Competency Improvement Needs of Farmers in Afforestation for Preventing and Controlling Soil Erosion in Kogi State, Nigeria

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ABSTRACT

Farmers' lack of awareness of agricultural activities that contribute to soil erosion and competencies needed to prevent or control the menace through afforestation contributed to unprecedented hardship, the farmers, stakeholders and individuals in Kogi state. The purpose of this study was to determine competency improvement needs farmers in pre-planting, planting and post-planting operations in afforestation and recommend for a way forward in containing the challenges. Three research question and three hypotheses guided the study. The study made use of survey research design; it was carried out in Kogi state. The population for the study was 1,244 made up of 834 registered crop farmers and 410 Agricultural Extension Agents. The sample of the study was 540. A random sampling technique (Balloting) was used to select 330 registered crop farmers out of 834 and 210 Agricultural Extension Agent out of 410 respectively. The instrument for

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data collection was a 49 items questionnaire titled: Competency Improvement Needs of farmers Questionnaire (CINFQ). The instrument was validated by three experts. Cronbach Alpha method was used to determine the internal consistency of the instrument and a reliability coefficient of 0.82was obtained. Five hundred and forty (540) copies of the questionnaire were administered to the respondents for data collection, but 534 copies were retrieved and analyzed. Weighted mean and Improvement Needed Index (INI) were used to answer the research questions while t-test statistics was used and test hypotheses of no significant difference at the probability of 0.05 level of significance at 532 degree of freedom. It was found out that farmers needed improvement in all the competencies in pre-planting, planting and post-planting operations for enhancing their skills in afforestation practices on their farms and that of their neighbours as a means of reducing the impact of soil erosion in the area of the study. It was recommended that the identified competencies should be used by the extension agents to re-train farmers on the practice of afforestation along with crop production and soil conservation to reduce soil erosion menace in the State.

1. INTRODUCTION

Soil is essential for the survival of all living things. Soil, according to Olaitan and Lombin in Onu and Abu [1] is defined as a natural body of loose unconsolidated materials which constitutes a thin layer several metres deep on the earth surface. Soil provides nutrients for the growth of the plants and serves as medium for rearing of animals. Both crops and livestock are essential for the survival of man. For the soil to continue meeting the demand of crops and livestock, it has to be protected and conserved. Soil conservation according to Olaitan and Mama [2] is the process by which certain practices and techniques are applied to the soil to enable it retain and sustain its fertility so it can continue to support crop growth and withstand. Wikipedia, (2017) explained Soil conservation as the prevention of loss of the top most layer of the soil from erosion or prevention of nutrient deficiency caused by over usage, acidification, salinization or other chemical that contaminate the soil. Soil conservation is beneficial to the farmer as it improves soil structure, increases soil nutrients availability and reduces surface run – off due to rain water or wind. Morgan [3] stated that soil conservation strategies should be based on covering the soil to protect it from rain drop impact, increasing the infiltration capacity of the soil, reducing surface run off, improving the aggregate stability of the soil and increasing surface roughness to reduce the velocity of run-off water and wind. This could be achieved through cultural practices and afforestation on degraded land, plating shrubs in boundaries of crop lands as well as planting trees in residential areas, among others. However, there could be many many practical (e.g., Yazici et al., [4];

Yazici & Babalik, [5,6]), and environmental factors (e.g., Yazici & Turan, [7]; Yazici, [8]) together with land status could be effective on success of afforestation.

Afforestation in the view of Lal [9] is the re-planting of trees in a deforested area of land. Anyanwu (1999) described afforestation as the planting of trees seedlings on a bare or degraded land and taking care of them till the land becomes a forest. Morgan [3] stated that afforestation is recognized as a suitable method for reducing surface run-off either by water or by wind especially when applied to head water catchment as a means of regulating flood. The trees, according to the author, can be incorporated into crops along boundaries of farm land, river banks, on terrace and contour bunds or area been re-vegetated to prevent or control desertification and soil erosion as wind break and shade trees. Soil erosion prevention and control according to Onu and Abu [1] refers to those anticipatory measures geared towards avoiding the occurrence or control of any type of soil erosion. Such measures include cultural and mechanical approaches. However, preference should be given to agronomic treatment such as tree planting and/or cultural measures in utilizing vegetation to prevent erosion. The report of United Nation Environmental Protection (UNEP) in Osinem [10] stated that the benefit of trees and various forms of agro-forestry combinations include; prevention of erosion, water shed, maintenance of soil fertility, shelter from wind, prevention of flood, land slide, desertification, among others. Afforestation in the contexts of this study is the planting of trees by farmers around their farms or boundaries or on terraces in order to replenish, protect and conserve the

soil for sustainable uses. In other to actualize this vital role of afforestation, there is need for training and re training of farmers with the requisite competencies (knowledge, skill and attitudes) in afforestation towards enhancing their abilities in soil conservations.

A farmer in the view of Hornby [11] is a person who own or manage a farm. Therefore, for farmers to successfully utilize afforestation for preventing and controlling soil erosion and conservation, they must be well equipped with the competencies and attitudes (knowledge skills in afforestation).

Grove in Ernest, Francis, Mathias and Vincent [12] submitted that competency is the quality or state of being functionally adequate or having knowledge, skill or strength for a particular duty or respect. In the context of this study, competency means the ability of farmers in Kogi State to put into practice knowledge and skills in afforestation acquired by them in planting trees within and around their farm for preventing soil erosion on their farms and their environs. Farmers need this knowledge and skills in order to improve on their practices towards protecting and conserving the soil against erosion in the area of the study. Hornby [11] defined improvement as the act of making profitable use or application of something or the state of being profitably employed or turning to good and practical application of knowledge and skills as stated in a discourse. If farmers in Kogi State improve their skills in afforestation, they will perform better in preventing and controlling soil erosion on their farm lands.

Telkar and Neha, [13] are of the view that soil erosion is the detachment and transportation of top soil particles by wind and/or water. The process of soil erosion according to the authors is made up of three parts: Detachment: scrapping of the top soil from the rest of the ground. Movement: This is when the topsoil is relocated to another area, and Deposition: where the topsoil ends up after this process. Ontario Ministry of Agriculture, Food and Rural Affairs [14] explained soil erosion as a naturally occurring process that affects all landforms. It refers to the wearing away of a field's topsoil by the natural physical forces of water and wind or through forces associated with farming activities such as tillage. Erosion, whether it is by water, wind or tillage involves three distinct actions – soil detachment, movement and deposition. Topsoil, which is high in organic matter, fertility

and soil life, is relocated elsewhere "on-site" where it builds up over time or is carried "off-site" where it fills in drainage channels. Soil erosion reduces cropland productivity and contributes to the pollution of adjacent watercourses, wetlands and lakes. Musaib, Shakeel, et al. [15] viewed soil erosion as a natural process in which particles of soil are moved by wind and or water and displaced to another location. The author stated further that soil is prone to erosion when trees and bushes that cover and bind it soil are stripped away for fuel wood and timber, by clearing land for cultivation and when animal eat away grasses and erode top soil with their hooves, other factors that causes soil erosion includes intensive farming without replenishing the soil, deplete soil nutrient, conflict forcing people to move into environmentally fragile area, mining, climate change and so on.

Kogi State is one of the Nigeria's most important agricultural regions which currently produces food and cash crops such as sorghum, rice, millets, groundnut, bambara nut, cowpea, vegetables under rain-fed as well as rearing sheep, goats, poultry among others. Kogi State features guinea savanna vegetation with distributed trees, however, some of these trees are continuously been harvested as wood fuel for domestic use as source of energy and to pave way for construction or building of residential places as well as during intensive land preparation for farming. The verse area of land with distributed trees is often faced with strong rainfall and wind action which erode soil from one place to another. This, in addition to extensive farming and continuous grazing of the land by livestock over the years have exposed the soil to erosion. Furthermore, some trees and grasses species already harvested hardly re-generate, thereby subjecting the land to degradation.

The state government have been making efforts towards reducing or preventing this situation by continuously producing and distributing tree seedlings to farmers as well as establishing shelter belts in some local government areas to checkmate soil erosion. The Kogi State Government over the years especially during tree planting campaign have been encouraging farmers and stakeholders in agriculture and forestry to plant trees. The government as part of her renewed efforts towards checkmating soil erosion in the state also distributed tree seedlings across local government areas for planting during the campaign, yet the impact of this effort has not being significantly felt as

erosion continues to degrade agricultural lands. This will on the long run, reduce the available land for agricultural production as well as make the environment prone. The purpose of this study, therefore, was to hazard that can endanger lives and economic activities. Identify competency improvement needs of farmers in afforestation for preventing and controlling soil erosion in Kogi State, Nigeria. Specifically, the study sought to identify: Competency improvement needs in pre-planting, planting and post planting operations in afforestation.

1.2 Research Questions

The following research questions guided the study:

i. What are the competency improvement needs of farmers in pre-planting operations in afforestation?
ii. What are the competency improvement needs of farmer in planting operations in afforestation?
iii. What are the competency improvement needs of farmers in post-planting operations in afforestation?

The following hypotheses guided the study:

There is no significant difference in the mean ratings of the responses of agricultural extension agents, and registered crop and livestock farmers on the competencies needed in.

i. Pre-planting operations in afforestation.
ii. Planting operations in afforestation.
iii. Post-planting operations in afforestation.

2. METHODOLOGY

Three research questions and three hypotheses guided the study; survey research design was adopted for the study. The area of the study was Kogi State, a State was naturally endowed with good ecological and environmental conditions favourable for production of food and cash crops which is currently being threatened as a result of soil erosion. The population for the study was 1250 made up of 410 agricultural extension agents and 840 registered crop and livestock farmers. The sample for the study was 540. A random sampling technique was used to select 210 agricultural extension agents and 330 registered crops and livestock farmers respectively. The instrument for data collection was a forty nine (49) competency item questionnaire with 27 in pre-planting, 07 planting and 15 in post planting operation respectively.

The questionnaire items make use of a four points response options of Highly Needed (HN), Averagely Needed (AN), Slightly Needed (SN), and Not Needed (ND). Also, its performance component made use of a four point response options of High Performance (HP), Average Performance (AP), Low Performance (LP) and No Performance (NP) with a corresponding value of 4, 3, 2 and 1 respectively.

The agricultural extension agents responded to the needed column based on the level at which each competency item is needed as a skill in afforestation by farmers for soil conservation practices toward controlling soil erosion. Registered crops and livestock farmers responded to the performance column based on the level at which they could put each skills into practice in their farming activities. Three experts validated the instrument from the Department of Agricultural Education, University of Nigeria, Nsukka. Their suggestions and corrections were utilized before producing the final copy of the questionnaire. Cronbach's Alpha method was used to determine the internal consistency of the instrument with reliability co-efficient of 0.82. The 540 copies of the questionnaire were administered on the respondents out of which 534 copies were retrieved representing a return rate of 98%. The 534 copies were analyzed using weighted mean, standard deviation and Improvement Needed Index (INI) to answer the research questions while t-test statistics was used for testing the hypotheses at 0.05 level of significance at relevant degree of freedom. The real limit of number was used for decision making as follows:

Any item with a mean value of 1.50 or above was regarded as needed while any item with a mean value of less than 1.50 was regarded as not needed. Any item with a standard deviation between 0.00 and 1.96 indicated that the respondents were not too far from the mean and the opinion of one another. The Improvement Needed Index (INI) was used to identify the area of skills in afforestation for preventing and controlling soil erosion where farmers needed improvement as follows:

1. The weighted mean of each item under the needed component which is $\bar{X}n$ was calculated.

2. The weighted mean of each item under the performance component which is $\overline{X}p$ was calculated.
3. The difference between the two weighted mean for each item ($\overline{X}n-Xp = PG$) was determined.
4. Where the difference (NG) was zero (0) for each item, there was no need for improvement, because the level at which the competency item was needed is equal to the level which the skill could be performed by farmers.
5. Where the difference (NG) was positive (+) for each item, the farmer needed improvement because the level at which the competency item was needed is higher than the level at which the farmer can perform the skill.
6. Where the difference (NG) is negative (-) for each item, there was no need for improvement because the level at which the competency item is needed was lower than the level at which the farmer perform the competency.

The hypotheses of no significant difference was upheld for any item where t-calculated value was less than the t-table value and rejected for any item whose t-calculated was greater than the t-value at 0.05 level of significance at relevant degree of freedom.

3. RESULTS

The results for the study were obtained from the research questions answered and hypotheses tested through data collected and analyzed.

Research question 1

What are the competency improvement needs of farmers in pre-planting operations in afforestation?

Hypotheses 1

There is no significant difference in the mean ratings of the responses of Registered Crop Farmers and Agricultural Extension Agents on competency improvement needs of farmers in pre-planting operations in afforestation.

The data for answering research question 1 and testing hypothesis 1 are presented in Table 1.

The data in Table 1 revealed that need gap (NG) exists for the fifteen (15) items, this gap ranged from 0.50 to 1.64. All the needed gap values are in the positive direction indicating that farmers needed improvement in the entire 15 competencies in pre-planting operations in afforestation. The result of the test of the hypothesis in Table 1 indicated that 14 out of 15 items had their t-calculated values less than table value of 1.96. This revealed that there was no significant difference in the mean ratings of the responses of registered crops farmers and agricultural extension agents on 14 out of 15 competencies in pre planting operation in afforestation needed by farmers for preventing and controlling soil erosion in Kogi state. With this result, the hypothesis of no significant difference was upheld for the 14 items since the t-calculated value was less than the table value and hence the hypothesis of no significant difference was rejected for item 2 whose t-calculated value is higher than the table value.

Table 1. Mean ratings (need gap), improvement needed index and t-test analysis of the responses of registered crop farmers and agricultural extension agents on competency improvement needs of farmers in pre-planting operations in afforestation (N = 532)

S/No	Competencies in pre-planting operations in afforestation	$\overline{X}_n$	$\overline{X}_p$	$\overline{X}_n - \overline{X}_p$ = NG	t-cal	Remarks
1	Identify appropriate seed source for forest nursery.	3.66	3.16	0.50	0.11	IN, NS
2	Collect core or fruits for the seed (only ripe seeds).	3.76	2.57	1.19	2.58	IN, S
3	Extract the seeds from the core or fruits.	3.68	2.80	0.88	-2.57	IN, NS
4	Dry the seed thoroughly before storage.	3.73	2.55	1.18	-2.65	IN, NS
5	Carry out pre-germination treatment to break seed dormancy.	3.57	1.93	1.64	-1.86	IN, NS
6	Package the seeds and place them in the store until sowing.	3.62	2.24	1.38	-2.15	IN, NS

S/No	Competencies in pre-planting operations in afforestation	$\overline{X}_n$	$\overline{X}_p$	$\overline{X}_n - \overline{X}_p$ = NG	t-cal	Remarks
7	Sort out the seeds by size before sowing in the nursery.	3.55	1.93	1.62	0.63	IN, NS
8	Select a suitable site for nursery practices.	3.74	3.16	0.58	-2.27	IN, NS
9	Plant the seed during or at the onset of rainy season on seed beds.	3.62	2.54	1.07	-1.86	IN, NS
10	Maintain a sowing depth of about 1½ - 2 times seed diameter.	3.64	2.25	1.39	-2.91	IN, NS
11	Add organic manure or fertilizer periodically.	3.63	2.28	1.36	-2.53	IN, NS
12	Provide shade for the seedling and irrigate periodically.	3.68	2.25	1.43	-3.58	IN, NS
13	Lift the seedling during or at the onset of rainfall for plating.	3.75	2.44	1.31	0.50	IN, NS
14	Lift the seedling from the nursery bed using hand, hoe, spade or mechanical lifter.	3.65	2.54	1.11	-1.42	IN, NS
15	Carry out grading and culling for uniform performance.	3.62	2.29	1.33	-3.64	IN, NS

Key: $\overline{X}n$ =Mean, NG = Need Gap, t-cal = t-calculated, IN = Improvement Needed, NS = Not Significant, S= significant

Research question 2

What are the competency improvement needs of farmers in planting operations in afforestation?

Hypotheses 2

There is no significant difference in the mean ratings of the responses of Registered Crop Farmers and Agricultural Extension Agents on competency improvement needs of farmers in planting operations in afforestation.

The data for answering research question 2 and testing hypothesis 2 are presented in Table 2.

The data in Table 2 revealed that need gap (NG) exists for the seven (7) items, this gap ranged from 0.50 to 1.81. All the needed gap value is in the positive direction indicating that farmers needed improvement in the entire 7 competencies in planting operation in afforestation. The result of the test of the hypothesis in Table 2 indicated that 6 out of 7 items had their t-calculated values less than table value of 1.96. This revealed that there was no significant difference in the mean ratings of the responses of Registered Crops Farmers and Agriculture Extension Agents on 6 out of 7 competencies in planting operation needed for preventing and controlling soil erosion in Kogi state. With this result, the hypothesis of no significant difference was upheld for the 6 items

since the t-calculated value was less than the table value and hence the hypothesis of no significant difference was rejected for item 5 whose t-calculated value is higher than the table value.

Research question 3

What are the competency improvement needs of farmers in post planting operations in afforestation.

Hypotheses 3

There is no significant difference in the mean ratings of the responses of registered crop farmers and Agricultural Extension Agent on competency improvement needs of farmers in post planting operation in afforestation.

The data for answering research question 3 and testing hypothesis 3 are presented in Table 3.

The data in Table 3 revealed that need gap (NG) exists for the ten (10) items; which ranged from 0.45 to 1.72. All the needed gap values is in the positive direction indicating that farmers needed improvement in the entire 10 competencies in post-planting operation in afforestation. The result of the test of the hypothesis in Table 3 indicated that all the 10 items had their t-calculated values less than table

value of 1.96. This indicated that there was no significant difference in the mean ratings of the responses of registered crops farmers and agricultural extension agents on 10 competencies in post-planting operations in afforestation needed by farmers for preventing and controlling soil erosion. With this result, the hypothesis of no significant difference was upheld for all the 10 items.

Table 2. Mean ratings (need gap), improvement needed index and t-test analysis of the responses of registered crop farmers and agricultural extension agents on competency improvement needs of farmers in planting operation in afforestation (N = 532)

S/No	Competencies on planting operation in afforestation	$\overline{X}_n$	$\overline{X}_p$	$\overline{X}_n - \overline{X}_p$ = NG	t-cal	Remarks
1	Plant the seedling at the onset of rainy season.	4.00	3.44	0.56	0.02	IN, NS
2	Plant the seedlings early in the morning or late in the evening or cloudy days.	4.00	3.50	0.50	0.04	IN, NS
3	Open a hole perpendicular to the surface and large enough for the seedlings rooting system.	3.92	2.44	1.48	0.79	IN, NS
4	Insert the root into the hole without bunching or twisting the roots.	3.90	2.50	1.40	-1.01	IN, NS
5	Hold the roots upright with the root collar.	3.97	2.16	1.81	3.17	IN, S
6	Fill around the roots with soil.	4.00	2.92	1.08	0.00	IN, NS
7	Park the soil firmly to ensure good contact with the roots.	3.93	2.89	1.04	-1.46	IN, NS
	Grand Mean	3.96	2.84	1.12	0.22	IN, S

Key: $\overline{X}$ =Mean, NG = Needed Gap, t-cal = t-calculated, t-table =1.96, IN = Improvement Needed, NS = Not Significant, S= significant

Table 3. Mean ratings (need gap), improvement needed index and t-test analysis of the responses of registered crop farmers and agricultural extension agents on competency improvement needs of farmers in post planting operation in afforestation (N = 532)

S/No	Competencies in post planting operation in afforestation	$\overline{X}_n$	$\overline{X}_p$	$\overline{X}_n - \overline{X}_p$ = NG	t-cal	Remark
1	Carry out beating up (Replacement of failed trees).	3.74	3.28	0.46	-0.24	IN, NS
2	Weed the plantation periodically.	3.89	3.25	0.63	1.08	IN, NS
3	Prune the dead and life branches of the trees.	3.63	2.86	0.77	-1.56	IN, NS
4	Protect the plantation against fire outbreak, pest and diseases.	3.94	2.59	1.34	-2.69	IN, NS
5	Monitor the plantation for early sign of environmental stress and poor nutrition.	3.86	2.52	1.34	1.20	IN, NS
6	Stake the trees if the wind in the area is much.	3.87	2.74	1.13	0.63	IN, NS
7	Maintain the trees to maturity.	3.80	2.81	0.98	-1.62	IN, NS
8	Harvest only selected mature tree for use.	3.91	2.87	1.05	0.51	IN, NS
9	Replace harvested trees through planting of young seedling.	3.91	2.93	0.98	-0.13	IN, NS
10	Use life stake to state yam or plant them on fallow soil to offer cover and reduce erosion.	3.77	2.04	1.72	-2.23	IN, NS
	Grand Mean	3.85	2.81	1.04	-0.36	IN, NS

Key: $\overline{X}$ =Mean, NG = Needed Gap, t-cal = t-calculated, t-table =1.96, IN = Improvement Needed, NS = Not Significant, S= significant

4. DISCUSSION

The results of this study indicated that farmers needed improvement in 14 competencies in pre-planting, 6 competencies in planting and 10 competencies in post planting operations in afforestation for preventing and controlling soil erosion in Kogi state. The result of this study are in agreement with the findings of Nwankwo [16] in a study carried out on requisite skills in soil conservation required for equipping secondary school graduates for profitable crop production in Abia State where it was found out that secondary school graduates required 13 skill items in tillage, 62 in soil testing and analysis, 18 in soil erosion prevention and control, 18 in drainages, 48 in manuring, 31 in crop rotation and 17 in afforestation for soil conservation practices. Azunku [17] in a study carried out on soil conservation skills required by students of agriculture in colleges of education for effective teaching in South eastern Nigeria, it was found out that students of agriculture required 11 skills in tillage, 40 skills in soil testing and analysis, 57 skills in manuring, 39 skills in soil erosion prevention and control, 11 skills in drainages, 32 skills in crop rotation and 38 skills in afforestation for soil conservation practices. The observation and findings of the authors cited in their various studies helped to validate the findings of this study.

The result of the hypotheses tested showed that there was no significant difference in the mean ratings of the responses of the agricultural extension agents and registered crop farmers in 31 out of 32 competency items needed by farmers in pre-planting, planting and post-planting activities in afforestation toward preventing and controlling soil erosion in Kogi state. The implication of these findings was that the professional difference of the two groups of respondents did not significantly influence their responses on the competencies needed by farmers towards enhancing their skills in afforestation for preventing and controlling soil erosion in the area of the study.

5. CONCLUSION

The researcher observed that farmers in Kogi state are not conscious of the impact of soil erosion which has taken over large portions of arable land meant for agricultural production. This is mainly attributed to continuous and consistent degradation of soil fertility due to faulty farming practices such as continuous cropping without fertilizer application or manuring, bush burning as well as deforestation. The situation further persisted due to lack of requisite skills in soil conservation practices in afforestation by farmers in the state. This study therefore found out that farmers needed improvement in competencies (knowledge and skills) in afforestation (pre-planting, planting and post-planting practices) for preventing and controlling soil erosion to promote soil conservation for increasing crop yield.

6. RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. The identified 32 competency items be packaged into a re-training programme by the Kogi state ministry of Agriculture for training farmers in skills acquisition centres to improve their skills in afforestation towards preventing and controlling soil erosion in the state.
2. The packaged competencies should be utilized to re-train agricultural extension agents in the State through seminars or workshops to enhance their performance on the job in soil conservation practices. This will, on the long run, improve the yield of the crops.
3. The competencies could also be used by teachers of agriculture in secondary schools to teach students step by step skills in afforestation along with farming and crop production practices.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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