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Enhancing the Role of Public and Private Extension in Soil Conservation and Agricultural Productivity

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1.0 Introduction and conceptual clarification

1.1 Historical evolution of agricultural extension

The term “extension” was derived from the practice of British universities of having one educational programme within the premises of the university and another away from the university buildings. The programme conducted outside the university was described as “extension education.” The expression connoted an extension of knowledge from the university to places and people far beyond. The term “Extension Education” was first introduced in 1873 by Cambridge University in England to describe a particular system dedicated to the dissemination of knowledge to rural people where they lived and worked. Within a short time, the idea had spread to other parts of Britain, Europe and North America. Extension work is an out of school system of education in which adults and young people learn by doing. It is a partnership between the government, the land-grant institutions, and the people, which provides services and education designed to meet the needs of the people (Kelsey and Hearne, 1966). The term “Agricultural Extension” was only adopted in 1914 when the United States Federal Smith-Lever Act of 1914 formalized a nationwide cooperative federal-state-county programme and gave operational responsibility for this to the land grant colleges and Universities. In the beginning, agricultural extension was concerned primarily with the improvement of agriculture, using conventional teaching methods. As time went on, home economics, youth programmes and rural community resource development were included. Agricultural extension spread to tropical Africa, the Caribbean, Asia and Latin America following the involvement of the United States of America (USA) in bilateral AID programmes after the Second World War.

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1.2 Agricultural extension in Nigeria

The history of agricultural extension in Nigeria is interwoven with that of agricultural development in general. This is because it is concerned with all areas of agriculture. During the pre-colonial era by the British, conscious efforts were made in selection, introduction and teaching of the practices involved in producing good varieties of crops and breeds of animals. Farmers selected the best seeds for multiplication, from which the seedlings are been transplanted to their farms. Similarly farmers introduced to their farms improved seeds and animals from their neighbouring communities and from trans-Saharan traders from neighbouring countries. The farmers themselves experimented upon and projected their production methodologies without the assistance of formally designated extension agents. Traditional farming practice was largely through apprenticeship. Families have taught succeeding generation crop production, animal husbandry and soil management through observation and participation by learners. Neighbors and friends shared new knowledge of improved farm practices. During the colonial era by the British, some agricultural development initiatives were undertaken with the purpose of increasing production. The first step was to establish the Department of Botanical Research in 1893 with its headquarters at Olokomeji in the former western Nigeria (Williams, 1978). Its responsibilities included conducting research in both agriculture and forestry. In 1905, the British Cotton Growers Association acquired 10.35 square kilometers of land at the site now called Moor Plantation, Ibadan for growing cotton to feed the British textile mills. In 1910, Moor Plantation, Ibadan became the headquarters of the Department of Agriculture in Southern Nigeria, while the Department of Agriculture was established in the North in 1912. In 1921, a unified Department of Agriculture was formed in Nigeria, after the amalgamation of the North and the South. The major policy of the central Department of Agriculture was to increase production of export crops for the British market, which was ready to absorb it for its industrial growth. Extension activities were therefore directed towards increasing efficiency in crop production and marketing. Regulations were made to set and enforce standards in export crop production.

The colonial government also established some agricultural development schemes to upgrade the skills of farmers and to produce agricultural commodities. The Kware irrigation scheme was established in 1926. It was situated 16miles or 25.74 kilometers north of Sokoto town. Its purposes were to increase rice yields and provide experimental data on production under severe drought during dry season and flooding during the rains. The scheme started with 1000 acres or 405 hectares involving 800 farmers with farms situated along the riverbanks. The irrigation scheme

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employed the shadoof, which is an ancient Egyptian technique, also used by the Sudanese. The colonial period also witnessed the establishment of the Niger Agricultural project in 1949 with the aims of producing groundnut as export and guinea-corn for local consumption. It was also to relieve world food shortage, demonstrate better farming techniques and increase productivity of Nigeria's agriculture. The project was sited near Mokwa at an area, which is suitable for mechanized food crop production.

The post-colonial agricultural extension in Nigeria can be categorized into two groups: (1) government-organized agricultural programmes; and (2) extension programmes organized and sponsored by private agencies. The first group constitutes the more extensive of the two. Government organized agricultural extension include the National Accelerated Food Production Project (NAFPP) which was introduced in 1972, Agricultural Development Projects, ADP (alongside the ADPs, faculties of agriculture in some Nigerian universities as well as the three universities of agriculture also offer some extension services, especially to their immediate host communities) (1975), the Accelerated Development Area Project, ADAP (1982), and Multi-State Agricultural Development Projects, MSADP (1986). Other programmes were the Operation Feed the Nation Programme, OFN (1976), the River Basin Development Authority, RBDA (1973), the Green Revolution Programme, GRP (1980), the Directorate of Food, Roads and Rural Infrastructure, DFRRRI (1986), the National Directorate of Employment, NDE (1986), the Nigeria Agricultural Insurance Scheme, NAIS (1987) and the National Fadama Development Project, NFDP (1992). In recent years, the Poverty Alleviation Programme, PAP (2000), and National Economic Empowerment and Development Strategy, NEEDS (2004) were introduced. Specifically, the National Special Programme for Food Security, NSPFS was launched in March 2003. Some private agencies have embarked on agricultural extension services largely towards a specific clientele system of their choice. Some of the agencies are; the Nigerian Tobacco Company (NTC) (now British American Tobacco Nigeria [BATN]), oil companies such as Shell Petroleum Development Company, and religious organizations such as the Catholic and the Anglican churches. Some Non-governmental organizations (NGOs) such as the Leventis Foundation also operate some extension services. Many international organisations have been involved in agricultural extension, agricultural and rural developments in Nigeria for decades. Notable among these are the World Bank, International Fund for Agricultural Development, IFAD, United States Agency for International Development, USAID, Technical Centre for Agricultural and Rural Cooperation ACPECCTA, and Food and Agriculture Organization, (FAO) of the United Nations. Some NGOs also provide extension services as part of their

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mandate. Most NGOs adopt precision targeting of the most vulnerable poor and have been active all over Nigeria (Ladele, Awolola and Ogunlade, 2002 and Adegbola and Bamishaiye 2013). Private processing and marketing companies are also a vital part of the extension matrix in Nigeria. In their heydays the Nigerian textile companies and the Nigerian Tobacco Company had very robust out-grower programmes that they supported farmers with credit, inputs, and advisory services (Alamet *al.*, 2013).

1.3 Agricultural extension and national development agenda

Extension is an activity that facilitates the transmission of useful innovation to the end users. These innovations flow from the technology generating system traditionally represented by research institutes, universities, and other formal institutions doing research, but also recently including NGOs and indigenous technical knowledge of farmers (Asiabaka, 2007). The history of innovation generation in Nigeria parallels the developments in the management of extension. Early agricultural research in Nigeria was based on exportable crops. The first of such activities was the Cotton Research Institute established in 1905 in Ibadan, but later moved to Samaru, Zaria. In 1922 the Institute of Agricultural Research was established in Samaru. In 1939 an oil palm research station was established, and this later metamorphosed into the Nigerian Institute for Oil-Palm Research (NIFOR). The West African Institute for Oil-Palm Research replaced NIFOR in 1951. A second set of research institutes operating in Nigeria had the same objective of researching on export commodities, but their mandates covered the whole of Anglophone West Africa. They operated under the umbrella “West African Research Organizations.” In the euphoria of post-independence nationalism this body was dismantled to give way to several national research institutes (Anka, 2014). These included the Nigerian Institute for Trypanosomiasis Research, the Nigerian Stored Products Research Institute (NSPRI), the Cocoa Research Institute of Nigeria, and of course the rebirth of NIFOR. In 1972, the National Science and Technology Development Agency was put in place by the military government to coordinate research in science and technology. Some key institutes under its ambit were the NSPRI and the Nigerian Agricultural Extension and Research Liaison Services (NAERLS). The ARCN Decree No. 44 set up the Agricultural Research Council of Nigeria (ARCN) in 1999, however, it was not until 2006 the council took off. It is mandated to coordinate and supervise agricultural research in Nigeria (ARCN, 2016). This body has been responsible for the coordination of agricultural research in Nigeria to date.

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1.4 Shifting perceptions of the research-extension-farmer nexus in Nigeria

From colonial times up to the mid-1980s, the relationship between research, extension and the end-users of products of research was viewed as uni-linear. The formal public research sector was viewed as the generator of innovations. This was in line with the high visibility of government in the operation and funding of national extension systems otherwise known as National Agricultural Research Systems. This approach places much emphasis on the generation of technology from the formal research sector and its transmission through the extension system to the farmers in an almost patronizing fashion (Agwu, Dimelu and Madukwe, 2008). In line with shifting analytical emphasis, the Agricultural Knowledge and Information System (AKIS) emerged with a focus on linkages that exist between research, education and extension in generating and nurturing innovation. However as noted by Agwuet *al.* (2008), AKIS was limited in its analysis to the public agricultural research sector as at the heart of technological change. It represents progress from NARS in that it focuses not just on generation, but the diffusion of innovations within an agricultural system. The Agricultural Innovation System (AIS) analytical framework has gained acceptance lately. AIS have been described as “a set of agents that jointly and/or individually contribute to the development, diffusion and use of agriculture-related new technologies and that directly and/or indirectly influence the process of technological change in agriculture” (Agwuet *al.*, 2008). The agents in reference include research institutes, training and education institutions, credit institutions, policy and regulatory bodies, private consultants/NGOs, farmers, farmers’ associations and public services delivery organizations. This approach conceptualizes the research-extension-farmer nexus as a complex system with all players as equal partners working through complex location specific linkages to generate, diffuse and use innovations (Asiabaka, 2007). It has been suggested that existing agricultural extension policy would need to give way to more flexible policy that would promote not only technical innovations but also institutional, organizational and managerial innovations (Agwuet *al.*, 2008). These remain ideal that have to be made practical. Meanwhile, the major part of innovation diffusion is played by the public domain adopting the NARS orientation, represented by the ADP system although increasing partnership with NGOs seem to influence a gradual adoption of the AKIS and AIS outlook.

1.5 The role of agricultural extension in agricultural modernization

The Agricultural Transformation Agenda (ATA) was essentially a modernization programme. The major aim of the ATA was to transform agriculture in Nigeria from a

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mere traditional practice to a business enterprise. The value-chain approach adopted promises to lift agricultural activities beyond primary production to embrace significant investment in storage, processing, services and marketing (Akinwumi, 2012). Coming during a period of serious national economic stress, there was a shift of emphasis from public services to favor public-private partnership, and free-market operations. The policy claims to be sensitive to the needs of the most vulnerable farmers as structures are set in place for to capture their peculiar needs. For instance, the Growth Enhancement Support Scheme is designed to deliver subsidized farm inputs including fertilizers, seeds and other inputs the resource poor farmers. The strategy to achieve this was the e-wallet system. Another key component of ATA was the Nigeria Incentive-based Risk-sharing System for Agricultural Lending. This strategy was designed to make agricultural credit more accessible to all players in the agricultural value chain and attractive to the lenders by considerably reducing the risk associated with lending for agricultural production. The ATA was sustained and gave rise to the Agricultural Promotion Policy in 2016. Agricultural Promotion Policy of 2016 was produced based on the review of the Agricultural Transformation Agenda (ATA). The review noted that ATA did not sufficiently address the critical challenges of agricultural extension. APP identified the main challenge of extension as “the absence of coordination of extension activities at the federal level, since agricultural extension function has been vested in the states.”

Functions of agricultural extension can be provided in three major ways. The first is the public sector or supply-driven extension where the government takes full responsibility. Secondly is the NGO extension, which provides philanthropic outreach to a limited number of clientele by donor agencies and other private NGOs. The third extension approach is the private or demand-driven extension where manufacturers, marketing firms, and other commercial players provide extension functions. In many developing countries the private sector-led extension model (both nonprofit and for profit) is expanding because of shrinking government funding for extension. The consensus however is that the resource-poor farmers are too poor to participate in the private sector led extension and must be supported by public funding.

2.0 Public and private extension in Nigeria

The deficiency of Nigeria Government in the administration of agricultural extension was the factor responsible for her inability to cater for the development of agriculture and rural areas. Strengthening of national agricultural support system has been advocated as a strategy for increasing agricultural production in Sub-Saharan Africa

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by governments in the region and by international development agencies (Bindlish and Evenson, 1997). The T & V system (training and visit) system of agricultural extension has been central to this strategy. The World Bank supported agricultural extension programmes, based on the T & V system, which has been implemented in some Sub-Saharan countries or in about three-fifths of African countries. A substantial amount of resources has been committed to this system, both by national governments and international development agencies (Bindlish and Evenson, 1993). There is however an emerging controversy as to cost-effectiveness and productivity of a national system of agricultural extension, particularly in Sub-Saharan Africa where governments' ability to meet a large recurrent cost that the system entails is limited (Purcell and Anderson, 1997; Gautam, 1998). The fact is well acknowledged in Nigeria government circles, academics and among the citizenry. It was this awareness that led to the involvement of some private individual and organizations in the provision of extension and rural development process.

Government or public extension on one hand is described as the extension activities provided by government under the authority of Agricultural Development Programme (ADP) in all states of Nigeria to cater for the needs of farmers. Agricultural extension administration is expected to foster a sustainable and dynamic approach to agricultural development and which has remained of great concern to the government and priority for discourse in policy arena (Agwuet *et al.*, 2008). It is the realization of this fact that has made the successive Nigerian government to make effort towards raising the productivity level of rural people. The country has therefore, over the years, tried many agricultural extension systems, which include Agricultural Development Project (ADP). The ADPs across the country adopted the training and visit system (T & V) in order to boost production, solve the prevailing extension problem, foster self-reliance and sustain the problem, foster self-reliance and sustain the agricultural sector.

Non-governmental organizations or private extension on the other hand are referred to as a wide range of organized people, groups, system or services that are not directly set up, funded, controlled and operated by government or any of its agencies (Adedoyin and Omolafe, 1995). It is further described as any national or international private non-profit making institutions with development objectives (Babington *et al.*, 1993). In addition, Ladele (2019) explained private extension as the provision of extension services purely by individuals/ outfits with the exception of the NGOs and must not be understood as privatization of extension services. Some private agencies have embarked on agricultural extension services largely towards a specific clientele system of their choice. Some of the agencies are; the Nigerian

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Tobacco Company, oil companies such as Shell Petroleum Development Company, and religious organizations such as the Catholic and the Anglican churches. Some non-governmental organizations (NGO's) such as the Leventis Foundation also operate some extension services.

Other private enterprises, agencies and Non-Governmental organizations (NGOs) playing supportive role in research and extension delivery in Nigeria include; Sassakawa Global 2000 and Women in Agriculture (WIA), Practicing Farmers Association of Nigeria (PFAN), Farmers Agricultural Development Union (FADU), Farmers Agricultural Supply Company (FASCOM) and Evangelical Church of West Africa (ECWA). The National Seed Service (NSS) is charged with the general supply of certified seeds to farmers but there are private seed companies that complement its role and take care of her shortcomings. Such companies include; Premier Seed Nigeria Limited, UAC Seed Company, Alheri Seed Limited, Pioneer Seed Company, Sun Seed Company and lots more.

Many international organizations have also been involved in agricultural extension, agricultural and rural developments in Nigeria for decades. Notable among these are the World Bank, International Fund for Agricultural Development (IFAD), United States Agency for International Development (USAID), Technical Centre for Agricultural and Rural Cooperation, and Food and Agriculture Organization (FAO) of the United Nations (Salawuet *al*, 2008). Some international research centres and networks have made their presence known and supportive in Nigeria in the area of research and extension delivery. Some of them have established collaborative efforts with the NARIs and other relevant agencies. Some of the international research centres are; International Institute of Tropical Agriculture (IITA), International Fertilizer Development Centre (IFDC), International Livestock Research Institute (ILRI), International Crops Research Institute for Semi-Arid Tropics, International Fund for Agricultural Development (IFAD), Food and Agriculture Organization (FAO) of the United Nations and the United Nations Development Programme (UNDP).

2.1 Forms of private sector participation in agricultural extension and related matters of concern to the agricultural system:

- i. Information: This is often thought of as inherently a public good. It is both non-excludable (a person who acquires it cannot stop the people from using it) and non-sub tractable (or non-rival – one person's use of it does not diminish the supply from others to use). A user will not be prepared to pay the full cost of acquiring something that others can access without paying. It will therefore

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be under-supplied by the private sector in a free market. Information and advice may also be 'merit goods', that is, farmers who will therefore purchase sub-optimal amounts may not recognize their full value.

- ii. Providing information and advice is an essential part of any package of measures to correct other forms of market failure, such as externalities, high transaction cost, moral hazards and asymmetric information. Transaction costs include those involved in accessing and evaluating information and advice from different sources, which may also lead to sub-optimal use by farmers (Kyddet *al.*, 2000).

2.2 Key issues in private sector participation in agricultural extension service include among others:

- I. Confusion in multiplicity of service providers: It has been suggested that a pluralist array of private sector providers jeopardizes the synergy of a holistic, joined up knowledge and information system. Winter *et al.* (2000) suggests that fragmentation lead to confusion among farmers about where to go for information, duplication and wasteful competition among providers, and geographical imbalance in provision of services. Garforth *et al.* (2003) however found little evidence from cases from developed countries that this is specifically a problem of an extension system dominated by the private sector. Efforts by government and other actors to over manage the system are in any case likely to be counter-productive. The challenge is to ensure that (potential) extension clients can find their way around the array. Government can play a strategic role in identifying gaps in the provision of extension services and then seek to fill them through a brokerage role or by contracting service providers.
- II. Credibility of information sources: Credibility comes through as an important consideration from the point of view of clients. The fact that extension services are provided by the private sector, even when government funds it, is a positive feature. This may be more related to clients' everyday experience in other aspects of life. Commercial interests can also compromise credibility. But if farmers perceive a government policy which is against their interest, they are likely to be wary of government funded extension services and particularly those delivered by government agencies.
- III. Conflict of interest: Where a service provider is delivering advice on a commercial or semi-commercial basis to client and at the same time fulfilling a public interest role, there is a potential conflict of interest. A decision that is in the best business interest of a farmer does not necessarily optimize social

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returns to the community as a whole. In the end, it is the farmer who trades one off against the other in the decision he makes within the prevailing regulatory parameters. The intensity of potential conflict varies with the institution arrangements. Where the client is receiving commercial and public interest advice from two or more different providers, there is no conflict. Where different sections or staff members of the same organization are offering the two types of advice, the conflict is minimized to the extent that clients recognize their different remits. At an organizational level, transparent recording of advisory inputs against specific contracts minimizes potential conflicts with individual clients and with government.

2.3 Principles of private agricultural extension services

There are principles that are very important in the performance of private extension service providers especially in ensuring soil conservation and agricultural productivity. According to Ladele (2019), the principles include among others the following:

1. Profit making with fairness and competitiveness
2. Professionalism
3. Group dynamics
4. Partnership with public/private agencies including ADPs, AIDAs, NIRSAL etc.
5. Entrepreneurial skills
6. Appropriate selection of clientele
7. Advocacy role
8. Transparency and integrity
9. Sound communication skills
10. Round-out technical knowledge of commodity of interest & policies on agriculture
11. Sound team leadership spirit
12. Good negotiation skills
13. Sensitivity to legal implications

3.0 Soil Conservation and Agricultural Productivity

The drive towards agricultural prosperity in terms of employment opportunities, wealth creation, food security, industrial growth and robust foreign exchange earnings needs to be strengthened owing to the current realities. Basically, the achievement of the afore-mentioned are principally hinged on availability of the foremost factor of agricultural production and productively using the foremost factor for agricultural production and its produce and products. The foremost factor of

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agricultural production is land and must be protected for the good of all. Hence, holistic soil management culture is needed to avert imminent devastation soil destruction will cause the entire human race.

3.1 Importance of soil in agricultural production

The importance of land availability and quality of the land in agricultural production cannot be over emphasized especially in the context of the level of the technological advancement in Africa and Nigeria in particular. Although, advancement in technology is quite revealing that there is possibility of growing crops without depending on the natural component on land. However, it is practically impossible in Nigeria to completely produce crops independent of land, this is based realities in the nation's agricultural sector. Without any doubt, the progress made so far in terms of technological advancement in the nation's agricultural sector will still substantially be dependent on land.

Furthermore, considering the level of small holding, low technical know-how, illiteracy and poverty ridding nature of most Nigerian farmers, there is no realistic alternative to the dependency on land for agricultural production in Nigeria. Fortunately, arable land resources in Nigeria indicates its potentials of the agricultural lands in the transformation of the country's agricultural sector. Emphatically, there is no aspect of agriculture that doesn't have indirect or direct relationship with land. For instance, the method and result demonstrations, which are part of the learning tools in agricultural extension, cannot be actualised in the absence of land.

3.2 Challenges affecting soil quality for agricultural production

However, there are militating factors against access to quality soil for agricultural production in Nigeria. In northern part of Katsina state, El-Ladan, Maiwada, and Rumah (2014) identified some natural and man-made factors that are affecting soil quality in the part of the state. The identified natural and man-made factors are deforestation, soil degradation and erosion, biodiversity loss and desertification. This is a matter of common knowledge for it's a major feature and repeated occurrence in many frontline northern states. Hence, there is serious problem of land degradation with its attendant consequences on the agricultural productivity in Nigeria (Oyekale, 2012). Also, in southwestern part of Nigeria, the issues of soil compaction, low soil fertility, termite infestation, erosion, hardpan formation, poor drainage and land use intensification have identified identified as the issues that are adversely affecting soil quality in Itapaji watershed in Ikole Local Government Area of Ekiti State (Adeyolanu,

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Are, Adelana, Oluwatosin, Denton, Ande, Egbetokun, Ogunsumi, and Adediran, 2018). Without any doubt, the challenge of poor soil quality in Nigeria is a cross-regional challenge.

In addition, most of the Nigerian soils are fairly good but not very great in supporting very high level of agricultural productivity. According to Agboola (1979), Nigeria soils that have high, good, medium, low and very low potentials for agricultural productivity are 0%, 5.52%, 46.45%, 31.72 and 16.31%, respectively. This suggests that there should be pragmatic steps to avert reduction in the quality of available lands.

Consequently, there is need to ensure that all the existing categories of soils in terms of their ability to enhance agricultural productivity especially those in medium category and above are properly protected and maintained. Hence, the seriousness at which land especially the crop supporting components of soil is conserved, the greater the ability to make judicious use of the soil available on land for the attainment of meaningful agricultural production and increased agricultural productivity.

3.3 Connection between soil conservation and sustaining agricultural productivity

Holistic understanding of the concept of soil conservation and the appropriate measures to be taken in ensuring soil conservation are very germane in achieving robust, comprehensive and sustainable soil conservation. Soil conservation can be understood from the various explanations that have been enunciated by different scholars and organizations. According to the Organisation for Economic Co-operation and Development (OECD) (1997), soil conservation denotes the safeguarding of soil from erosion and other elements that can degrade soil in order to sustain its fertility and productivity. It mainly involves watershed management and water use. Also, Baumhardt, and Blanco-Canqui (2014) described soil conservation as the practices and management strategies that are employed in ensuring that that soil erosion is controlled to prevent loss of soil particles either through water or air.

The importance of soil conservation is underscored by its relevance to optimum agricultural productivity. Realisation of sustainable and robust agricultural productivity will be elusive regardless of whether all other factors are available if the quality of soil is poor. Dabi, Fikirie and Mulualem (2017) affirmed that the conservation of soil, water and vegetation are very crucial in achieving higher productivity of crop and livestock. Furthermore, National Academy of Sciences

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(1993) stressed the fact that quality soil contributes tremendously to agricultural productivity directly and indirectly because it is the storehouse for water and nutrients, which are very essential to plant growth.

Rice production in Thailand stagnated for ten years in terms of yield due to the deterioration of soil quality (Office of Agriculture and Economics, Ministry of Agriculture and Cooperatives (OAE), (2016). Invariably, the inability to ensure the conservation of soil used for rice production in Thailand affected the production and productivity of rice in the country persistently for a decade. Another inspiring example is from Japan where only 13% of the land is arable, however, due to the doggedness of the nation in soil fertility build up and consistent maintenance of soil fertility it has enhanced agricultural production in the country (Nations Encyclopedia, undated).

4.0 Sustaining agricultural productivity

The agricultural sector of any developing economy like Nigeria plays a vital role in the long-term sustainable development of such economy. In Nigeria, the sector provides employment, food for domestic consumption and raw materials for agro-based industries. Given the importance of this sector and the complexity in the nation's agricultural development amidst varying challenges such as fragmented small farm holdings, low literacy level of the farmers, aging farm population, low productivity, etc. it becomes imperative that the sector should be effectively supported if it must play its roles in the economic development of the nation. According to Yahaya (2017), the agricultural productivity is very low in Nigeria. The low productivity has made Nigeria to lose its past glory as a leading country in the export of very important crops such as groundnut, oil palm, cocoa, rice, cotton and so on. The country is not only experiencing low productivity in some of the very important crops that have high value in the world agricultural market and are contributing significantly to the Gross Domestic Product (GDP) of countries, it is equally overwhelmed by the challenge of decline in the productivity of some of the aforementioned. The table below highlights the productivity of some selected crops in Nigeria.

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Table 1: Agricultural products demand - supply situation

C r o p	Demand (tons)	Supply (tons)	O b s e r v a t i o n s
R i c e	6.3 million	2.3 million	Insufficient supply chain integration remains issue.
W h e a t	4.7 million	0.06 million	Driven by demand for various types of wheat (white, hard, durum), etc. for bread, biscuits and semovita.
Maize/Corn	7.5 million	7.0 million	Limited imports required but can shift due to feed demand.
Soya Beans	0.75 million	0.6 million	Animal feed and protein cost alt. driving demand.
Chickens	200 million birds	140 million	Gap filled by illegal imports that enter market at lower price point than domestic producers; gap also a moving target based on fast food/QSR demand.
F i s h	2.7 million	0.8 million	Fall off in ocean catch and weakness in aquaculture yields due to cost of fish feed; a constraint on growth.
Milk / Dairy	2.0 million	0.6 million	Driven by insufficient milking cows and low yields (~15-25 liters/day versus norm of 35 –40 liters NZ/US).
T o m a t o	2.2 million	0.8 million	Actual production is 1.5 million tons but 0.7M ton is lost during post-harvest.
Y a m s	39 million	37 million	Limited gap today but volumes expected to rise in planning period.
Oil Palm	8.0 million	4.5 million	Refers to fresh fruit bunch (FFB) from which oil is extracted at a 10% -15% efficiency rate.
C o c o a	3.6 million	0.25 million	Demand is global demand which will rise to 4.5M by 2020.
C o t t o n	0.7 million	0.2 million	Demand is for seed cotton and could rise to 1.0 –1.5 million tons subject to textile sector revival.
Sorghum	7.0 million	6.2 million	Demand will rise further as use in feed grows in 2016 –2020. Import of malt extracts and glucose syrup is currently used to manage gap, hence a commercial threat for Nigerian farmers.

Source: FMARD (2016)

Yahaya (2017) maintained that there is not a single crop in the nation with satisfactory performance requisite for export purpose. The situation is so disturbing that the deficiency is experienced for all the crops in one or combinations of these aspects. The aspects include production, productivity, export capacity and consistent

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or improvement in their performance in the global agricultural market. The shortage experienced in the supply of all the above listed agricultural products can be solved if there is proper development of human capital and the deployment of state of the art technologies and improved practices in the agricultural commodities value-chain.

The level of agricultural productivity calls for serious concern. The extremely low agricultural productivity in Nigeria is not peculiar to any part of the country. It's actually a challenge that is serious both in the northern and southern parts of the country. The average Nigerian smallholders produce 80% of the food and considered prominent feature of the informal sector with land holding of 0.2 – 2.0 ha; generally poorly resourced; largely family labor dependent; suffered low and marginal productivity with less benefits from economies of scale (Yahaya, 2017). This is considered abysmal performance when compared to Malaysia that is presently flourishing economically as a result of harnessing the full potentials of its agricultural sector.

The low productivity in agriculture and building upon the Agricultural Transformation Agenda (ATA) led to the build-up of the Agricultural Promotion Policy (APP) framework which seeks to unlock Nigeria's full agricultural potential by solving underlying challenges in its agricultural system which includes the following:

- i. **Policy Framework:** Nigeria suffers from policy instability driven by high rate of turnover of programmes and personnel, which in turn has made the application of policy instruments unstable. The outcome is an uneven development pathway for agriculture; lack of policy accountability, transparency and due process of law, relating to willful violation of the constitution and subsidiary legislations governing the agriculture sector. That in turn has made the business environment unpredictable and discourages investors. To address this challenge, Nigeria needs to create a policy structure that matches evidence-driven coordination among decision-making authorities with common and public goals for an agricultural transformation of the country. Building that evidence base requires that Nigeria adopt a consistent fact base to drive decision making, as well as build on prior successes.
- ii. **Political Commitment:** This pertains to the non-implementation of international protocols or conventions agreed to with other members of the comity of nations. For example, Nigeria has failed to achieve the targets in the Maputo Declaration that prescribes a minimum of 10% budgetary allocation to the

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agricultural sector. Political commitment at both the Federal and State levels will be required to enforce reforms.

- iii. **Agricultural Technology:** Persistent shortcomings of the National Agricultural Research System (NARS) to generate and commercialize new agricultural technologies that meet local market needs. NARS's challenges have been relatively severe particularly around improved varieties of seed or other planting materials and breeds of livestock and aquatic species. The failure to also deliver already proven technologies available on the shelf to farmers' fields where they are needed is a challenge. Addressing these will require better coordination among extension delivery system, the national agricultural research system, as well as public and private sector suppliers of agricultural inputs.
- iv. **Infrastructure Deficit:** Nigeria's agricultural sector suffers from an infrastructure challenge. Infrastructure such as motor roads, railroads or irrigation dams are either insufficient, or when available, not cost competitive. They are thus unable to operate to support scale-driven agriculture. That imposes an added cost (up to 50% - 100%) on the delivered price of agricultural produce in Nigeria, making it uncompetitive compared to global peers. In order to boost farm productivity, raise the level of marketable surplus and expand value chain participants' access to low cost infrastructure, Nigeria will need to rethink the business and operating model for agricultural infrastructure.
- v. **Finance and Risk Management:** Nigeria's agriculture sector continues to have poor access to financial services that enable farmers and other agricultural producers to adopt new technologies, improve market linkages, and increase their resilience to economic shocks. Poor access to financial services that enable input suppliers, processors, traders and others in agribusiness to address liquidity and encourage targeted private sector engagement in agriculture remains a challenge. Lending rates still routinely range from 10% to 30% subject to whether the borrower is considered prime, has access to low cost, government-provided financing (BoA, CBN, BOI), or is offered a NIRSAL Plc. -financed interest rate subsidy and credit guarantee. To improve financing options and de-risk value chains further, Nigeria will need to intensify innovation in financing ecosystems.
- vi. **Institutional Reform and Realignment:** Today, many federal and state agricultural institutions only exist on paper. In fact, the system even ignores local government areas which are actually where a majority of activity takes place. There is a need to streamline, clarify mandates and ensure continued

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accountability for results. Unless these issues are tackled, Nigeria will continue to struggle with the capacity of its agricultural institutions to deliver on their public mandates. A turnaround will mean, for example, adding more resources such as adding up to 15,000 extension workers, setting up more operational coordination mechanisms between the Federal Government and States in between the National Council of Agriculture, and linking rewards to performance. In addressing these constraints, the government will apply prudent, market based policy measures to grow the sector, with a clear recognition that widespread poverty reduction through the transformation of the agriculture sector is integral to the country's long run economic growth trajectory and prosperity.

Accordingly, the APP policy statement is anchored on three main pillars in line with the constitutional provision for the role of Federal Government in agricultural development. They include:

- Promotion of agricultural investment;
- Financing agricultural development programmes; and
- Research for agricultural innovation and productivity.

Leaning on the APP framework, agricultural productivity in Nigeria can thus be enhanced with due considerations for fundamental shift and pathways where the following are top on the agenda at policy design and implementation.

4.1 Advancement of Science, Technology and Innovation (STI)

According to Yahaya (2017), the nation can only survive if it weans itself from the present mono-economy. The only way out is to diversify the economy by adopting positive approach to agricultural development. Level of advancement in STI especially for the agricultural sector is a crucial determinant for satisfactory economic development in Nigeria. The nation will do very well once technology is used to galvanize its agro-based resources. The level of advancement in STI is contingent upon several factors. The factors include high level of human capital development, generation of sound, effective, efficient, cost effective, less complex, environmentally sustainable and relatively advantageous STI products; formulation and implementation of appropriate STI policies and more importantly; efficient and effective mechanism for diffusion of innovation and facilitation of the adoption of STI products.

Human capital development is recognized as a potent tool that is germane for generation and eventual utilization of STI products for improved agricultural production and productivity and transformation of the nation's agricultural sector and

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agro-allied industries. Human capital is the most vibrant asset any nation can possess as acknowledged by Musiyiwa that ***“I was blown away by the qualifications...“whenever I hear people talk about the wealth of Nigeria in terms of oil, I shake my head to say: “You have no idea what you’re talking about!”*** He concluded that the true wealth of Nigeria is its extraordinary human capital, and passion for education. ***“Unleash that and no one can stop them!”***

Therefore, the generation and utilization of viable STI products by properly developed human capital will expectedly translate to tremendous transformation of agricultural production, enhanced productivity and a robust agro-allied industries such that there will be sufficient agricultural raw materials and products in Nigeria for both local demand and export that can surpass her counterparts in African and indeed the global agricultural market.

4.2 Viable agricultural extension system (AES)

Leaving extension of the equation will always undermine a productive agricultural venture even when other agri-support services suffice.. This implies that the progress made in the agricultural sector cannot be discussed without the mention of agricultural extension. This reveals the position and role of agricultural extension in the development of agriculture.

Agricultural extension service is the most veritable support system for farmers to increase the productivity of their farms. This support is particularly needful now that the Nigerian government seeks to leverage on the available potentials in the sector through the Agricultural Promotion Policy (APP) as a growth pull for the national economy. However, the national agricultural extension system has left much to be desired in the provision of effective support to farmers due to several challenges. Some of these include; inadequate and untimely funding, poor coordination, low private sector participation, weak Research-Extension-Farmer-Inputs Linkages system and sometimes, inappropriate extension approaches for innovation delivery.

Critical success factor for innovation delivery as a platform for Nigeria agriculture is where the role of agricultural extension becomes imperative to take advantage of the cardinal role of extension in bridging the gap that may exist between various categories of stakeholders in the agricultural innovation system. Extension services have the traditional role to facilitate the innovation platform and extension practitioners have the training in soft skills to foster partnerships and interaction among stakeholders. The country’s hub for extension services need to be proactive

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in responding to needs of the different stakeholders where capacity development is well entrenched from extension training at tertiary level. This is carried out under well-structured and packaged comprehensive modules and delivery on the agricultural innovation systems. Hence, there is strong justification for the up scaling of the agricultural innovation, which requires continuous capacity development of the National Agricultural Research System to work in the innovation systems mode.

4.3 Integration of E-extension platforms into the National Agricultural Extension System

The basic concepts of E-extension as conceptualised and currently being promoted by the Federal Ministry of Agriculture and Rural Development and amplified by NAERLS involve the use of Information Communication Technology (ICT) as a platform for exchanging information and providing services to actors in the agricultural value chains. It is an electronic means of extending information to farmers through mobile phones and similar devices as well as the use of ICT to enhance traditional method (face to face extension) of extension services delivery especially in the face of low manpower engagement in extension agents as well as the need for the extension service to leverage on emerging technologies to enhance its outreach to its service recipients and other beneficiaries/actors in the agricultural value chains. Electronic extension has the following advantages:

- Most of the farmers in Nigeria live in rural areas and are in most cases devoid of technology and vital agricultural support services needed to carry out farming activities.
- Reduced number of frontline extension agents
- Wider penetration (more than the traditional face-to-face extension)
- Timeliness
- Evidence that most farmers have access to mobile phones
- Versatile application (weather, mapping, soils, etc.)

4.3.1 Key opportunities of electronic extension

- i. E-extension tools support delivery of information in diverse styles such as voice, image, motion, instants messages, and applications.

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- ii. Extension practitioners and farmers are among the owners and users of mobile phone.
- iii. The National Agricultural Extension Service (NAES) system apply a diversity of methods, therefore E-extension presents a larger scope for the utilization of appropriate technologies for information sharing, capacity strengthening, program and performance management, and other EAs activities.
- iv. Private operators can come in and partner, even the telecom operators
- v. It is cheaper than traditional “face to face” approach.

4.4 Imparting technical know-how on agricultural production

Agricultural development under any educational system as stated by Nyako (2019) is studied under science and technology. He reiterated that it is not by self-incantation; a clergyman or witch-doctor; it is not by public pronouncement by a public officer/politician or any other person(s) but to give farmers and herdsman, young and old, adequate knowledge on production of their agricultural units. He (Nyako, 2019) maintained that as a fact, virtually all-agricultural units, be they livestock, plants, ponds of water etc. are today yielding less than 10% of what their counter-parts in other nations are producing. Some of the consequences of these low yields, as he noted are glaring. A teeming population of near 200 million people cannot be fed based on these primitive yields. It is further made clear that Nigeria would not be able to operate viable food industries with such insufficient raw materials locally produced, or imported because of insufficient funds to pay for them. A brace up is needed to substantially improve the yields of all agricultural units required for good health and productivity, earnings of foreign exchange from the sales of our agricultural produce, a sizable reduction of unnecessary imports into the country. Agricultural businesses must be viable and paying as the human resource is adequate; eco-balance is right, arable land is available to support extensive agricultural production.

4.5 Agricultural value chain finance (AVCF)

Value Chain (VC) involves the sequential linkages through which raw materials and resources are converted into products for the market. Agricultural Value Chain(AVC) as posited by Yahaya (2019) identifies the set of actors (private, public, including service providers) and a set of activities that bring a basic agricultural product from production in the field to final consumption, where at each stage value is added to the product. It may include production, processing, packaging, storage, transport and distribution. Each segment of a chain has one or more backward and forward linkages. Thus, with AVCs, there is movement away from a commercial, segmented

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form of agriculture in which many separate links operate in isolation, out of sync with each other, in which farmers produce in bulk, are exposed to price risks and capital needs and produce independently. The AVC is based on integrated systems, differentiated production, risk management, information needs and interdependent farmers.

Agricultural Value Chain Finance (AVCF) according to Yahaya (2019) is the flow of funds to and among the various links within the AVC in terms of financial services and products and support services that flow to and/or through VC to address and alleviate constraints, and fulfill the needs of those involved in that chain, be it a need for finance, a need to secure sales, procure products, reduce risk and/or improve efficiency within the chain and thereby enhance the growth of the chain. AVCF is a comprehensive approach.

4.5.1 Key participants and other key components

According to Yahaya (2019), there are five main components to consider in VC analysis. These are the actors directly providing inputs, producing and distributing the product; the relationships and embedded services between these actors; the markets, the financial, general and specialized services coming from sources external to the production and distribution chain, and the enabling environment, including tax and trade policies and regulations. Apart from primary producers, several other players drive the AVCF and play important roles; these include dealers in agri-commodities and agri-inputs, food processors, retailers, support service institutions, banks and financial institutions. Each of these players may be operating in the AVCF at varying scales with investments of only a thousand dollars or even less or outlays of more than several million dollars. They operate along the VC with linkages into one another.

Key participants in a value chain are:

- Producers
- Agri-Input Dealers
- Aggregators
- Processors
- Wholesalers, and
- Retailers

Connecting to value chains is a first step towards economic development, but the principal objective of partner countries remains to capture more of the value-added in each chain. Indeed, the link between participation in value chains and development

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still is questioned (Ismail, 2013) and while participation in value chains can bring maximum benefits.

5.0 Soil and water conservation

The importance of water conservation for agriculture has been recognized for centuries (Unger, Kirkham and Nielsen, 2010). Bennett (1939), in his book *Soil Conservation*, cited numerous examples from ancient times of countries where canals were developed to convey water to agricultural lands for improved crop production. In addition, reservoirs were constructed for retaining water for later use on agricultural land, terraces were constructed to reduce runoff, plowed fallowing was promoted to conserve water, deep plowing was used in some cases, and contouring was used to retain water on land. Water for agriculture is derived from precipitation or from a stream, reservoir, or aquifer where irrigation is practiced.

5.1 Water harvesting techniques

Water harvesting, according to the Netherlands Water Partnership (NWP, 2007), can best be described as all activities to collect available water resources, temporarily storing excess water for use when required, especially in periods of drought or when no perennial resources are available. The starting point is the collection of natural water resources from rainwater, fog, runoff water, groundwater or even wastewater, which otherwise would have escaped. World water resources are facing dramatic changes as a result of global climate change, high water demands, population growth, industrialisation and urbanisation. As climate change leads to more extreme variations, water-harvesting solutions must cope with both extreme rainfall and extreme droughts. Extreme rainfall requires good flood protection and diversion structures. Extreme drought requires large storage capacity and more emphasis on groundwater replenishment. In some cases, droughts last so long that alternative water sources are required, which means that water rationalisation schemes must be developed in advance. The 2006 'United Nations Water Development Report' points out that a combination of lower precipitation and higher evaporation in many regions reduces water levels in rivers, lakes and groundwater. In addition, increased pollution damages ecosystems as well as the health, lives and livelihoods of those without access to adequate, safe drinking water and basic sanitation. The same report highlights how equal right of access to good quality water resources is a key challenge, crucial for domestic, agricultural, industrial and environmental use. By managing available water resources, livelihoods and human development can

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improve. To respond to water scarcity and unequal distribution, new techniques need to be explored and old techniques revisited. Small-scale water harvesting techniques provide a direct solution, especially in rural and drought-prone areas. Local storage of water is increasingly important for ensuring water availability and food security for rural and urban populations, especially in developing countries. This is particularly the case in areas with dry seasons where perennial rivers and fresh groundwater are not available or difficult to reach. In urban areas dam construction, long distance conveyance of water or desalinization may provide options for ensuring water availability. However, such solutions are generally too costly and complicated for rural water security. Rural populations require low-cost systems that can be constructed, operated and maintained with a high degree of community involvement and autonomy (NWP, 2007).

5.2 Potentials of water harvesting

- It may reduce the need for deep well drilling or other costly investments in piped water supplies.
- Water harvesting can also have a positive impact on soil conservation, erosion prevention, groundwater replenishment and the restoration of ecosystems.

Despite its tremendous potential, water harvesting has not received adequate recognition from policy makers and engineers. Water harvesting techniques are often considered unsophisticated or ‘traditional’, while water quality is not always guaranteed and unit costs can be high compared to supplies in humid countries. Moreover, these techniques require a high degree of flexibility and adaptation to the local situation. Many NGOs lack the capacity or interest to upscale and institutionalize successful local innovations, and this can contribute to lack of recognition by policy makers. Most good practices applied by small-scale farmers or development workers are developed by themselves through trial and error, by building on indigenous knowledge, or have resulted from the modified application of ideas introduced from outside. Often, these local innovations go unnoticed (NWP, 2007).

5.3 Smart water harvesting solutions

A water harvesting technology is ‘smart’ when adapted to local conditions and adaptable to a changing environment. Smart Solutions (SS) meet the needs of the user, are possible to replicate at a larger scale and are simple to implement, use, maintain and repair. Moreover, the techniques are affordable. Some success factors can be identified for water harvesting techniques. However, successful replication

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and implementation depends on local conditions. Success factors according to NWP(2007) include:

- Start small, learn as you go and expand when needed;
- Build on existing practice, experience and infrastructure;
- Focus on local construction materials, local knowledge and techniques, local labour;
- Recognise local customs, social structures and habits;
- Consider existing institutional settings (develop institutional support);
- Ensure political commitment;
- Involve local stakeholders in design and planning (developing ownership and skills), including women;
- Organise operation and maintenance: simple, local, affordable, low frequency, accessible services, e.g. performed by water committees with balanced representation;
- Ensure proper local training, capacity building;
- Secure property laws/ownership; own benefits, motivation, financing mechanisms;
- Evaluate capital resources, loans, micro-credits;
- Recover costs; make choices based on affordability and willingness to pay;
- Respond to actual needs (demand responsive);
- Build on co-operation successes in communities;
- Inspire by showing results/successes of other projects.

6.0 Conclusion and Recommendations

6.1 Conclusion

Enhancing the role of both public and private extension service entails a unified framework for performance. Many extension agencies and private service providers involved in extension service delivery in Nigeria have their own unique set of objectives, strategies and approaches which presents an unwieldy service environment that is uncoordinated and unregulated in terms of quality control and assurance, and sometimes conflicting information dissemination. This individualistic approach to extension service delivery affects agricultural productivity, which in turn, leads to decline in the gross domestic product of the nation.

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6.2 Recommendations

- i. Fast-tracking the national policy on agricultural extension in Nigeria. The agricultural extension policy, which has been drafted to harmonize the critical elements that are required to drive a sustainable and market-oriented agricultural development, should as a matter of urgency be implemented. This will unify the roles and functions of both private and public extension service delivery.
- ii. The strengthening of agricultural value chain is very critical to the achievement of sustainable agricultural development globally and locally. Therefore, value chain actors deserve special attention in the series of activities in value creation process of a product particularly, producers, processors, marketers, exporters.
- iii. Agricultural extension, which combines series of embedded communicative interventions that helps to resolve challenges facing agriculture, should accommodate the issue of climate change (including adaptation and mitigation). In response to the changing nature of agriculture and farmers' needs as occasioned by climate change, the focus of extension should shift from transferring skills, technologies and knowledge related to the production of crops, livestock and forestry products from research outcomes to farmers, to developing technologies with farmers and facilitating innovation processes for climate-smart agriculture.
- iv. There is need to intensify agricultural extension efforts in assisting smallholder farmers with information on how to be climate-smart which include developing closer linkages between agricultural research and extension providers; taking into account existing local knowledge and having a clear understanding of farmers' needs and problems as well as obtaining feedback on how technological interventions are performing.
- v. National sensitization programme is needed since the foremost factor of agricultural production is land it must be protected for the good of all. Hence, holistic soil management culture is needed to avert imminent devastation its destruction will cause the entire nation in particular and human race in general.
- vi. It is further made clear that there is urgent need Nigeria would not be able to operate viable food industries with such insufficient raw materials locally produced, or imported because of insufficient funds to pay for them

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