diseases and Insect-pest attacks | |
| *Tetraplura tetraptera* | Dry seeds of *Tetraplura tetraptera* are burnt at different location on farmland | Pests and Insects control | All crops | All pests and insects | Eso ayidan |
| Neem,Pawpaw,Scent leaf and Red Jatropha | Little quantity of leaves of each of Neem, Pawpaw, Scent leaf and Red Jatropha are soaked in water inside a drum and sprayed on farmland at 10days interval | Pests and Insects control | All crops | All pests and insects | Ewe dongoyaro,ibepe,efinrin ati lapapupa |
| Tree felling | falling of big trees to prevent birds from poaching on trees | Birds expeller | Maize | Birds | Igi gige |

| | | | | | |
|---|---|---|---|---|---|
| **Dead birds** | **killing at least 3 birds & sundry them, then hang at strategic location s on the field** | **Birds expeller** | **Maize** | **Birds** | **Eye ija** |
| **Cage traps** | **Setting of Cage traps on farmland and leaving the captured bird in the field, so that it cry out to ward off the other birds** | **Birds expeller** | **Maize** | **Birds** | **Panpe dide fun eye** |
| ***Sida acuta*** | **Leaves e xtract from *S.acuta* or Atori are sprayed on maize plant to prevent logging** | **To enhance firmness** | **Maize** | | **Ewe Osepotu tabi ewe atori** |
| | | | | | |
| **DISEASE MANAGEMENT** | | | | | |
| **Neem** | **Leave extracts is used to rub infected parts** | **Anti-mange solution** | **Ruminants** | **Mange(Ekuku)** | **Dongoyaro** |
| **Tobacco & Black Coconut Oil** | **Mixture of leave extracts of tobacco & black Coconut oil are used to rub infected parts** | **Anti-mange solution** | **Ruminants** | **Mange(Ekuku)** | **Ewe Taba ati adin dudu** |
| **Moringa** | **Addition of Moringa leaves in livestock feeds & water** | **Antibiotics,Immune booster&Feed supplements** | **Farm livestock** | | |
| **Pawpaw** | **Pawpaw leave extracts are applied to infected parts of livestock** | **Antifungal/Antibacterials** | **Farm livestock** | **Fungi, Bacterial &Parasitic infections** | **Ibepe** |
| **Pawpaw** | **Dried Pawpaw seeds are mixe d with livestock feeds** | **Worm expeller** | **Farm livestock** | **Worms** | **Ibepe** |
| **Palm kernel** | **Fresh extract of Palm kernel shafts are applied on infected parts of livestock** | **Anti-minge** | **Farm livestock** | **Minge** | **Eeyin** |
| **Black Palm kernel oil** | **Application of black palm kernel oil on affected parts** | **Disease control** | **Sheep, goat and cattle** | **Minge** | **Adin eyan** |
| **Movement control** | **Controlling the movement of livestock by tying them with a long rope to a pole** | **Disease control** | **Sheep, goat and cattle** | **Several Diseases** | |

| Corn sap | Giving corn sap to livestock to drink | Disease control | Sheep, goat and cattle | | Omi agbado | |
|---|---|---|---|---|---|---|
| Salt | Addition of salt in water for livestock at regular interval | immune booster | Sheep, goat and cattle | | Iyo | |
| Wooden stands | Construction of wooden stands for livestock to rest on | Disease control | Sheep, goat, cattle and pigs | | | |
| Sulphur and Palm oil | Application of the mixture of sulphur and palm oil on affected parts | Disease control | Sheep, goat and cattle | Minge | Imi ojo ati epopupa | |
| Palm kernel extract | Application of palm kernel extrac t on the udder of the nursing livestock to cure mouth infection in young animals | Disease control | Sheep, goat and cattle | Mouth rot (ifakun eyun) | Eyin | |
| Copper sulphate | Application of copper sulphate at the infected parts | Disease control | Sheep, goat and cattle | Foot rot | Semi roro | |
| Engine oil | Cob of maize are deeper inside engine oil and applied to infected parts of livestock | Disease control | Sheep, goat and cattle | Minge | | |
| Hot pepper and water | Mixture of hot pepper and water are given to livestock | Disease control | Sheep, goat and cattle | Meningitis | Ata ijosi ati omi | |
| Tagiri and water | Tagiri are cut into pieces and soaked in water, the solution is given to livestock | Disease control | Sheep, goat, cattle and poultry birds | | Tagiri ati omi | |
| STORAGE PEST MANAGEMENT | | | | | | |
| *Ficus esalspirata* | The leaves of *Ficus esalspirata* are used to barricade the seeds stored in barns | Pests and Insects control | All grains | | All pests and insects | Ewe epin |
| Dried pepper(not powdered pepper) | Application of dried pepper inside stored seeds | Seeds storage | All grains | | All insects and pests | Ata gbigbe |
| Yellow Limes | Application of the fruit of yellow limes inside Gari stored in sacks | Storage management | Gari | | All insects and pests | Osan wewe ti o pon |
| Smoking | Constant smoking of dried maize | Storage management | Maize | | | Effin |

| STORAGE TECHNIQUES | | | | | | |
|---|---|---|---|---|---|---|
| Smoking | Make a square peg with 4 poles, place harvested Maize in the middle, cover with dry leaves & make fire around it with wood. The smoke from the wood helps to preserve it | Preservatives &Pest control | Maize | | | Efi ati ina igi Idaho tabi ina oju aro |
| Air tight bags and wooden stands | Storing powdered farm produces inside Air tight bags and placed on wooden stands | Storage management | Powdered plantains | | | |
| Air drying | Hanging dried maize on poles in an open environment, but avoid water contacts | Seeds storage | Maize | | | |
| Smoking | Harvesting seeds with pods and placed beside a smoke source | Promotes seed storage | All grains | | | Effi ino |
| Wooden Barns and Smokes | Seeds in pods/Tubers are stored in well raised barns under a shed with good ventilation and placed near a smoke source | Seeds/Tuber storage | All grains/Tuber crops | | | |
| Sacks and Baskets | Seeds harvest with pods are stored in sacks or baskets and are placed near smoke source | Seed storage | Beans and other grains | | | Apo ati apere |
| Plastic bottles | Dry seeds are stored in plastic bottles with cover | Seed storage | Beans, vegetables and other grains | Ike ragolis | | |
| Covered plastic and ash | Dry seeds are stored in covered plastic with ash at the base | Seed storage | Beans (awuje) | | | Ike olomori ati edu |
| Amaranths in pods | Seeds of amaranths are harvest with pods and stored | Seed storage | Amaranths and other grains | | | Omo ooyo |
| Gourds and Bottles | Dry seeds are stored in gourds or bottles | Seed storage | Vegetables and grains | | | Ado,Akereghe ati igo |
| | | | | | | |
| NUTRITION MANAGEMENT | | | | | | |
| Feeding Habits | Feeding livestock during the early hours of the day | Nutrition management | Sheep, goat and cattle | Several Diseases | | |
| Beans shaft | Feeding livestock with beans shaft | Growth development | Sheep, goat and cattle | | | Epo ewa |

| Peas shell | Feeding livestock with well processed (dried and made into flakes) cassava peels | Growth development | Sheep, goat and cattle | | Epo ege |
|---|---|---|---|---|---|
| Cassava peels | | | | | |
| Healthy cassava peels | Feeding livestock with healthy cassava peels | Nutrition management | Sheep, goat and cattle | | Epo ege to dara |
| Corn sap | Giving corn sap to livestock to drink | Disease control | Sheep, goat and cattle | | Omi agbado |
| | | | | | |
| PARTURITION MANAGEMENT | | | | | |
| Corn shaft and Salt | Feeding livestock with a mixture of Corn shaft and salt | Promote easy delivery | Sheep, goat and cattle | | Eeri ogi ati iyo |
| *Spondia mombim* | Soak leaves of *Spondia mmbim* in water inside a pot and give to animal in labor | Promote easy labor | Sheep, goat and cattle | | Ewe iyeye |
| Palm oil and Black soap | Application of the mixture of palm oil and black soap on hands as aseptic measures when helping livestock during delivery | Promote easy delivery | Sheep, goat and cattle | | Epopupa ati ose dudu |
| Seeds of Corchorus | Seeds of Corchorus are boiled in hot | Promote easy delivery | Sheep, goat and cattle | | Omo ooyo |
| Corn | Feeding livestock with corn | Promote easy delivery | Sheep, goat and cattle | | Guguru |
| ENVIRONMENTAL MANAGEMENT | | | | | |
| Sanitation | Proper sanitation at regular intervals of pens and cages | Disease control | All crops(Cocoa) | Black pod disease of cocoa | Imo toto |
| Daily sanitation | Observing sanitation on daily basis on farmland | Environmental management | Both plants and animal farming | Imototo ayika lojojumo | |
| Hot water | Spraying the environment with hot water | Environmental management | | | Omi gbono |
| FERTILITY MANAGEMENT | | | | | |
| Peg with 3 branching | Cutting off umbilical cord, carry with peg of three branching to bury, promote delivery of multiple birth | promote multiple birth (triplet) | Sheep, goat and cattle | | Igi amugaga meta |
| Raffia palm | Immediately after a female livestock mate, tie a raffia palm with 2 or 3 nuts on its neck to promote multiple birth | Multiple birth (triplet/twins) | Sheep, goat and cattle | | Iko |

**Table 4: Documentation of Application of Local Knowledge to the Development of EOA in North Central (Niger State), Nigeria.**

| ACTIVE INGREDIENT | MODE OF APPLICATION | USES | TARGET PLANTS/ ANIMALS | PESTS & DISEASES | LOCAL NAME |
|---|---|---|---|---|---|
| SOIL FERTILITY MANAGEMENT<br>Cow dung/ Goat and poultry droppings | spreading across the farmland prior to cultivation | promote soil fertility | all crops | | |
| Household and kitchen waste | Dumping of household and kitchen waste on farmlands | promote soil fertility | all crops | | |
| Bush burning | burning of farmland prior to cultivation | promote soil fertility | | | |
| Rice Chaff | Burning of rice chaff after harvesting on the farmland | promote soil fertility | all crops | | |
| SEED DRESSING | | | | | |
| Ashes/ Powder from dry cell | coating seeds with ashes/ powder from dry cell prior to sowing | seed dressing | legumes and cereals | | |
| WEED CONTROL | | | | | |
| Weeding with hoe | weeding with hoe on farmlands | weed control | all crops | | |
| Cover crops | planting of cover crops during early planting season | weed control | all crops | | |
| Inter cropping | Intercropping of maiz e, cassava and melon on a farmland | weed control | | | |
| FIELD PEST MANAGEMENT | | | | | |
| Bird Scarer | Employment of bird scarers on farmland | Pest /Insect management | rice and maize | | |
| kerosene and Omo detergent | spraying farmland with the mixture of kerosene and detergent solution | Pest /Insect management | Cowpea | | |
| Nets | Bird nets are use to trap birds on rice field | Field Pest management | Rice | | |

| Traps | traps are set on farmlands to capture rodents | Field Pest management | all crops | | |
|---|---|---|---|---|---|
| Scarecrow | use of scarecrow to ward off birds and other rodents | Field Pest management | | | |
| Ashes | Ashes are sprinkled on termite holes and tracks | Field Pest management | all crops | Termite | |
| DISEASE MANAGEMENT | | | | | |
| Burring of disease plants | Disease plants are removed and buried | Disease management | all crops | | |
| Baobab leaves and water | the mixture of grinded leaves of baobab and water are administered to infected animals | Disease management | Goat and Cattle | dysentry, worms & stomach ach | |
| Wood ash | sprinkling of wood ash on plants established on farmland | Disease management | | | |
| Barks of 'karo,'madaci', 'gamji' and 'kirya' | Barks of 'karo,'madaci', 'gamji' and 'kirya'boiled in water is administered to sick animals | Disease management | Goat, Sheep and Cattle | | karo, madaci, gamji & kirya |
| STORAGE PEST MANAGEMENT | | | | | |
| Bark of 'Gamji' tree | Bark of 'Gamji' tree are use to store grains | storage pest management | | | Gamji |
| Wood ash | seeds are dust with wood ash | storage/pest management | | | |
| Chilli pepper | Chilli pepper are mixed with cowpea | storage/pest management | Cowpea | | |
| ACTIVE INGREDIENT | MODE OF APPLICATION | USES | TARGET PLANTS/ ANIMALS | PESTS & DISEASES | LOCAL NAME |
| SOIL FERTILITY MANAGEMENT<br>Cow dung/ Goat and poultry droppings | spreading across the farmland prior to cultivation | promote soil fertility | all crops | | |

| | | | | | |
|---|---|---|---|---|---|
| **Household and kitchen waste** | **Dumping of household and kitchen waste on farmlands** | **promote soil fertility** | **all crops** | | |
| **Bush burning** | **burning of farmland prior to cultivation** | **promote soil fertility** | | | |
| **Rice Chaff** | **Burning of rice chaff after harvesting on the farmland** | **promote soil fertility** | **all crops** | | |
| **SEED DRESSING** | | | | | |
| **Ashes/ Powder from dry cell** | **coating seeds with ashes/ powder from dry cell prior to sowing** | **seed dressing** | **legumes and cereals** | | |
| **WEED CONTROL** | | | | | |
| **Weeding with hoe** | **weeding with hoe on farmlands** | **weed control** | **all crops** | | |
| **Cover crops** | **planting of cover crops during early planting season** | **weed control** | **all crops** | | |
| **Inter cropping** | **Intercropping of maiz c, cassava and melon on a farmland** | **weed control** | | | |
| **FIELD PEST MANAGEMENT** | | | | | |
| **Bird Scarer** | **Employment of bird scarers on farmland** | **Pest /Insect management** | **rice and maize** | | |
| **kerosene and Omo detergent** | **spraying farmland with the mixture of kerosene and detergent solution** | **Pest /Insect management** | **Cowpea** | | |
| **Nets** | **Bird nets are use to trap birds on rice field** | **Field Pest management** | **Rice** | | |
| **Traps** | **traps are set on farmlands to capture rodents** | **Field Pest management** | **all crops** | | |
| **Scarecrow** | **use of scarecrow to ward off birds and other rodents** | **Field Pest management** | | | |
| **Ashes** | **Ashes are sprinkled on termite holes and tracks** | **Field Pest management** | **all crops** | **Termite** | |
| **DISEASE MANAGEMENT** | | | | | |
| **Burring of disease plants** | **Disease plants are removed and buried** | **Disease management** | **all crops** | | |

| Baobab leaves and water | the mixture of grinded leaves of baobab and water are administered to infected animals | Disease management | Goat and Cattle | dysentry, worms & stomach ach | |
|---|---|---|---|---|---|
| Wood ash | sprinkling of wood ash on plants established on farmland | Disease management | | | |
| Barks of 'karo,'madaci', 'gamji' and 'kirya' | Barks of 'karo,'madaci', 'gamji' and 'kirya'boiled in water is administered to sick animals | Disease management | Goat, Sheep and Cattle | | karo, madaci, gamji & kirya |
| STORAGE PEST MANAGEMENT | | | | | |
| Bark of 'Gamji' tree | Bark of 'Gamji' tree are use to store grains | storage pest management | | | Gamji |
| Wood ash | seeds are dust with wood ash | storage/pest management | | | |
| Chilli pepper | Chilli pepper are mixed with cowpea | storage/pest management | Cowpea | | |

## DISCUSSION

Organic agriculture is an age long practice that is common in all farming communities of Africa which has a lot of advantages. The advantages include the reduction of residues of inorganic compounds that can cause health hazards in the agro ecosystem; it is ecologic, sound and combines traditional knowledge, innovation and modern science to sustain sound health, good environment and total well-being of nature. Organic agriculture also improves the long-term sustainability of agriculture and promotes farmers' markets and food quality.

Accordingly, diversity of plants from different family (majorly parts, residue, extracts, and formulations) and inorganic substances were used in the crops and animal production system across the zones studied. This indigenous knowledge was derived from years of utilization as a result of the consciousness of the available agro biodiversity and agricultural practices adopted in the zones. The study indicated that more adult males were involved in organic agriculture practices in the Southwest than in North-Central and indication that there is the need to sensitize, mobilize and motivate youth population interests in agricultural production in the country.

The farmers highlighted several challenges encountered in production which include land clearing and weeding drudgery, insect and diseases attack, lack of buyers and good market for the produce, shortage of good and productivity seedlings, need for finance, This was corroborated by Olabiyi *et al* (2010) who noted that lack of institutional support, enabling policies, infrastructure, and marketing facilities, limited access to capital and inability to capture economies of scale are among the major constraints encountered by organic producer in Nigeria

Documentation of the indigenous knowledge on ecological organic agriculture provide a veritable tool and source of information for agriculturists, producers and farmers now and in posterity towards development of research and development initiatives in the agricultural

sector in Nigeria. There is the need to develop research and developmental framework in the efficiency, efficacy and functionality of this documented knowledge in order to drive ecological sustainability and productivity.

Consequently, the targeted cultivation and conservation of plant species inventoried in the various communities will promote conservation of threatened and endangered species among the ones identified. Converted efforts should be put in place by government at local, state and federal levels towards the development and popularization of ecological organic agriculture in Nigeria through curriculum development, agricultural extension services provision of enabling environment and policy formulations. These efforts should be geared towards adequate agricultural policies and support for the marketing of farmer's produces. Also, subsidies and grants from Government as are practiced in United States and other developed countries which are given to the organic farmers will go a long way to encourage organic agriculture practices in Nigeria.

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