The Needed Practices by Crop Farmers in Green Manuring for Maintaining Soil Fertility for Sustainable Food Security in Enugu State, Nigeria

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ABSTRACT--- ***This paper x-rayed practices needed by crop farmers in green manuring for maintaining soil fertility for sustainable food security in Enugu State, Nigeria. Three specific objectives were developed for the study. Three research questions guided the study. Descriptive survey research design was adopted for this study. The target population of the study was 449 registered crop farmers. The population of the respondents was 320. The sample of the study was 133 respondents. A random sampling technique was used to select 84 teachers of agricultural science while the entire population of the extension workers was used. A 35- Green Manure Practices Questionnaire (GMPQ) items was developed from literature and used for data collection. The instrument was subjected to face and content validation by three experts. Cronbach Alpha reliability method was adopted to determine the internal consistency of the questionnaire items. A reliability of 0.88 was obtained. One hundred and thirty-three copies of the questionnaire were administered to the respondents while one hundred and twenty-six copies were retrieved and analyzed using mean and standard deviation. The result of this study showed that 9 plants serve as green manure in Enugu State, 12 practices are needed by crop farmers in utilizing green manure as a sole crop and 10 practices as an intercrop for maintaining soil fertility in Enugu State. It was recommended that the identified plants and practices should be utilized by extension workers in retraining farmers for maintaining soil fertility and so on.***

Keywords--- sustainable food security, crop farmers, soil fertility, green manuring, practices

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1. INTRODUCTION

Food is any liquid or solid substance that provides man with the nutrients needed for energy and growth. The rate at which man has access to food indicates the level of his physiological security. Food security has become a global concern because it is one most basic human right. Food and Agricultural Organization (FAO, 2008) defined food security as the availability of food and one's access to it. A household is considered food-secure when its occupants do not live in hunger or fear of starvation. World Health Organization (WHO, 1996) stated that food security exists when all people at all times have access to sufficient, safe, nutritional food to maintain a healthy and active life. It includes both physical and economic access to food that meets people' dietary needs as well as their preferences. Duhaime and Godmaire (2002) proposed four categories of food security which are sustainable security (SS), relative security (RS) relative insecurity (RI) and chronic insecurity (CI).

According to Food Security Network (FSN, 2013) sustainable food security means that all people at all times have physical and economic access to adequate amounts of nutritious, safe and culturally appropriate foods, for a long period of time. The food need to be produced in an environmentally sustainable and socially just manner and people are able to make informed decisions about their food choices. Therefore, sustainable food security is the ability of people to have both physical and economic access to sufficient, safe, nutritious and preferred food that meets their physiological need to maintain healthy and active life for a long period. The WHO (1996) reported that food security is built on three pillars namely: food availability (having sufficient quantities of food consistently), food access (having sufficient resources to obtain appropriate foods for a nutritious diet) and food use (refers to knowledge of basic nutrition and cure, as well as adequate water and sanitation). The first pillar which is food availability of a state or country, to a great extent,

depends on certain agricultural issues among which include the number and competence of farmers, technological innovations and adoption, government policies on Agriculture, cultural practices adopted by farmers among others.

A farmer as described by Olaitan, Ifeanyieze and Eze (2012) is a person who grows plants or rears animals for the benefit of mankind. It is an individual who owns or manages a crop or an animal farm. In this study, a crop farmer is an individual who owns or grows crops such as grain, cassava, vegetables, cocoyam, yam among others for the benefit of mankind. These farmers make use of different approaches towards maintaining soil fertility to increase crop yield sufficiently for sustainable food security in the area.

Soil fertility, in the submission of Havlin, Beaton, Tisdale and Nelson (2005) is the richness of a soil with reference to nutrient contents for the support, growth and yield of crops. It refers to the extent of which a soil contains and supplies nutrients needed to sustain the growth, development and yield of healthy plants. The fertility of a soil is usually measured by observing the growth, yield and health of crops growing on it. When the fertility of the soil is discovered to be low, farmers utilize fertilizers to rehabilitate the soil to ensure sufficient food supply for sustainable food security. An example of such manure includes green manure.

Green manure is explained by Schmid and Klay (1984) as growing crops which are meant to be incorporated into the soil to increase its fertility. Howard and Wad (2008) stated that green manure refers to crops grown for the express purpose of ploughing them into the soil to increase the soil fertility through the nutrient and organic matter returned to the soil. The authors explained that the act of growing green manure (legumes) and incorporating them into the soil at certain stage of their development (especially before they start flowering) is known as green manuring. Sullivan (2003) observed that green manure is one of the effective alternatives to chemical fertilizers in the management and preservation of soil fertility for productivity as it adds organic matter and nutrients to the soil as well as protecting soil from damage due to wind, rain and sun. The author further stated that green manure can also be used as animal feed as well as fertilizer. Clark (2007) outlined advantages of green manure to include: (i) symbiotically-fixes free nitrogen to the farming system with the help of root nodule bacteria (ii) retains soil nutrient with them that could have been washed out by rain (iii) decomposes into humus thereby increasing the fertility of the soil (iv) mines nutrients leached deep into the subsoil due to deep root system (v) crates a temporary habitat for beneficial predators (vi) promoting water infiltration (vii) suppresses weeds and so on. The extent to which farmers obtain the above benefits from green manures especially for maintaining soil fertility depends on the knowledge of the farmers about plants that serve as green manure and practices utilized in green manuring.

Practices refer to the general knowledge and standard procedures employed in utilizing green manure for the maintenance of soil fertility in a crop farm. The farmers need to be competent in practices in green manuring so that they could maintain soil fertility for sustainable food security in the State. However, the questions are: do farmers know the plants that serve as green manure? Can farmers perform the practices in utilizing green manure as a sole crop or an intercrop for maintaining soil fertility?

In Enugu State, it was observed that most crop farmers apply mainly inorganic fertilizer in the farm for maintaining soil fertility. Studies have shown that inorganic fertilizers, at short run, increases yield but at long run, have many adverse effects on agriculture and the ecosystem. The United Nations Environment Programme (UNEP, 2008) reported that organic farming could be more conducive to food security in Africa than most inorganic farming which uses synthetic chemicals in production. The report expressed that even though inorganic farming seems to be more time and energy saving, yield and income generating; it has heavy adverse effects on human beings, natural environment and the ecosystem. It is not self sustaining because most of inorganic materials are imported into developing countries like Nigeria. The report also indicated that organic farming is sustainable and environmental friendly. Mowo, Janssen, Laura, Mrema, and Shemdoe, (2010) stated that currently, inorganic fertilizer prices doubled their levels in 2006, and Africa account for less than 1% of global fertilizer consumption. Lal (2009) emphasized that the use of inorganic fertilizers by smallholders to replenish their soils is often not economically feasible, due to high prices and the risk of drought stress. This suggests that the utilization of inorganic fertilizer in Enugu State is not sustainable to ensure sustainable food security.

In a pilot study conducted by the researchers with 47 crop farmers in two out of the three Agriculture zones in Enugu State, it was found out that most of the farmers have very little knowledge of plants used as green manure; they have doubts on the efficacy of green manure in maintaining soil fertility without inorganic fertilizer and have not cultivated green manure with the intention of using any of them to enhance fertility of the soil. Besides, there is dearth of literature indicating the plants that serve as green manure and the practices in utilizing green manure for increasing soil fertility in Enugu State. Therefore, the findings of the pilot study and the gap in literature vindicated the need for this study which the major purpose was to identify practices needed by crop farmers in green manuring for maintaining soil fertility for sustainable food security in Enugu State, Nigeria. Specifically, the study sought to identify:

- plants that serve as green manure in Enugu State.
- practices needed by crop farmers in utilizing green manure as a sole crop for maintaining soil fertility.
- practices needed by crop farmers in utilizing green manure as an intercrop for maintaining soil fertility.

2. RESEARCH MEHODOLOGY

Three research questions guided the study. Descriptive survey research design was adopted for this study. Olaitan, Ali, Eyo and Sowande (2000) stated that descriptive survey research design is a plan, structure and strategy that the investigator wants to adopt in order to obtain solution to research problems using questionnaire in collecting, analyzing and interpreting the data. This design was suitable for this study because questionnaire was used to collect data from teachers of agricultural science and agricultural extension agents.

The study was carried out in Enugu State, Nigeria. The target population of the study was 449 registered crop farmers. The population of the respondents was 320 made up of 281 teachers of agricultural science in senior secondary schools (Post Primary School Management Board, 2012) and 49 extension workers (Enugu State Agricultural Development Project, ENADEP, 2012). The sample of the study was 133 respondents made up of 84 (30%) teachers of agricultural science and 49 extension workers. A random sampling technique was used to select 84 teachers of agricultural science while the entire population of the extension workers was used because of its manageable size.

A 37- green manure practices questionnaire items was developed from literature and used for data collection. The instrument has a 4- point response scale of highly accepted, averagely accepted, slightly accepted and not accepted with a corresponding value of 4, 3, 2 and 1. The instrument was subjected to face and content validity by three experts, one from the department of Soil Science, another from the department of Crop Science and the third from the department on Agricultural Education, all from University of Nigeria, Nsukka. The corrections and suggestions of validates were used to produce the final version of the questionnaire. Cronbach Alpha reliability method was adopted to determine the internal consistency of the questionnaire items. A reliability of 0.88 was obtained. Six research assistants who were familiar with the three Agriculture Zones in Enugu State were involved and given orientation on how to administer the questionnaire to the respondents.

One hundred and thirty-three copies of the questionnaire were administered to the respondents while one hundred and twenty-six copies were retrieved and analyzed using mean and standard deviation to answer the research questions. Any item with a mean value of 2.50 or above was regarded as accepted while any item with a mean value below 2.50 was regarded as not accepted. Any item with a standard deviation between 0.00 and 1.96 indicated that the respondents were not far from the mean and the opinion of one another; therefore, the item was term valid.

3. RESULTS

3.*1 Plants that serve as green manure in Enugu State*

Table 1: Mean ratings of the responses of teachers of agricultural science and extension workers on green manure plants in Enugu State (N=126)

S/N	Name of plants	X	SD	Remark
1.	Cowpea	3.43	0.41	Accepted
2.	Buckwheat	3.13	1.01	Accepted
3.	French white millet	3.06	0.72	Accepted
4.	Japanese millet	2.69	1.84	Accepted
5.	Soybean	3.72	0.61	Accepted
6.	Groundnut	3.84	0.54	Accepted
7.	Lucerne	1.43	1.44	Not accepted
8.	Faba bean	2.22	1.39	Not accepted
9.	Mucuna	3.20	0.54	Accepted
10.	Mung bean	3.54	1.23	Accepted
11.	Lablab	2.04	0.94	Not accepted
12.	Woolly pod vetch	2.10	0.64	Not accepted
13.	Fenugreck	1.88	0.57	Not accepted
14.	Alfalfa	2.51	0.77	Accepted
15.	Lupins (bitter blue)	2.41	0.21	Not accepted

N= number of respondents, X = mean, SD = standard deviation.

The data in table 1 revealed that 9 out of 15 plants had their mean values ranged from 2.51 - 3.84. The mean values of the 9 items were above the cut of point of 2.50, indicating that the respondents accepted that the 9 plants were green manure in Enugu State. The table also revealed that 6 out of the 15 plants had their mean values ranged from 1.43 -2.41. These mean values were below the cut of point of 2.50, indicating that the 6 green manure plants were not utilized in Enugu State. The table showed that the standard deviation of the items ranged from 0.21- 1.39 which were below 1.96. This indicated that the respondents were not too far from the mean and from one another in their responses.

3.2 ***Utilizing green manure as a sole crop for maintaining soil fertility***

The data in table 2 revealed that all the 12 practices were needed by crop farmers in utilizing green manure as a sole crop had their mean values ranged from 2.66 - 3.95. The mean values were above the cut of point of 2.50, indicating that the respondents accepted that all the 12 practices were needed by crop farmers in utilizing green manure as a sole crop for maintaining soil fertility. The table also showed that the standard deviation of the responses of the respondents ranged from 0.19 - 1.12, indicating that the respondents were not too far from the mean and from the opinion of another in their responses.

Table 2: Mean ratings of the responses of teachers of agricultural science and extension workers on the practices needed by crop farmers in utilizing green manure as a sole crop for maintaining soil fertility (N=126).

S/N	Practice item statements	X	SD	Remark
1.	Select legume species with desirable characteristics	3.63	0.84	Accepted
2.	Inoculate the legume seeds/cutting if required	3.95	0.70	Accepted
3.	Prepare seed bed by removing weeds and cultivating the site	3.76	0.81	Accepted
4.	Water the seed bed if dry	3.06	0.73	Accepted
5.	Broadcast the inoculated seeds or plant the cuttings before heavy rain.	3.19	1.12	Accepted
6.	Weed the farm regularly to reduce weeds, pest and disease pathogens.	3.77	0.65	Accepted
7.	Cut the leaves and stems for folder if required	2.66	0.81	Accepted
8.	Harvest the pods of green manure for next season crops	2.84	0.37	Accepted
9.	Slash the stalks of the green manure before it starts flowering.	3.41	0.19	Accepted
10.	Keep ruminants away from grazing on it.	3.55	0.44	Accepted
11.	Turn the slashed manure into the soil through harrowing or ploughing after two weeks.	3.64	0.54	Accepted
12.	Plant food crops on the soil immediately after soil tillage.	3.78	1.00	Accepted

N= number of respondents, X = mean, SD = standard deviation.

3.3 Utilizing green manure as an intercrop for maintaining soil fertility

Table 3: Mean ratings of the responses of teachers of agricultural science and extension workers on the practices needed by crop farmers in utilizing green manure as an intercrop for maintaining soil fertility (N=126).

S/N	Practice item statements	X	SD	Remark
1.	Select legume species compatible with the food crop.	3.33	0.70	Accepted
2.	Inoculate the legume seeds/cutting if required	2.95	0.37	Accepted
3.	Prepare seed bed by removing weeds and digging the soil.	3.11	1.31	Accepted
4.	Water to irrigate the seed bed if dry	3.16	1.12	Accepted
5	Plant food crops especially cereals on the soil immediately after soil tillage.	3.00	1.00	Accepted
6	Broadcast inoculated seeds or cuttings of green manure 2 weeks of planting the food crop.	3.90	0.17	Accepted
7.	Rake the seeds 2cm into the soil or firm the stands of the cuttings with wet soil.	3.51	1.32	Accepted
8.	Weed the farm regularly to reduce weeds, pest and disease pathogens.	3.07	1.25	Accepted
9.	Cut the leaves and stems for folder if required	2.57	0.61	Accepted
10.	Uproot green manure as they begin to flower and lightly work them into the soil.	2.88	1.41	Accepted

N= number of respondents, X = mean, SD = standard deviation.

The data in table 3 revealed that all the 10 practices needed by crop farmers in utilizing green manure as an intercrop had their mean values ranged from 2.57 - 3.90. This showed that the mean values were above the cut of point of 2.50, indicating that the respondents accepted that all the 10 practices are needed by crop farmers in utilizing green manure for maintaining soil fertility. The table also showed that the standard deviation of the responses of the respondents ranged from 0.17 - 1.41, indicating that the respondents were not too far from the mean and from the opinion of another in their responses.

4. DISCUSSION

The result of this study showed that 9 plants were accepted by teachers of Agricultural science and extension workers to serve as green manure in Enugu State. The result also showed that 12 practices are needed by crop farmers in utilizing green manure as a sole crop and 10 practices as an intercrop for maintaining soil fertility in Enugu state. The findings of the study are in line with the observation of Grubinger (2012) that cowpea, soybean, alfalfa and buckwheat are crops used as green manure. The author also stated that crops such as red clover, white clover, sweet clover and hairy are used for both cover crops and green manure which are not in conformity with the finding of this study. Grunbinger believed that the terms cover crops and green manure are reasonably interchangeable. The result of the study is supported by Schonbeck (1988) who classified green manure into cool season green manure and warm season green manure. The former, according to the author, include faba bean, fenugreck, lupins, oats, subclover, woolly pod vetch while the letter include buckwheat, cowpea, french, white millet, lablab, soybean among others.

The result of the study in table 2 is in consonance with the observation of Amede (2003). who identified skills in planting green manure as a sole crop to include collect green manure crop seeds/cuttings, prepare the seed beds, water the seeds among others. The author added that the principles in applying green manure as an inter crop include that the compatibility of the main food crop and the green manure, broadcasting the seeds of green manure after two weeks of planting the food crop, removing weeds that keep pest and disease pathogens, sets competition among others.

Therefore, the findings of the study stating some plants utilized as green manure in Enugu State does not mean that other plants cannot be used. It simply means that they are the most common plants know to teachers of Agricultural science and extension workers. It also implies that the identified practices if acquired, are adequate to enable crop farmers utilize green manure in maintaining soil fertility for sustainable food security in Enugu State.

5. CONCLUSION AND RECOMMENDATION

Food has become a global issue especially on how to ascertain sustainable food security. There are many factors that make food security to be sustainable. Such factors include marketing channels, processing and storage facilities, competence of farmers, cultural practices in maintaining soil fertilities among others. Green manure is one of the cultural approaches that are utilized in maintaining soil fertility. Utilizing green manure for the maintenance of soil fertility has some challenges to crop farmers with regards to knowledge about plants that serve as green manure and practices in green manuring. It was to this effect that this study was born. The study found out that 9 plants serve as green manure and 12 practices in utilizing green manure as a sole crop and 8 practices in utilizing green manure as an intercrop for maintaining soil fertility for sustainable food security in Eungu State. It was therefore recommended that:

1. the identified plants and practices should be utilized by extension workers in retraining farmers for maintaining soil fertility.
2. the practices should be utilized by teachers of Agriculture in teaching green manure to students in schools.

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