

Promoting Conservation Agriculture in Rural Nigeria: Relevance of Environmental Literacy Education

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ABSTRACT: *Agricultural practice in Nigeria includes farming, fishing and herdskeeping. However, in the rural areas, farming tends to dominate the practice; hence, the term agriculture is generally used interchangeably with farming. Farmers in rural Nigeria generally adopt the traditional method of farming which involves environmentally unfriendly processes known to result in low productivity and income, occasioning the ultimate impoverishment of the farmers. Conservation/ Non-Tillage Agriculture is being advocated globally as a veritable alternative towards the solution of the adverse effect of both the traditional farming method and the contemporary incidence of climate change. Although global statistics indicate that Africa experienced relative increase in her land area under CA between 2007/2008 and 2012, nonetheless, Nigeria was conspicuously not among countries with up to 340 hectares (ha) of land area under CA in Sub-Saharan Africa. With the several known benefits of the CA system, there is a need to promote the adoption of the system by farmers in rural Nigeria. However, the constraints limiting the adoption of the CA system, as well as the notable hiatus in the spurring elements of the farmers' demographic/ educational profile call for salient approaches (including education) towards promotion of CA among the farmers. The purpose of this paper is to expound the latent benefits and challenges of the CA system, the necessary strategies for the promotion of the system and the pertinence of Environmental Literacy Education to the promotion and adoption of CA in Rural Nigeria.*

KEYWORDS: conservation agriculture, promoting, rural Nigeria, environmental literacy education, relevance.

INTRODUCTION

The Food and Agriculture Organization (FAO) has broadly defined agriculture as involving the processes of “production, conservation and marketing of crop, livestock and fish

products” (FAO, 2005, p.2). Put in other words, agriculture as a concept includes farming, fishing and herdskeeping. In Nigeria, for instance, agriculture involves, but is not limited to the practice of farming which, itself includes cultivation of the soil by tilling (especially for root crops) and breeding of livestock. In effect, the terms farming and agriculture are most often used interchangeably. Farming has afforded the teeming population of Nigerians, especially in the rural areas, with varieties of food and cash crops such as yams, cocoyams, vegetables, beans, maize, cassava and groundnuts (Amparo, 2016). However, farmers in Nigeria, generally adopt the age-old traditional pattern of land preparation which involves felling of trees, stumping, slash-and-burn (of grasses), application of inorganic fertilizers and so on. These traditional agricultural methods/practices have been found to be the primary factors for ecological imbalance, environmental deterioration, erosion, food insecurity (Eheazu and Uzoagu, 2021), poverty and the persistent syndrome of generally low income returns from occupational endeavours experienced by rural inhabitants in Nigeria (Eheazu, 2017).

Conservation Agriculture (CA) is being advocated globally as an alternative towards the solution of the adverse effects of both traditional farming methods and the contemporary incidence of climate change. The food and Agriculture Organization (FAO) has defined CA as “an approach to managing agro-ecosystems for improved and sustained productivity, increase profits and food security while preserving and enhancing the resource base and the environment” (FAO, 2015, p.1). The organization further identified some interlinked principles and advantages of CA which it says are universally applicable to all agricultural landscapes and land uses with locally adapted practices. The principles and advantages are summarized by FAO in the following excerpt which further explains CA (FAO, 2017, p.1):

Conservation Agriculture (CA) is a farming system that can prevent losses of arable land while regenerating degraded lands. It promotes maintenance of a permanent soil cover, minimum soil disturbance, and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increased water and nutrient use efficiency and to improved and sustained crop production.

Details of the summarized principles and advantages of CA are given in the appropriate section below.

The purpose of this paper is to x-ray the benefits and challenges associated with promoting Conservation Agriculture (CA), with particular reference to rural Nigeria, and the pertinence

of Environmental Literacy Education to the realization of the ultimate outcome of the advocacy; namely, improved adoption of the CA system in Nigeria.

Profile of Nigeria's Rural Farmers/Agriculturalists and their Activities

Following The Free Dictionary (2014) definition, rural farmers in Nigeria are common or ordinary citizens who inhabit the agricultural and rural areas located outside towns and cities of the country. From reliable research studies, rural farmers constituted up to 90% of Nigeria's rural population of about 79.5 million in the preceding one decade or so (World Bank, 2010, IFAD, 2010). Within the same period, also, about 65% of the rural population (including the farmers) were found to be "illiterate in any given language" (NMEC, 2010, p. 20). As briefly hinted in the introductory part of this paper, the farmers engage in a diversity of subsistence agricultural practice which include crop farming, livestock rearing, fishing, wine tapping – all of which are virtually dependent on the natural environment (IFAD, 2010). Owing to a number of circumstances beyond their control, including low participation in the processes of managing the environmental resources on which they depend for livelihood, as well as neglect of the rural areas in most government development agenda, the farmers tend to engage principally in exploitation of environmental resources for their survival which eventually leads to massive environmental degradation problems. Specifically, their livelihood activities to obtain food, shelter and income include tree felling, application of harmful chemicals like nitrogen oxide in their agriculture, allowing their livestock to overgraze in marginal lands, and so on. These activities, coupled with the high population density of the rural farmers, lead to deforestation, pollution of land, artisanal waters and air which adversely affect the health and work capability of farm households. Thus, although it has been recorded that rural farmers contribute up to 40% of Nigeria's GDP (World Bank, 2010), it is also well known that the traditional methods which they employ in preparing the land for cultivation as well as improper application of fertilizers tend to create a number of issues of soil and environmental degradation which reduce total yield (Okafor & Udeh, 2012). Furthermore, such anthropogenic (man induced) degradation coupled with natural factors like climate change exacerbate resultant disasters like loss of biodiversity, erosion, flooding and general ecosystemic deterioration which diminish the economic returns from the farmers' activities and ultimately impoverish them.

PROMOTING CONVERSATION AGRICULTURE IN NIGERIA'S RURAL AREAS: INHERENT BENEFITS AND PROBLEMS

Principles of Conservation Agriculture

To comprehend the advantages and problems immanent in the promotion of Conservation Agriculture (CA), it is necessary at this point to examine in greater detail the three interlinked

key principles of CA imprecisely referred to earlier in the introductory section of this paper. According to the FAO (2015), the three key principles underline what conservationists and producers believe can be applied to conserve the resources they use for a longer period of time. Following Wikipedia (2015) the three principles could be succinctly articulated seriatim as follows:

- i. The principle of practising minimum mechanical soil disturbance which is essential for maintenance of minerals within the soil, stopping erosion and preventing water loss from occurring within the soil. This principle discourages tillage farming previously in vogue, but which totally has been discouraged to be not only a process that destroys organic matter found within the soil cover, but also a process that increases time and labour for crop production.
- ii. The principle of managing the top soil in a way to create a permanent organic soil cover (crop residue retention) which would allow for growth of organisms within the soil structure. This growth is seen to break down the mulch that is left on the soil surface to produce a high organic matter level which will act not only as fertilizer for the soil surface, but also would help to prevent soil erosion from taking place and ruining the soil profile or layout.
- iii. The principle of practising crop rotation with more than two species of crops. This practice is considered the best approach towards crops disease control as it would not allow pests such as insects to be set into a rotation with specific crops, but rather act to provide a natural insecticide and herbicide against specific crops and thus prevent insects and weeds from establishing a pattern that could create problems of yield reduction and infestations within fields.

The benefits and problems associated with the application of the above principles are duly highlighted immediately below.

Benefits of Conservation Agriculture with Special Reference to Rural Nigeria

Three categories of benefits of CA have been identified by experts; namely, economic, agronomic and environmental benefits (FAO, 2018; Yadav, 2020). These categories of benefits relate to the three inter linked principles of CA highlighted above and could be further described as follows:

- i. *Economic benefits:* These could be described as including:
 - a. Improved production efficiency arising from reduction in labour time, physical activities and costs;
 - b. More output from a lower input;
 - c. Improved income to the farmer

- ii. *Agronomic (scientific process of land management and crop production) benefits* which, on the other hand, refer to increase in soil productivity arising from:
 - a. Organic matter increase through crop residue retention;
 - b. Water retention in the soil as a result of the principle of minimum soil disturbance;
 - c. Soil structure and rooting ground improvement.
- iii. *Environmental benefits* which border on protection of the soil, the ecosystem and the general environment from pollution through application of the third principle above and, in particular, as a result of:
 - a. Reduction in soil erosion;
 - b Maintenance of artisanal water quality by being wary of improper application of inorganic fertilizers which produce agricultural runoffs that pollute nearby streams and rivers (Eheazu, 2016);
 - c Maintenance of good air quality sequestration (reduction of atmospheric carbon dioxide which causes global warming and climate change) and avoidance of the slash-and-burn method of farmland preparation for cropping, which leads to destruction of natural habitats and release of carbon dioxide into the atmosphere.

It is important to note at this point that in view of the factors of the disasters that accrue from the methods employed by rural farmers in Nigeria, as highlighted under their profile above (soil and environmental degradation, poor yield, food insecurity, erosion, flooding, loss of biodiversity, poverty and so on); the benefits of Conservation Agriculture (CA) discussed above make the promotion of the system a welcome option, at least for the remediation of the disasters and improvement of productivity. Besides, CA recommends itself as a way of addressing the farm labour shortages which are gravely affecting many rural areas in Africa (including Nigeria) where teeming populations of young men with potential for arduous physical work are migrating to the urban centres, leaving virtually ageing mothers, already saddled with household chores and child rearing, to run the farm operations (Ashburner et al., 2015). Beyond highlighting the above benefits of CA, it is equally important to examine the latent constraints/challenges to the adoption of the CA as well as the extent of global patronage of the system.

Constraints/Challenges to the Promotion of Conservation Farming

Notwithstanding the benefits of the CA system globally and in the specific case of agricultural practice in rural Nigeria, some experts and researchers have highlighted a number of challenges/constraints constituting barriers to the feasibility of promoting/adopting CA and the application of its principles to location-specific agricultural production systems, especially in Africa (Ashburner et al., 2015; Wikipedia, 2015; Thierfelder et al., 2018; Yadav, 2020). The challenges/constraints enunciated by these sources could precisely be described, with particular reference to many African Countries (including Nigeria) as follows:

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- i. General lack of knowledge, especially of how best to introduce CA and its basic processes to small-holder and other levels of farmers in many parts of Africa.
- ii. Lack of local infrastructure to support the manufacture and repair of CA equipment (draft animal seeders, tractors, ploughs and so on). Importation of such equipment from advance countries may be prohibitive to the low purchasing power of small-holder farmers, and this may affect decision to go into CA.
- iii. Land tenure systems that do not permit farmer ownership of large expanses of land for CA.
- iv. Uncontrolled grazing in many parts of Africa which makes application of the CA practice of biomass (especially cover crops and crop residue) retention difficult or obviously impracticable. This situation is a major problem in Nigeria where even currently the herdsmen versus farmers conflict is ragging.
- v. Absence of awareness creation about the need, techniques, technology/equipment and the situation-specific strategies for CA, especially in many African countries (including Nigeria).
- vi. The process of CA takes time. It may take some years before producers will start to realize the level of yields they envisaged. For instance, the practice in CA of cutting back inorganic fertilizer, adopting a NO-TILL policy and so on may lower food production than what would obtain in traditional method of farming, using same or less extent of land.
- vii. Limited knowledge and capacity of farmers to implement CA systems at a certain standard (including use of critical inputs like specialized machinery, seeds, organic fertilizers and herbicides) may further dissuade patronage of CA.
- viii. Lack of profitable crop rotation systems.
- ix. Cash constraints and lack of credit to traditional farmers' initial investment.
- x. Tradition and different prioritization by farmers may discourage their embrace with CA.

Global, Continental and Regional Adoption of Conservation Agriculture (CA)

In the light of the above listed constraints to the CA system, it is pertinent to examine the spread of the system globally and, in the context of the topic of this paper, the situation as it concerns Nigeria so as to, among other things, appraise the extent of the need and strategies for promotion of the CA system among the countries rural farmers.

In their publication titled, *Global Overview of Conservation Agriculture Adoption*, Derpsch & Friedrich (2009) note that Conservation Agriculture (CA), also known as No-Tillage system, has developed to a technically viable, sustainable and economic alternative to the usual (traditional) crop production practices and is being practised by farmers from different world geographical locations, within varying soil types and in various farm sizes. Derpsch

& Friedrich illustrate their assertions with data in tables 1 and 2 below which show global and continental levels of CA adoption respectively in 2007/2008.

Table 1: Extent of Global Conservation/Non-Tillage Agriculture Adoption by Countries; 2007/2008

S/No	Country	Area under No-Tillage (hectares): 2007/2008
1.	USA	26,593,000
2.	Brazil	25,502,000
3.	Argentina	19,719,000
4.	Canada	13,481,000
5.	Australia	12,000,000
6.	Paraguay	2,400,000
7.	China	1,330,000
8.	Kazakhstan	1,200,000
9.	Bolivia	706,000
10.	Uruguay	672,000
11.	Spain	650,000
12.	South Africa	368,000
13.	Venezuela	300,000
14.	France	200,000
15.	Finland	200,000
16.	Chile	180,000
17.	New Zealand	162,000
18.	Colombia	100,000
19.	Ukraine	100,000
	Others (Estimate)	1,000,000
	TOTAL	105,863,000

Source: Derpsch & Friedrich (2009); Table 4.

**Table 2: Land Area under CA/No-Tillage System by Continent;
2007/2008**

Continent	Area (hectares)	Percentage of Total
South America	49,579,000	46.8
North America	40,074,000	37.8
Australia & New Zealand	12,162,000	11.5
Asia	2,530,000	2.3
Europe	1,150,000	1.1
Africa	368,000	0.3
World total	105,863,00	100%

Source: Derpsch & Friedrich (2009); Table 5.

As Table 1 above shows a total of 105.863 million hectares (mha) of land were under CA/No-Tillage system in nineteen countries of the world (including others with an estimation of 1mha) in 2007/2008. The individual coverage of the 105.863 mha by the six continents of the world is shown in Table 2 above. It is noteworthy that by 2007/2008, the land area in Africa under CA was 368,000 ha (0.3%) of the total land under CA cultivation in the six continents listed in Table 2.

In a later publication titled, *Overview of the Global Spread of Conservation Agriculture*, Friedrich et al. (2012) provide further evidence to show that farmer-led transformation of agricultural production systems based on the interlinked Conservation Agriculture (CA) principles (discussed earlier in this paper) is further manifesting and gathering thrust globally as a new paradigm for the 21st century. In the said publication, the authors present, inter-alia, more up-to-date data from various sources on the adoption of CA globally, continentally and regionally showing the level of interest of farmers and governments in the alternate CA pattern of crop production method. Tables 3, 4 and 5 below show data on the extent of worldwide, continental and regional spread/adoption of CA by 2012.

Table 3: Extent of Adoption of Conservation Agriculture Worldwide (Countries with > 100,000ha); 2012

S/No	Country	CA area (ha)
1.	USA	26,500,000
2.	Argentina	25,553,000
3.	Brazil	25,502,000
4.	Australia	17,000,000
5.	Canada	13,481,000
6.	Russia	4,500,000
7.	China	3,100,000
8.	Paraguay	2,400,000
9.	Kazakhstan	1,600,000
10.	Bolivia	706,000
11.	Uruguay	655,100
12.	Spain	650,000
13.	Ukraine	600,000
14.	South Africa	368,000
15.	Venezuela	300,000
16.	France	200,000
17.	Zambia	200,000
18.	Chile	180,000
19.	New Zealand	162,000
20.	Finland	160,000
21.	Mozambique	152,000
22.	United Kingdom	150,000
23.	Zimbabwe	139,300
24.	Colombia	127,000
	Others (Estimate)	409,440
	TOTAL	124,794,840

Source: Friedrich et al. (2012); Table 1.

Table 4: Land Area under CA by Continent; 2012

Continent	Area (ha)	Percent of Total
South America	55,464,100	45
North America	39,981,000	32
Australia & New Zealand	17,162,000	14
Asia	4,723,000	4
Russia and Ukraine	5,100,000	3
Europe	1,351,900	1
Africa	1,012,840	1
World total	124,794,840	100

Source: Friedrich et al. (2012); Table 2.

Table 5: CA Adoption in the Sub-Saharan African Region by Country; 2012

Country	CA Area (ha)
Ghana	30,000
Kenya	33,000
Lesotho	2,000
Malawi	16,000
Madagascar	6,000
Mozambique	152,000
Namibia	340
South Africa	368,000
Sudan	10,000
Tanzania	25,000
Zambia	200,000
Zimbabwe	139,300
Total	981,640

Source: Friedrich et al. (2012); Table 7.

Brief Analysis and Implications of the Data in Tables 1-5 Relative to Promotion of CA in Rural Nigeria

A close look at the data in tables 1- 5 reveals, among other facts that:

- i. Globally, more nations came into the bracket of countries having $\geq 100,000$ ha of total area of CA practice between 2007/2008 (table 1) and 2012 (table 3). For instance, in the African Continent, Zambia, Mozambique and Zimbabwe came into the bracket by 2012 in addition to South Africa which was the only African country within the said category in 2007/2008.
- ii. At the continental level, it is observable that the total land area under CA/No-Tillage in the six continents listed in tables 2 and 4 increased from 105,863,000 ha (table 2) to 124,794,840 ha (table 4) i.e. an increase of 17.9% within a 4-year period (2008-2012). Specifically, Africa as a continent, had her land area under CA increased from 0.3% (368,000) to 1% (1,012,840) within the same period.
- iii. In all, despite the observable increment of land area under CA in Africa at both the global and continental levels, it is equally conspicuous that Nigeria is not represented as a country among those with $\geq 100,000$ ha (tables 1 and 3). Again, even at the Regional (Sub-Saharan Africa) level (table 5), Nigeria is not recorded among countries with up to 340 ha or above of land under CA. This situation obviously evinces the need for adoption of salient strategies towards promotion of CA/No-Tillage system of Agriculture in the country in order reap the benefits of and assuage the constraints to the system, especially with reference to farming in rural Nigeria.

Declaration of the First Africa Congress on Conservation Agriculture: A Guide for CA Development in Africa

From 18th to 21st March, 2014, the African Conservation Tillage Network (ACT) convened the 1st Africa Congress on Conservation Agriculture in Lusaka, Zambia. The Congress brought together 414 delegates from Africa and other countries of the world to share experiences and lessons and forge alliances that would eliminate barriers to expanded and elevated adoption of CA, especially among the smallholder farming communities in Africa in the contemporary era of climate change. After recognizing and highlighting the various positive attributes of the CA system of agriculture, which recommend the system for adoption by African farmers, the Congress came up with a number of pivotal guidelines for CA development in Africa under resolutions/recommendations emphasizing, among other things (ACT, 2014), that:

- i. All national and international stakeholders in the public, private and civil sectors should support the up-scaling of CA as a climate smart technology to reach at least 25 million farmers across Africa by 2025.

- ii. African governments should create a conducive environment for the adoption and development of CA by investing more in CA education and extension; integrating CA training in educational curricula and supporting CA farmers and their organizations.
- iii. The governments should also create enabling policy environment to allow investment financing and technological development, including private sector involvement, in CA related value chains.
- iv. Development partners need to increase support to CA programmes under the Agriculture climate agenda of the Comprehensive African Agriculture Development Programme (CAADP).
- v. The private Sector should be urged to proactively support up-scaling of CA through further innovations and increased investments financing in appropriate CA technologies and related services.
- vi. ACT should establish a quality-assurance system for accredited agricultural training institutions to provide CA training certificates and collaborate with relevant stakeholders for the harmonization of CA training curricula.
- vii. Farmers who have adopted CA should be supported to be leaders and educators for their counterparts and establish locally relevant collaborations, innovation platforms and associations that can engage with government and other CA actors.
- viii. Agricultural training institutions should take up CA as an integral part of their training programmes and take part in farmer sensitization and training efforts.

THE OVERRIDING NEED FOR APPROPRIATE EDUCATION AND TRAINING PROGRAMMES TO PROMOTE CA ADOPTION IN AFRICA AND RURAL NIGERIA

Various pertinent references have been made to the cardinal position of education as a strategy towards successful promotion/adoption of Conservation Agriculture (CA), especially in Africa. For instance, in her discussion on the challenges facing widespread adoption of C.A, Yadav (2020, p. 2) clearly highlights the importance of “site-specific knowledge” in the following words:

Conservation agriculture systems are much more complex than conventional systems. Site-specific knowledge has been the main limitation to the spread of CA system. Managing these systems efficiently will be highly demanding in terms of understanding of basic processes and component interactions, which determine the whole system performance.

Yadav’s view corroborates an earlier observation by Ashburner et al. (2015, p.4) that “a general lack of knowledge is a major constraint, particularly concerning how best to

introduce CA techniques and the need for appropriate equipment and inputs such as cover crop seeds and herbicides”.

Focusing on agriculture in Sub-Saharan Africa (which includes Nigeria), the Food and Agriculture Organization (FAO) has noted that success stories of agriculture and rural development in countries like Costa Rica, Cuba and Taiwan resulted from long term vision and strategy by this countries bothering significantly on “emphasis on relevant education in rural schools and colleges, literacy and training centres for rural youth and adults, etc” (FAO, 2005, p.16). Indeed, FAO sees success in realizing the potentials of African Agriculture as being largely dependent on the crucial factor of education. Along the same grain of thought and with particular reference to the crucial role of education in fostering adoption of Conservation Agriculture (CA), Friedrich et al. (2012) have noted that experience and empirical evidence across many countries have shown that rapid adoption and spread of CA requires a change in commitment and behaviour of all concerned stakeholders. For the farmers, Friedrich and his colleagues say, a mechanism to experiment, learn and adapt constitutes a prerequisite for migration from tillage systems to CA; while policy makers and institutional leaders need to fully understand the long term economic, social and environmental benefits the CA system bestows on both the producers and the society at large. This, obviously, justifies mainstreaming CA education within the various modes of contemporary education systems as advocated by FAO (2005) and the 2014 African Conservation Tillage Network Congress (ACT, 2014) already highlighted in this paper.

PERTINENCE OF ENVIRONMENTAL LITERACY EDUCATION

Conservation Agriculture (CA) has been referred to as “Agricultural Environmental Management” (Wikipedia, 2015, p. 1). This, no doubt, is a correct nomenclature as indeed with conservation came environmental benefits of CA which include mitigated erosion possibilities, better sub-terranean water conservation, improvement in air quality sequestration (arising from minimal emission of hydrocarbons due primarily to control of the traditional slash-and-burn method of farmland preparation in CA/No-Tillage farming) and promotion of wider biodiversity in CA practised areas (Wikipedia, 2015). The implication of these considerations is that basic knowledge, awareness and skills relevant to the sustenance of the environmental benefits of CA adoption should be mainstreamed to form part of education on CA processes, techniques and inputs to foster optimal promotion/adoption of the CA system, especially among small-holder farmers in rural Sub-Saharan African (Eheazu, 2020). Herein lies the germaneness of Environmental Literacy Education (ELE)

Competencies Derivable from Environmental Literacy Education to Foster Promotion of Conservation Agriculture in Rural Nigeria.

The Concept and Content of Environmental Literacy (EL)

The term Environmental Literacy (EL) has been explained by the North American Association for Environmental Education (NAAEE, 2011) as a reference to an awareness of and concern about the environment and its associated problems, as well as the knowledge, skills and motivations to work towards solution of current problems and the prevention of new ones. Roth (1992, p. 16) concisely described the content of EL as consisting of:

... a set of understandings, skills, attitude and habits of mind that empowers individuals to relate to their environment in a positive fashion and to take day-to-day and long term actions to maintain or restore sustainable relationship with other people and the biosphere ... The essence of EL is the way we respond to the questions we learn to ask about our world and our relationship with it; the ways we seek and find answers to those questions; and the ways we use the answers we have found.

Roth further capsulized the above content in three levels of EL as follows:

- i. Environmental Literacy Level One (ELL₁)
- ii. Environmental Literacy Level Two (ELL₂)
- iii. Environmental Literacy Level Three (ELL₃)

These levels he called *nominal*, *functional*, and *operational* respectively, showing an ascending expansion from basic understanding through a broader knowledge and interaction to a higher level of understandings and skills in dealing with the environment and its problems.

Competencies Offered by Environmental Literacy (EL)

The competencies derivable from EL could be seen from the attributes of an environmentally literate person. Further to its definition of EL cited above, the North American Association for Environmental Education has defined an environmentally literate person as “someone who, both individually and together with others, makes informed decisions concerning the environment, is willing to act on these decisions to improve the wellbeing of other individuals, societies, and the global environment; and participates in civil life” (NAAEE,

2011, pp. 2-3). The Association further adds that those who are environmentally literate possess, to varying degrees, four attributes; namely:

- ✓ knowledge and understanding of a wide range of environmental concepts, problems, and issues;
- ✓ a set of cognitive and affective dispositions;
- ✓ a set of cognitive skills and abilities; and
- ✓ appropriate behavioural strategies to apply the acquired knowledge and understanding in

order to make sound and effective decisions in a range of environmental contexts.

Accordingly, NAAEE has identified four interrelated components of EL acquisition as Competencies (abilities), Knowledge, Dispositions and Environmentally Responsible Behaviour. The Association has also identified “contexts” (from local to global) within which these components of EL acquisition are manifested (NAAEE, 2011, p. 6).

Process and Expected Outcomes of Environmental Literacy Education

By way of clarification, Environmental Literacy Education (ELE) could be described as the process of disseminating the components and competencies of EL outlined above in order to develop in beneficiaries environmental responsible behaviour expected of environmentally literate persons. With regard to the concern of this paper, such behaviour, as identified by Hungerford et al. (1994) include:

- i. Belief in their ability, both individually and collectively to influence decisions on environmental problems and issues (such as a policy for ensuring strict adoption of the three key principles of conservation agriculture).
- ii. Assumption of responsibility for curbing or totally avoiding personal environmental degradation activities (like burning of plant residue and the use of inorganic fertilizers).
- iii. Personal and/or group involvement in Environmentally Responsible Behaviours (such as restriction of grazing activities in areas where CA is practised).
- iv. Persuasion – e.g. using informal discussions to encourage one another to support a positive environmental position (such as participation in government education/training programmes on environmental protection and upscaling of CA as a climate smart strategy for realization of the many benefits of CA).
- v. Political action – e.g. approaching elected officials on environmental issues touching on CA (such as the need to sponsor legislation against bush burning and uncontrolled grazing in areas where CA is practised).
- vi. Legal action; for instance, reporting violations of environmental legislation, as in (v) above and providing information or testimony in a law suit against such violations.

ENVIRONMENTAL LITERACY EDUCATION PROGRAMMES FOR PROMOTION OF CONSERVATION AGRICULTURE IN RURAL NIGERIA

Beyond its potential to inculcate in farmers the above identified strands of environmental behaviour needed for adoption of CA, Environmental Literacy Education (ELE) is also expected to:

- i. solve the problem of unawareness of the techniques, benefits and challenges of CA arising from the poor educational profile of rural farmers and policy makers in Nigeria discussed earlier in this paper; and
- ii. facilitate implementation of the African Conservation Tillage Network (ACT) Pivotal Guidelines for CA development in Africa (also listed earlier in this paper).

From the above analysis of the process, expected outcomes and other potentials of Environmental Literacy Education towards enhancement of the chances of CA promotion in Africa (including rural Nigeria), it stands clear that the development of environmental literacy is a multi-focal process. Succinctly put, the process begins with basic environmental knowledge inculcation and acquisition. This basic knowledge component is based on the idea that before an individual can act on an environmental problem, that individual must first understand the problem (Pooley & O'Connor, 2000). The next step is training of the individuals towards the application of their acquired knowledge to investigate and evaluate environmental issues and apply appropriate solutions. Finally, the individual must be equipped to be able to choose which course of action is best in a given situation. The said multi-focal process is applicable through mainstreaming of ELE at every level of education, including basic, formal and non-formal as well as higher education. This presupposes that ELE for promotion of CA in Rural Nigeria should take place through every mode of education, formal, non-formal and informal as also recommended by the ACT (2014) and FAO (2005).

Accordingly, the role of ELE is to design situation-specific programmes (based on relevant content, expected outcomes and the prevailing situations to be tackled as discussed above) to provide for the rural Nigerian farmers and relevant policy makers environment based sensitization, awareness creation, mobilization and skills development programmes aimed at enabling the beneficiaries to appreciate the need, processes, benefits and challenges of CA. This would then facilitate promotion and adoption of CA (No-Tillage) Agriculture system among the farmers.

The situation-specific ELE programmes would include:

- i. Awareness creation among and sensitization of the target beneficiaries regarding the economic and agronomic benefits of CA as a viable alternative to the usual (traditional) crop production methods;

- ii. Programmes for inculcation of knowledge of the environmental benefits of CA (such as mitigated erosion incidences, better sub-terranean water conservation for improved crop yield, improvement in air quality sequestration following mitigated or avoidance of slash-and-burn, promotion and advantages of wider biodiversity).
- iii. Inclusion of the following environmental issues in the sensitization programmes for policy makers on the various factors (identified by Ashburner et al. (2015) and also discussed in this paper which challenge/constrain adoption of CA in Africa and thus may require legislations on:
 - a. Uncontrolled grazing that makes biomass retention which is necessary in CA rather difficult or even impracticable;
 - b. Practice of environmentally and CA – unfriendly traditional methods of preparing farmlands for cropping (slash-and-burn, tree felling and so on) in CA practised areas.
- iv. Creation of opportunities for town hall meetings by experts to meet with rural farmers to discuss and offer solutions to the above environment-related constrains to CA promotion and adoption.

Process of Achieving the Above ELE Programmes for Promotion of Conservation Agriculture in Rural Nigeria

Considering the demographic profile of Nigeria's rural populations (including farmers) earlier discussed in this paper, as well as the need for both promotion and sustenance of practice of the CA system, one would include among the beneficiaries already listed above; (i) Rural pupils and students in formal education institutions, (ii) The less educated/illiterate rural adult farmers, (iii) the more informed community leaders/policy makers. Accordingly, the ELE programmes identified above would have to be mainstreamed through the usual Formal, Non-Formal and Informal modes of education for appropriate content dissemination to accommodate the various levels of education/experience of the target groups as follows:

i. The Formal Mode

This would involve appropriate inclusion in the syllabuses of basic literacy, primary, secondary and tertiary education institutions within the rural areas of what Roth (1992) referred to as the *nominal*, *functional* and *operational* contents of EL (already highlighted in this paper). The formal mode will ensure that children of the rural communities in primary schools as well as adolescents/adults at the basic literacy, secondary and tertiary levels of education will have the opportunity to acquire necessary awareness and knowledge to understand the economic and environmental benefits of Conservation Agriculture (CA), as well as how to address the associated challenges, both as individuals and as groups along the lines suggested by Hungerford et al. (1994) and outlined above.

ii. The Non-Formal Mode:

The non-formal mode of ELE is an alternative to the school or institutionally based formal mode. Accordingly, it is not systematized or hierarchically arranged like in a school curriculum, but would, in the case of the subject of this paper, address individual, group and communal leadership needs for awareness of environmental benefits of the adoption of the CA system and the responsibility of all Stakeholders to embrace them. The programme would be implemented virtually *in situ* or centrally, as many of the rural people involved may not be able to leave their places of domicile. In effect, school halls, basic literacy centres, and their likes would serve as veritable centres for the Non-Formal ELE for promotion of CA adoption. The content of the programme would be tailored to achieve inculcation of the necessary knowledge, skills and behavioural changes already outlined in this paper and would aim at meeting the hitherto unaddressed environmental degradation challenges stalling promotion and adoption of CA in the rural communities. Furthermore, the programme content would also be geared towards enhancing the beneficiaries' adoption of the CA system, as well as their partnership with government and agricultural development agencies for effective remediation of environmental problems affecting the rural communities and discouraging them from adopting the CA system.

The Non-formal ELE would take the forms of awareness creation seminars, conferences, workshops and short training programmes to be designed and organized by commissioned environmental literacy education and community development experts/professionals from higher education institutions to be funded by government with possible solicited assistance from Agricultural Development Agencies (like the FAO) and other willing organizations.

iii. The Informal Mode of ELE

In Informal education, generally, learning takes place spontaneously, unintentionally and/or accidentally. It is education that occurs outside an institutionalized or school setting and which is usually informative. It could take place anywhere and anytime. However, differences exist in delivery methods and materials between one mode of informal education and another, based on the objectives to be achieved and the nature of the exposure of the target beneficiaries (Eheazu, 2016). In the context of the topic of this paper, the informal environmental literacy education being discussed is the type that would focus on the promotion and sustenance of CA adoption in Nigeria's rural areas. The ultimate aim would be to transform the rural communities from sole dependence on tillage farming to adoption of an alternative, Conservation Agriculture. The radio, the television, bill boards and mobile megaphones (where practicable) are among the channels to impact learning via the Informal mode of ELE. Well designed radio jingles and talks, television dramas, large attractive posters at strategic areas, as well as information passed through mobile mega phones and loudspeakers could provide requisite ELE to the rural community members at work or at home on the need for them to adopt the CA system. Here again, the services of environmental

literacy and community development educators as well professional artists would be required to design and implement the Informal ELE programmes. Government (through the Ministries of Agriculture at the Federal and State levels in Nigeria) and possibly with solicited assistance from the organizations mentioned under the Non-Formal mode above.

CONCLUSION

As a concept, agriculture, generally, includes farming, fishing and herdskeeping. In Nigeria, agriculture mainly involves, but not limited to farming, which has afforded the teeming population of the country's rural dwellers with varieties of food and cash crops. However, farming in the rural areas has been associated with serious environmental degradation (such as destruction of soil cover and biodiversity and reduction of underground water and nutrients) through the practice of traditional method of land preparation for cropping which involves 'slash-and-burn' of grass, tree felling/stumping, application of inorganic fertilizers and so on. The traditional method of farming is known to have led to perennial reduction in productivity, low income returns and eventual impoverishment of the rural farmers. Conservation/No-Tillage Agriculture or farming is globally advocated as an alternative towards the solution of the adverse effects of both the traditional method of farming and the present-day incidence of climate change. Unfortunately, due to their poor demographic/educational profile, the rural farmers in Nigeria are not readily aware of the processes, benefits (including the environmental advantages) and challenges of Conservation Agriculture (CA). In effect, and as statistics in this paper show, most African nations (including Nigeria) are lagging behind in the adoption of CA when compared globally, continentally and regionally with other nations. The situation thus craves special approaches towards promotion of CA in Africa (including rural Nigeria). On the specific case of the environmental degradation and other adverse effects associated with traditional methods of farming, this paper has shown that there is a need to provide Environmental Literacy Education (ELE) to the rural Nigerian (and indeed African) farmers alongside other necessary approaches to create appropriate awareness and provide necessary knowledge and training for the farmers to appreciate the need and opportunities for their adoption of the CA system. For this purpose, this paper has articulated four situation-specific ELE programmes capable of fostering promotion and adoption of CA by the farmers under reference. In the light of the detailed discussion on the potential of the identified ELE programmes, the author of this paper deems it pertinent to conclude that ELE is indeed relevant to the promotion of CA adoption by rural farmers in Nigeria. The author has also gone further to enunciate and clarify the relevant content and modes (formal, non-formal and informal) for mainstreaming and delivery of the outlined ELE programmes.

RECOMMENDATION

Following the detailed discussions on the topic of this paper and the conclusion arrived at, it becomes appropriate to recommend that:

- i. Environmental Literacy Education (ELE) should be employed to provide situation-specific programmes that would assist in motivating rural farmers in Nigeria and Africa generally towards adoption of CA.
- ii. Experts in ELE, Curriculum Design and other relevant professionals and artists should be involved in the planning and implementation of the different modes of the ELE programmes appropriate for various segments of the communities of the rural Nigerian farmers.
- iii. The primary source of funding the ELE programmes should be the Federal and State Governments in Nigeria. However, solicited assistance could be obtained from the Food and Agriculture Organization (FAO), the International Fund for Agriculture Development (IFAD), the African Conservation Tillage Network (ACT) and other willing Agricultural Development Partners (ADPs) like the Comprehensive African Agriculture Development Programmes (CAADP).

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