



Nagging Food Insecurity Amidst Numerous Public Agricultural Policies, Strategies, Programmes and Projects in Nigeria: Identifying and Fixing the Key Issues

Onyenekenwa Cyprian Eneh

Institute for Development Studies, Enugu Campus, University of Nigeria, Nsukka

Received: 01 Jul 2021; Received in revised form: 25 Jul 2021; Accepted: 06 Aug 2021; Available online: 14 Aug 2021

©2021 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license

(<https://creativecommons.org/licenses/by/4.0/>).

Abstract— Despite numerous public agricultural policies, strategies, programmes and projects aimed at boosting agricultural production for the attainment of food security in the past consecutive five decades in Nigeria, seven out of ten Nigerians are food insecure. The study identified the key issues that need to be fixed, using theoretical and documentary methods and survey research designs. Four hundred (400) academics/practitioners in food policies/production/security were purposively selected based on online visibility. They were reached for information, using Google Questionnaire. Data were analysed using frequency tables and factor analysis. Finding identified six (6) key issues that needed to be fixed, namely predominance of smallholder subsistence farming, use of rudimentary tools, unimproved varieties of seeds and other inputs, traditional storage and preservation practices, deficit of marketing infrastructure, and dependence on rain-fed agriculture. Fixing them can address the four dimensions of food security. The key issues were related more to science technology and innovation (STI) than to other selected development sub-sectors. They were attributable to poor STI adoption and can be fixed by STI adoption. Therefore, STI adoption for agricultural production was recommended for the attainment of food security in Nigeria.

Keywords— Agricultural production, Science technology and innovation adoption, Food security policy, Pillars of food security, Dimensions of food security.

I. INTRODUCTION

Hungry people—persons with a sense of inner emptiness—are bereft of a sense of discernment of right and wrong. They settle for anything that can minister to their empty stomachs, even if it offends someone. What is bitter tastes good to them. Food is a foremost basic need of people and food security is a *sine qua non* for meaningful development, which is about improving the welfare of people. The welfare of people begins with food, but does not end with it. People may do without clothing or shelter for as long as necessary, but not food, the absence of which destabilizes them mentally, such that they cannot engage in any meaningful activity to help selves, other people or the society. Faced with an abject lack of food, clothing and shelter, the destitute scavenge for food from waste dumps, ignoring the other two basic needs of people, while going naked or ragged and making habitat of anything at all (Schuldt, 2019).

Therefore, it is a front-burner development concern that more than one billion people are hungry mostly in sub-Saharan Africa (SSA) and Latin America and the Caribbean (LAC), while 2 billion eat too much wrong food (Kaur, 2019). This unacceptable situation informs the SDG 2 which aims to “end hunger, achieve food security and improved nutrition, and promote sustainable agriculture” by 2030 in all the countries of the world (<http://sustainabledevelopment.un.org/focussdgs.html>). The first United Nations Millennium Development Goal (MDG 1) had aimed to “eradicate extreme poverty and hunger” between 2000 and 2015 in all the countries of the world. Poverty is connected to food. Indeed, the thresholds for determining that someone is poor were originally calculated as the budget necessary to buy a certain number of calories, plus some other indispensable purchases, such as housing. A poor person is essentially someone without enough to eat (Banerjee and Duflo, 2011). At the end of the

target year, 2015, the G8 countries might have hit the MDGs, but Nigeria certainly did not, with hunger rising and poverty deepening to the point that Nigeria became the poverty capital of the world by 2019 (<http://sustainabledevelopment.un.org/focussdgs.htm>). It is being hoped that SDG 2 will not fare the way of MDG 1 in Nigeria.

In the past five decades (1970-2019), Nigeria has had a plethora of public agricultural policies, strategies, programmes and projects for boosting agricultural production for the attainment of food security and agricultural sustainability. It is curious that, in spite of the numerous public initiatives and interventions, seven out of ten Nigerians are food insecure (Okojie, 2019). There must be some issues which need to be identified and fixed. What are the key issues behind the failure of public agricultural policies, strategies, programmes and projects for food security in Nigeria? What is the extent fixing them can address the four dimensions of food security? To which development sub-sectors are the key issues related? How can the key issues be fixed? These are the objects of the study, the findings of which would help tease out workable recommendations for way-forward.

1.1 Review of relevant literature

The concepts of food security policy, science technology and innovation (STI) and its adoption are reviewed. A brief profile of food security in Nigeria is examined. Public policies, strategies, programmes and projects for boosting agricultural production for the attainment of food security in Nigeria, as well as factors affecting food security and their effects on development in Nigeria are reviewed.

1.1.1 Food security policy

Food security policy includes decision-making around production and processing techniques, marketing, availability, utilization and consumption of food in the interest of meeting or furthering social objectives. It is designed to influence the operation of the food and agricultural system for the community (local, national, regional or global) and for commitment to nurturing the development of a food secure nation in which all citizens are hunger-free, healthy and benefit from the food systems that impact their lives. It affirms the nation's commitment to supporting sustainable food systems that provide people with high quality food, employment, and that also contribute to the long-term well-being of the environment (FAO, 2009).

It addresses current access to quality food in the nation, hunger and malnutrition, impacts/effects of an inadequate diet, citizen education, economic injustice in the food system, urban agriculture, the role of schools and other public institutions, and emergency response. The

document is organized by a statement of the issues, followed by actions needed to address those issues (FAO, 2009).

1.1.2 Science technology and innovation (STI) and its adoption

According to National Academies of Sciences, Engineering, and Medicine (NASEM, 2017), STI refers to science technology and innovation. Other nuances and their acronyms are S&T (science and technology), R&D (research and development), STIP (science, technology, innovation and partnership), and R&P (research and partnership).

Scientific research produces discoveries to improve lives and societies; technological breakthroughs revolutionize commerce and knowledge-sharing; and innovation inspires people to seek new solutions to persistent problems. The use of technology in industrial development and the resulting gaps in productivity explains the differentials in development status of countries. Countries with high levels of investment in physical capital instead of in technology run the risk of facing diminishing returns and slow growth. Ultimately, weak productivity growth in developing countries exacerbates poverty, energy deficiency and environmental debt, to name but a few significant implications. Conversely, investment in technology guarantees continuous productivity growth and potential for inclusive and sustainable industrial development. It is therefore important to focus on the factors that are involved in increased technical efficiency (more output per input or more resource productivity) and technological change, both of which are components of productivity growth. A significant reason behind developing countries' weak productivity is the low rate of innovation. A coordinated national system of innovation (NSI) is needful to promote investment in innovation, decreases the constraints on the creation of new knowledge and technology, and boosts the rates of adoption and adaptation of existing technologies. STI policies help raise productivity, improve firm competitiveness, support faster growth and create jobs (NASEM, 2017).

According to Eneh (2010), STI adoption refers to the stage in which STI is selected for use by an individual or an organization. Related terms are technology diffusion and technology integration. The former refers to the stage in which the technology spreads to general use and application, while the latter connotes a sense of acceptance, and perhaps transparency, within the user environment. Typically, adoption of a new technology signals a confidence in its potential to alleviate a particular problem or to make a job easier or more efficient; rarely has bringing about new social and functional conditions been a consideration.

1.1.3A brief profile of food security in Nigeria

Before attainment of political independence in 1960, Nigeria was self-sufficient in food production and exported not only food but also raw materials to England. The establishment of the Department of Botanical Research in 1893; the acquisition of over 10 sq. km. of land at Moor Plantation in Ibadan for cotton production in 1905; the establishment of the Department of Agriculture in the North in 1912 and the establishment of Central Department of Agriculture after the Amalgamation of 1914 put Nigeria on a steady path to agricultural development. In the early 1960s, Nigeria was one of the world's most promising agricultural producers. Regionally focused policies based on the economic principle of commodity comparative advantage ensured that the agricultural sector served as the nation's main source of food and livelihoods (Ibirogbu, 2018).

The immediate post-independence years were the golden era of agriculture in the country. Service accounted for 32%, manufacturing 11% and agriculture over 30% of the country's gross domestic products (GDP). The productiveness of Nigerian soil, enhanced by conducive climate and weather, supported the production of a variety of foods and cash crops. Until early 1970s, Nigeria was leading in the production of cash crops, such as cocoa, cotton, groundnuts, palm oil/kernel, rubber, etc., which were mostly exported to Britain, United States of America (USA), Canada and Germany. Till the early 1980s, animal husbandry, fishing and poultry contributed more than 2% to the country's GDP. A 1987 report of the United Nations Food and Agriculture Organization (UN FAO) submits that there were 12.2 million cattle, 13.2 million sheep, 26 million goats, 1.3 million pigs, 700,000 donkeys, 250,000 horses, and 18,000 camels in Nigeria around this period. Most of these livestock were owned by rural dwellers (Odumade, 2017).

Nigeria soon turned to petroleum as the mainstay of the nation's economy, neglected agricultural sector and rapidly grew into a major food importer. The oil-economy quickly polarized the nation's population into a small fraction of high-income group that benefit from the oil wealth and a major fraction of low-income group suffering food insecurity because it cannot afford imported foods. Nigeria became shackled in food insecurity (Matemilola and Elegbede, 2017).

Engagement of a sizable ratio of the population in subsistence agriculture and high regulation of the economy of 1960-1986 became the responses, which could only ensure supply, but not affordability and accessibility, of food (Adebayo, 2010). Food supplies improved considerably in the subsequent deregulated economy that followed the adoption of the Structural Adjustment

Programme (SAP) in 1986. But, food accessibility, utilization and security status worsened. Between 1980 and 1990, per capita agricultural production even declined or stagnated (Dauda, 2006).

Currently, Nigeria's estimated 200 million population grows at an annual rate of 2.6. Yet, staple food crops are under-produced. Maize, vegetables and cassava crops yields are constant in the past 10 years in Nigeria because there is no right hybrid seeds and seedlings for cultivation; those available are adulterated. Crops yields are 1.2mt/ha maize and 2mt/ha cassava, as against 3mt/ha and 6mt/ha respectively by peers in other African countries. Nigerian farmers record the least yield/ha in Africa. Tomato yield is 7mt/ha in Nigeria, 20mt/ha in Kenya, 8mt/ha in Ghana and 76mt/ha in South Africa. Maize yield is 1.6mt/ha in Nigeria, 2mt/ha in Kenya and Ghana, and 6mt/ha in South Africa. Potato yield is 3.7mt/ha in Nigeria, 15.5mt/ha in Kenya, and 38.8mt/ha in South Africa. Rice paddy yield is 2mt/ha in Nigeria, 3mt/ha in Kenya, Ghana and South Africa. Nigeria has the lowest yield/ha globally. Crops yield gaps are high in Nigeria. Average rice yields in Nigeria are between 1 and 2.5 tons/ha against potential yields of 5–6 tons/ha. Maize yields in Nigeria are less than 2 tons/ha on average compared to greater than 9 tons per hectare attained in the USA. Half of fruits and vegetables get lost to post-harvest rot because of inadequate storage facilities and huge road deficits. Nigeria is the poverty capital of the world with 91.8 million Nigerians living in extreme poverty. Rural communities account for 52.8% of poverty in Nigeria. This low productivity results in extensive and persistent food insufficiency/insecurity and poverty. Up to 70% of Nigerians are food insecure (Okojie, 2019).

1.1.4 Public policies, strategies, programmes and projects for boosting agricultural production for the attainment of food security and agricultural sustainability in Nigeria

A society evolves three basic ways to provide food as an existential imperative: (i) policy to rely on its resources (e.g. primitive societies), (ii) food imports to supplement local production (e.g. modern economies), and (iii) involving the control of the resources of others to ensure regular supply of its needs (e.g. imperialists). The Vision 2010 recognized that Nigeria is well endowed with natural resources and sought to improve the enabling environment to enhance the exploitation of these resources to make Nigeria Africa's leading economy and an industrial nation (Njoku, 2000).

Nigeria has had a plethora of policies, strategies, programmes and projects for boosting agricultural production for the attainment of food security and agricultural sustainability (Okuneye, 2002). Nigeria's

agriculture policies, which are geared towards ensuring food security and improved nutrition among citizens, particularly children, include (1) Agriculture Promotion Policy (2016-2020) driven by engagement of market place participants, farmers, states, investors, financial institutions and communities, and (2) National Plan of Action on Food and Nutrition in Nigeria (Abu, 2012).

Pre-independence government policies, strategies, programmes and projects focussed on agricultural commodities (especially export crops) which generated extractable surpluses in agriculture. Regional governments created development corporations for agricultural interventions. Corporations in the East and West regions established oil palm, cocoa and rubber plantations. The North region provided extension services to transform smallholder production activities. Allocations to agriculture in 1951-1959 period averaged 7.5%, 8.3% and 13.6% of total government expenditure in the West, East and North respectively. The marketing boards extracted surpluses from agriculture for the development of other sectors, since agriculture was the goose that laid the golden egg and provided the engine of growth for the rest of the economy. In 1960-1966 period, agricultural development was a responsibility of the region, except agricultural research located in the Federal Ministry of Economic Development. Food production surpassed population growth. Output of export crops grew by 4-6%. Government agricultural allocation averaged 7% in 1962-1968 period. Oil revenue grew upto the early 1970s, and allocation to agriculture dropped to 2.2% in 1966-1975 period. To spend the oil money, a floodgate of imports were maintained up to 1980s, when depressed domestic prices accelerated the decline of local food production and contributed to the economic crisis that erupted in the early 1980s. The neglect of the agricultural sector notwithstanding, certain agricultural programmes were initiated. The National Accelerated Food Production Project (NAFPP) was established in four states in 1973 and extended to all states in 1977. Three Agricultural Development Projects (ADPs) were established in 1975 in Funtua, Gausau and Gombe, and were increased to 13 in 1979 (Njoku, 2000).

Ten (10) federal universities/colleges of agriculture (<https://www.federal-universities-and-colleges-of-agriculture>), 16 national agricultural research institutions (<https://agriculturenigeria.com/research>) and 12 river basin development authorities (RBDAs) were established in the 1970s to accelerate agricultural development, power generation, navigation, rural development, among others (Ogundele, 2019; Akindele and Adebo, 2004; <http://lawnigeria.com/LawsoftheFederation/RIVER-BASINS-DEVELOPMENT-AUTHORITIES-ACT.html>;

https://en.wikipedia.org/wiki/River_Basin_Authorities_in_Nigeria).

From 1978, fall in oil prices continued into the 1980s, leading to a drastic fall in government revenue. Government made some investments in development of extension services, distribution of improved inputs (notably fertilizer) and development of marketing facilities. Several parastatals were created for large-scale farming activities, including the National Livestock Production Company, the National Grains Production Company and the National Root Crops Production Company. The Federal Ministry of Agriculture was created in 1975, besides the Federal Ministry of Natural Resources created in 1964. Operation Feed the Nation (OFN) started in 1976, while the State Marketing Boards were replaced with National Commodity Board in 1977. Nonetheless, agriculture received 1% allocation of the federal expenditure during 1975-1979 period. In 1979-1983 period, the Economic Stabilisation Act (ESA) of 1982 was established to restrict food importation and exportation. The Green Revolution Programme (GRP) came to expand the production of grains. Allocation to agriculture rose to 13% of federal government expenditure. In 1983-1999 period, commodity boards were abrogated, public companies were deprived of agricultural production, the Directorate of Food, Roads and Rural Infrastructure (DFRRI) was established to foster rural and agricultural development, ADP received improved budget, and building of a fertilizer and Savana Sugar projects took place. The National Agricultural Land Development Authority (NALDA) came on board in 1990 to make land available to people who wanted to go into farming. The National Agricultural Research Project (NARP) was also established. The Nigeria Export Import Bank (NEXIM) was established in 1990 to provide fund to indigenous exporters. Also lending their support were international financiers, including the World Bank, UNDP, FAO, UNIDO and others (Njoku, 2000).

In spite of these public agricultural policies, strategies, programmes and projects aimed at boosting agricultural production for the attainment of food security in the past consecutive five decades, seven out of ten Nigerians are food insecure (Okojie, 2019). This is intriguing and contrary to the expectations that putting sufficient public agricultural policies, strategies, programmes and projects on ground would boost agricultural production and result in food security in Nigeria. Therefore, it has become necessary to identify the key issues that need to be fixed.

1.1.5 Factors affecting food security and their effects on development in Nigeria

Ogundele (2019), Okojie (2019), Odumade (2017), Matemilola and Elegbede (2017) and Njoku (2000) submit

that the factors affecting food security are climate, predominance of smallholder subsistence farming, technology, use of rudimentary tools, loss of farmlands, unimproved varieties of seeds and other inputs, pests and diseases, traditional storage and preservation practices, water stress (irrigation), deficit of marketing infrastructure, dependence on rain-fed agriculture, and poverty. These and other factors lead to famine (undernourishment, malnutrition, wasting and stunting), soil erosion, deforestation (overgrazing, over-cultivation), rising prices, debt, and social unrest. But, boosting agricultural production for the attainment of food security ensures a well-fed and healthy population, availability of raw materials for local use and export, growth of foreign reserves through export of raw materials, ease of financing (from rich foreign reserves) food import to supplement local production, transfer of productive resources (investable surpluses of capital and labour) to other sectors of the economy for economic development of the country, value addition through effective value chain management, revenue improvement through payment of taxation, diversification that averts the vagaries of price fluctuation of the nation's monolithic oil economy, and provision of remunerative employment. Unfortunately, numerous and varied public agricultural policies, strategies, programmes and projects to boost agricultural production for the attainment of food security since 1970 have not yielded the desired food security status.

II. METHODS

A combination of theoretical and documentary research methods and a survey research design was adopted. Four hundred (400) academics/practitioners in food policy/production/security were purposively selected based on their online visibility, qualifications, experiences and outputs, as most competent to address the research questions. Inclusion criteria were having a minimum of ten (10) cognate research highly rated publications in food security policy and agricultural production, and being among the first 400 persons to indicate availability for the study. Exclusion criterion was inability to make it to the list of the first 400 persons selected based on the inclusion criteria.

Information was elicited in three separate questionnaires. The first questionnaire, which served for preliminary survey, contained an open-ended question on the issues that needed to be fixed to reverse the failure trend of the numerous public agricultural policies, strategies, programmes and projects and bring about the much needed food security. The suggested items formed a long list of twenty-eight (28) random answers arranged vertically in descending order of frequency. The list was subjected to factor analysis to pick the key issues, which happened to be six (6) (Table 1).

Table 1: Factor scores for the key issues

S/N	Item	Factor scores		
		1	2	3
1	Predominance of smallholder subsistence farming	0.51	0.52	0.62
2	Use of rudimentary tools	0.41	0.43	0.52
3	Unimproved varieties of seeds and other inputs	0.61	0.63	0.73
4	Traditional storage and preservation practices	0.67	0.68	0.89
5	Deficit of marketing infrastructure	0.56	0.67	0.79
6	Dependence on rain-fed agriculture	0.44	0.70	0.89

Source: SPSS

The second questionnaire, which was sent again to respondents, contained questions on the extent the key issues were real, fixing the key issues could address the four dimensions of food security, and the key issues were related to selected development sub-sectors (politic-economic, socio-religio-cultural and STI). Analysis showed that the key issues were more related to STI than the other two sub-sectors. Based on this finding, the third questionnaire was sent to the respondents to interrogate the extent to which the key issues were attributable to poor STI adoption and to which STI adoption could fix them.

The answer options for the questions in the second and third questionnaires were arranged on a scale of "great extent" (scale 4), "good extent" (scale 3), "average extent" (scale 2) and "low extent" (scale 1). The data were arranged in a frequency table and subjected to factor analysis, to obtain the factor scores/weights. Factor weight was obtained as the quotient of the frequency score and 400.

III. RESULTS

Twenty-eight (28) factors suggested by respondents for the failure of government efforts geared towards food security were predominance of smallholder subsistence farming, use of rudimentary tools, unimproved varieties of seeds and other inputs, traditional storage and preservation practices, deficit of marketing infrastructure, dependence on rain-fed agriculture, weak institutions, insecurity, leadership ineptitude, poor administration of justice, inadequate infrastructure, unsupportive macro-economic environment, poor basic health, poor basic education, business-unfriendly environment, policy summersault, abandonment of projects, poor release of project funds, lack of patriotism, corruption, poverty, greed, crime,

nepotism, tribalism, mediocrity, cronyism, and sycophancy. The first 6 (Table 1) automatically appeared on the factor analysis table as having factor scores above the universal minimum benchmark of 0.4, thereby proving that the factors were significant and were the key issues. The other 22 factors were, therefore, considered insignificant.

Table 2 shows the factor scores for the extent fixing the key issues could address the four dimensions of food security. All the factor scores were above the universal minimum benchmark score of 0.40, showing that each of the key issues could address each of the four dimensions of food security.

Table 2: Factor scores for the extent fixing the key issues can address the four dimensions of food security

S/N	Item	Factor scores (Availability of sufficient amount of food through the provision of machines and technology for mechanized food production to keep per capita food production high at all times)			Factor scores (Stability of food supply by provision of chemicals and techniques to preserve/store produced food and to supplement available food through imports if necessary)			Factor scores (Accessibility to the available food through production of food that is affordable to all income levels at all times, culturally appropriate, and from sources that are environmentally sound and just, as well as address infrastructure deficits, such as feeder roads, for effective distribution and marketing of food)			Factor scores (Utilization of food with adequate nutrition through provision of scientific means of procurement, ingestion and digestion, education and health)		
		1	2	3	1	2	3	1	2	3	1	2	3
1	Predominance of smallholder subsistence farming	0.53	0.62	0.51	0.53	0.62	0.51	0.53	0.62	0.51	0.53	0.62	0.51
2	Use of rudimentary tools	0.41	0.43	0.52	0.41	0.43	0.52	0.41	0.43	0.52	0.41	0.43	0.52
3	Unimproved varieties of seeds and other inputs	0.61	0.51	0.73	0.61	0.51	0.73	0.61	0.51	0.73	0.61	0.51	0.73
4	Traditional storage and preservation practices	0.89	0.67	0.74	0.89	0.67	0.74	0.89	0.67	0.74	0.89	0.67	0.74
5	Deficit of marketing	0.79	0.51	0.63	0.79	0.51	0.63	0.79	0.51	0.63	0.79	0.51	0.63

	infrastructure												
6	Dependence on rain-fed agriculture	0.44	0.70	0.89	0.44	0.70	0.89	0.44	0.70	0.89	0.44	0.70	0.89

Source: SPSS

Table 3 shows the frequency scores for relatedness of the key issues to selected development sub-sectors (politico-economic, socio-religio-cultural and STI). STI had the highest frequency scores for each of the key issues, showing they all belonged to STI development sub-sector more than the other two sub-sectors. Table 3 also shows

the factor weights for the relatedness of the key issues to selected development sub-sectors. STI had the highest factor weight for each of the key issues, showing they were related to STI development sub-sector more than the other two sub-sectors.

Table 3: Frequency scores for relatedness of key issues to selected development sub-sectors

S/N	Item	Frequency scores			Factor weights		
		Politico-economic	Socio-religio-cultural	STI	Politico-economic	Socio-religio-cultural	STI
1	Predominance of smallholder subsistence farming	117	103	180	0.2925	0.2575	0.45
2	Use of rudimentary tools	121	101	178	0.3025	0.2525	0.445
3	Unimproved varieties of seeds and other inputs	132	107	161	0.330	0.2675	0.4025
4	Traditional storage and preservation practices	128	111	161	0.320	0.2775	0.4025
5	Deficit of marketing infrastructure	146	102	152	0.365	0.255	0.38
6	Dependence on rain-fed agriculture	140	108	152	0.350	0.270	0.38

Source: Field work 2019

Table 4 shows the factor scores for the extent the key issues were attributable to poor STI adoption. The factor scores were all above the universal minimum benchmark score of 0.4, showing that all the key issues were attributable to poor STI adoption.

Table 4: Factor scores for the extent the key issues are attributable to poor STI adoption

S/N	Item	Factor scores		
		1	2	3
1	Predominance of smallholder subsistence farming	0.48	0.54	0.59
2	Use of rudimentary tools	0.50	0.73	0.75
3	Unimproved varieties of seeds and other inputs	0.51	0.47	0.73
4	Traditional storage and preservation practices	0.43	0.61	0.71
5	Deficit of marketing infrastructure	0.49	0.62	0.64
6	Dependence on rain-fed agriculture	0.56	0.58	0.83

Source: SPSS

Table 5 shows the factor scores for the extent STI adoption could solve the problems associated with the key issues. The factor scores for STI adoption were all above the universal minimum benchmark score of 0.4, showing that STI adoption could solve the problems associated with each key issue.

Table 5: Factor scores for the extent STI adoption could fix the key issues

S/N	Item	Factor scores		
		1	2	3
1	Predominance of smallholder subsistence farming	0.43	0.57	0.52
2	Use of rudimentary tools	0.82	0.79	0.67
3	Unimproved varieties of seeds and other inputs	0.57	0.42	0.77
4	Traditional storage and preservation practices	0.49	0.64	0.73

5	Deficit of marketing infrastructure	0.44	0.67	0.69
6	Dependence on rain-fed agriculture	0.45	0.78	0.59

Source: SPSS

IV. DISCUSSION/ CONCLUSION

4.1 Discussion

Since the key issues were determined by statistical factorization of the suggestions from top expert theoreticians and practitioners in food policy and production, they were regarded as most credible, and are briefly discussed below.

4.1 Predominance of smallholder subsistence farming

Njoku (2000) submits that farms below 10 ha still account for over 95% of agricultural production in Nigeria. This is predicated on land fragmentation which still holds sway, especially in South-east Nigeria, where customary inheritance laws operate. Labour-intensive smallholder subsistence farming promotes extensification to use more farmers, more land and other resources to produce less food with attendant costs to the environment. On the other hand, mechanized farming promotes intensification to use less number of farmers and resources to produce more food.

Seventy-five (75%) of the world's poorest people derive their livelihood from farming small plots of land about the size of a football field. Agricultural mechanization will help the small farmers in developing countries to increase production and sell more crops to combat global hunger and poverty (Drake, 2013). Aditya (2020) submits that mechanization of agriculture and farming process applies machines to work on land for agricultural production. Mobile mechanization attempts to replace animal power with machine power, while stationary mechanization aims at reducing the drudgery of certain operations which have to be performed either by human labour or by a combined effort of human beings and animals. Thus, mechanization may be partial (only a part of the farm work is done by machine) or complete (animal or human labour is completely dispensed with by power-supplying machines). According to Ndubuisi (2019), benefits of agricultural mechanization include reduction of manual labour drudgery, food sufficiency, foreign exchange generation through exportation of excess produce, employment generation through improved youth participation in agricultural activities, longer shelf-life of produce through improved preservation and packaging, among others. Emami, Almassi, Bakhoda and Kalantari (2018) submit that agricultural mechanization is the key to food security in developing countries.

STI and its adoption supply the machinery for mechanized farming to produce more food with less inputs, but are hampered by land fragmentation which promotes

smallholder subsistence farming characterized by a vicious cycle of low productivity, low income and low investment or poverty. This poverty or lack of investible fund ensures that technologies are not adopted. Smallholder subsistence farming needs to be jettisoned for STI-driven mechanized farming (Emamiet *al*, 2018).

4.2 Use of rudimentary tools

Even in the era of 4th Industrial Revolution, most Nigerian farmers still use traditional hand-tools (hoe, cutlass, pick-axe, shovel, etc.) for agricultural practice. Ogundele (2019) asserts that adoption of STI replaces rudimentary tools with machines to enable mass-production of food for teeming population. Use of machines produces food that is affordable to people of all socio-economic statuses. Eighty years ago, 25% of disposable income was spent on food. Today, it hovers around 10% in Canada and the U.S. – the lowest in the world. Therefore, mechanized agriculture, which relies heavily on machines (STI adoption), is the way to go.

4.3 Use of unimproved varieties of seeds and other inputs

So far, crop yields are marginal, compared to the potentials, because the improved varieties of seeds and other inputs are not used. For example, maize yields in Nigeria are less than 2 tons/ha on average, compared to greater than 9 tons/ha in the USA that drive agricultural production with STI adoption. Okojie (2019) opines that Nigeria needs to adopt STI techniques to provide improved varieties of seeds and other inputs to ensure bumper harvest corresponding to the potentials of rich agricultural environment. Such STI techniques are tissue culture, use of genetically modified organisms (GMOs) to produce genetically modified foods (GMFs), among others.

4.4 Traditional storage and preservation practices

Absence of storage and preservation facilities predispose half of fruits and vegetables to loss to post-harvest rot and pest attack, in addition to field losses (Eneh, 2011). According to Odumade (2017), STI supplies appropriate chemicals for pests control measures and preservation of agricultural yields, and needs to be adopted to solve Nigeria's issues of agricultural field and post-harvest losses.

4.5 Deficit of marketing infrastructure

Marketing infrastructure, such as network of feeder roads and railways, are not only deficit but the available ones are often in appalling conditions of rapid decay amidst deficient maintenance culture. Electricity power supply is irregular and in very short supply duration, where

available, because of inadequate power generation and poor distribution. Other comatose infrastructures abound. These facilities are products of STI and can be remedied by STI adoption. Therefore, STI adoption will take care of the daunting challenges to Nigeria's agricultural production. This is in line with the report of Matemilola and Elegbede (2017).

4.6 Dependence on rain-fed agriculture

Dependence on rain-fed agriculture is still the vogue in Nigeria and other African countries. Sachs (2008) submits that irrigation problem in Africa can be solved by rainwater harvesting and micro-irrigation driven by STI for dry season crop production.

4.7 Implications of findings for development

Since fixing the key issues could address the four dimensions of food security, all the six key issues are related more to STI than to the other development sub-sectors, all the key issues are attributable to poor STI adoption, and STI adoption can fix the key issues, it can be asserted that STI and its adoption are pivotal to Nigeria's quest for food security. This finding is externally validated by the report of Senor and Singer (2009) on Israel's experience which shows that agriculture ought to be 95% STI and 5% physical labour. Relying on the universities and R&D institutions to generate and transfer knowledge that increases productivity and yield, Israel has used STI to conquer their many natural disadvantages to emerge as a leading food net exporter. NASEM (2017) reports that the U.S.A. employs STI to respond to challenges and USAID focuses on STI to improve development outcomes.

Adoption of STI will address the four dimensions of food security in Nigeria by ensuring (1) availability of sufficient amount of food through the provision of machines and technology for mechanized food production to keep per capita food production high at all times; (2) stability of food supply by provision of chemicals and techniques to preserve/store produced food and to supplement available food through imports if necessary; (3) accessibility to the available food through production of food that is affordable to all income levels at all times, culturally appropriate, and from sources that are environmentally sound and just, as well as address infrastructure deficits, such as feeder roads, for effective distribution and marketing of food; and (4) utilization of food with adequate nutrition through provision of scientific means of procurement, ingestion and digestion, education and health.

Adopting STI to functionalize public policies, strategies, programmes and projects for boosting agricultural production for the attainment of food security will enhance good feeding and health for the population, supply of raw materials for local use and export, growth of foreign

reserves through export of raw materials, ease of financing (from rich foreign reserves) food import to supplement local production, transfer of productive resources (investable surpluses of capital and labour) to other sectors of the economy for economic development of the country, value addition through effective value chain management, revenue improvement through payment of taxation, diversification that averts the vagaries of price fluctuation of the nation's monolithic oil economy, and provision of remunerative employments.

4.2 Conclusion

Six key issues behind the failure to achieve food security in Nigeria have been established as predominance of smallholder subsistence farming, use of rudimentary tools, unimproved varieties of seeds and other inputs, traditional storage and preservation practices, deficit of marketing infrastructure, and dependence on rain-fed agriculture. They were found to be related more to STI development sub-sector than to other selected sub-sectors. Each of them was attributable to poor STI adoption and can be fixed by STI adoption. Fixing them was able to address the four dimensions of food security. Thus, poor STI adoption begets the key issues which can be fixed by STI adoption for agricultural production for food security.

Evolving STI trend for mechanized agricultural production, storage system and preservation, transport and marketing of agricultural products is imperative for addressing the nagging food insecurity in Nigeria. STI-driven agricultural production will turn Nigeria from food insecure to a food secure nation. Therefore, STI adoption is recommended for Nigeria's march to food security.

CONFLICT OF INTEREST

There is no conflict of interest.

REFERENCES

- [1] Abu, O. 2012. Food security in Nigeria and South Africa: Policies and Challenges. *Journal of Humanities and Ecology*38(1): 31-35.
- [2] Adebayo, A.A. 2010. Food security status in Nigeria: Pre and post economic deregulation review. *International Journal of Economic Development Research and Investment*1(1):1-10.
- [3] Aditya, H. 2020. Mechanization of agriculture: Meaning, benefits and progress. Available at <https://www.economicsdiscussion.net/india/farming/mechanization-of-agriculture-meaning-benefits-and-progress/21655> [Accessed, 7/13/2020]
- [4] Akindele, S.T. and Adebo, A. 2004. The political economy of river basin development authority in Nigeria: A retrogressive case study of Owena-River Basin and Rural Development Authority (ORBRDA). *Journal of Human Ecology*16(1): 55-62.

- [5] Banerjee, A. and Duflo, E.2011, More than 1 billion people are hungry in the world, Available at <https://foreignpolicy.com/2011/04/25/more-than-1-billion-people-are-hungry-in-the-world/> [Accessed 8/29/2019]
- [6] Dauda, R.S. 2006. Food security: A critical variable in Nigeria's quest for economic empowerment and development. In Akano, O. and Familoni, K. (eds.) The National Economic Empowerment and Development Strategy: Philosophy, Opportunities and Challenges. Lagos: Lagos University Press, 295-313.
- [7] Drake, M. 2013. The Borgen Project. Farming in Developing Countries. Bill and Melinda Gate website.
- [8] Emami, M., Almassi, M., Bakhoda, H. and Kalantari, I. 2018. Agricultural mechanization: The key to food security - strategy formulating for Iran. Agriculture and Food Security 7 (article number 24).
- [9] Eneh, O.C. 2011. Enhancing Africa's environmental management: Integrated pest management for minimization of agricultural pesticides pollution. Research Journal of Environmental Sciences 5 (6): 521-529.
- [10] Eneh, O.C. 2010. Technology transfer, adoption and integration: A review. Journal of Applied Science 10(16): 1814-1819.
- [11] Food and Agriculture Organization (FAO) 2009. Establishment of a Food Security Policy Framework Learners' Notes: Lesson 1. Food and Agriculture Organization (FAO) of the United Nations. <http://www.fao.org/elearning/Course/FP/en/pdf/trainerresources/learnernotes0419.pdf>
- [12] Ibirogba, F. 2018. When will Nigeria attain food independence? The Guardian, October 1.
- [13] Kaur, B. 2019, World's 1 billion people are hungry and 2 billion eat too much wrong food. Available at <https://www.downtoearth.org.in/news/food/world-s-1-billion-people-are-hungry-and-2-billion-eat-too-much-wrong-food-62852> [Accessed 8/29/2019.]
- [14] Matemilola, S. and Elegbede, I. 2017. The challenges of food security in Nigeria. Scientific Research, 4(12):1-22.
- [15] NASEM (National Academies of Sciences, Engineering, and Medicine) (2017). Summary - The Role of Science, Technology, Innovation, and Partnerships in the Future of USAID. Washington, DC: The National Academies Press. doi: 10.17226/24617.
- [16] Ndubuisi, C.O. 2019. The Role of Mechanized Agriculture in a Developing Economy. Paper presented at the 1st National Conference of the School of Engineering Technology Federal Polytechnic Nekede Owerri, Imo State, 1000 Capacity Auditorium, 12th -15th November 2019.
- [17] Njoku, P.C. 2000. Nigerian agriculture and the challenges of the 21st century. Agro-Science 1(1): 1-28.
- [18] Odumade, B. 2017. Revamping the nation's agricultural sector. Available at www.pmnewsnigeria.com [Accessed 7/27/2019].
- [19] Ogundele, A.T. 2019. River Basin Development Authorities in Nigeria: The neglected tools for national development. International Journal of Advanced Academic Research 5(3):39-49.
- [20] Okojie, J. 2019. Bridging Nigeria's farm yields gap to tackle rural poverty. BusinessDay July 3.
- [21] Okuneye, P.A. 2002. Rising Cost of Food prices and food insecurity in Nigeria and its implication for poverty reduction. CBN Economic and Financial Review 39 (4):6-20.
- [22] Sachs, J. 2008. Promises, promises. Developments 2008, Issue 40:6.
- [23] Senor, D. and Singer, S. 2009. Start-up Nation: The Story of Israel's Economic Miracle. United States: Twelve.
- [24] Schuldt, J.B. 2019. When sharks won't bite. In Our Daily Bread, June-August 2019 edition, June 29.