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THE ROLE OF AGRICULTURAL TECHNOLOGY ON ECONOMIC DEVELOPMENT IN NIGERIAN

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Abstract

The agricultural sector is considered an important sector in the development of any economy. Both the developed and developing nations have undeniably acknowledged the cardinal role the sector plays in their development. Despite Nigeria's huge natural resource endowment (favourable climate, abundant water and sunlight), the agricultural sector still faces a set back because of archaic farming practices and medieval mindset, which has led to severe hunger, malnutrition, poverty and food insecurity. This study examines the role of agriculture technology in transforming the agricultural sector towards fostering economic growth and development. The quantitative approach method was applied and materials were analysed through the content approach. Data for the study was sourced through secondary means while relevant information were gathered from textbook, government publications and other articles. The study reveals that application of agricultural technology has the potential to boost production, create more job, opportunities, increase farmers income, alleviate poverty, curb food insecurity and foster economic growth and development in Nigeria. The study recommends that government should create awareness about agriculture technology through campaigns and funding, investment by government and private sector in agricultural technology infrastructure and the recruitment of skilled educators to enhance the quality of agricultural technology educations.

Keywords: Agriculture, Technology, Agricultural Technology, Transformation, Productivity.

Introduction

The agricultural sector in Nigeria has been the backbone of the economy, providing food and livelihood for millions of Nigerian's and contributing significantly to Nigeria's Gross Domestic Product (GDP) (National Bureau of Statistics (NBS), 2023). The role of the agricultural sector cannot be underestimated. According to Mwangi and Kariuki (2015), it is at the centre of any rural development program and important livelihood options to reduce poverty and enhancement of food security among rural households in developing countries. Adebayo and Okuneye, (2015) also agreed that the Nigerian Agricultural sector is the main thrust of national survival, source of employment, food and foreign exchange earnings. Over the years, the agricultural sector in Nigeria has been performing below expectations. The poor performance of the sector has manifested itself in numerous ways; in the forms of decline in agricultural output, decline in its contribution to GDP, decline in export growth, increase in net food imports and decline in the sectors employment generation. The acute food insecurity experienced in the last decade is a clear indication that the sector is lagging behind in terms of food production. Food and nutrition problems have engulfed the nation to the embarrassment of policy makers and political leaders (Ojo, 1981). According to Ekong (2009), this poor performance can be attributed to the fact that majority of Nigerian farmers live in rural areas with agricultural practices being so rudimentary, subsistence and

counterproductive that the nation has been found wanting in her struggle towards making great efforts to increase food production in quantity and quality for her fast ever growing population. For the transformation of traditional farming system in other to increase food production, there is need for the adoption of modern technology and improved practices (Ayodele et al, 2023). As a primary sector, the agricultural sector has lagged behind many other sectors in the application of digital technology.

Agricultural technologies include all kinds of improved technologies and practices which affects the growth and development of agricultural output (Jain et al, 2009). Agricultural technologies can lead to significant increase in agricultural output and stimulate the transformation of subsistence nature of farming characterized by low productivity to a high – productivity and ultimately towards the agro-industrialized economy (Donstop – Nguezet et al, 2011). Technology in agriculture affects many areas such as; fertilizer, pesticides, seed technology, soil fertility management. Biotechnology and generic engineering has resulted in pest- resistance and increase crop yields. The result of mechanization is efficient soil tilling, harvesting and reduced manual labour, processing machinery has reduced wastage. New technologies focus on robotics, precision agriculture, artificial intelligence, block-chain technology and more (Sehgal, 2023).

Despite the importance of the agricultural sector and its potentials to transform the Nigeria's economy towards achieving socio-economic development, the issues of hunger malnutrition and poverty have continued to wage war on majority of the Nigerian populace. For several decades, the Nigerian leadership has adopted myriad of agricultural policies and projects with the objective of revamping the agricultural sector towards achieving food security and economic transformation, all these measures have not significantly addressed the problems of hunger, malnutrition and poverty. It is against this background that this study seeks to analyze the role of technology in transforming the agricultural sector towards attaining national development. Scholarly efforts have focused on other factors militating against national development, but scholars are yet to give serious attention on how agricultural technology plays a key role in transforming the agricultural sector towards achieving growth and development in Nigeria.

Literature Review

Conceptual Issues

Agriculture: Agriculture is as old as man and up till date, it is the occupation that employs millions of Nigeria's labour force. Agriculture involves the cultivation of lands, raising and rearing of animals for the purpose of production of food for man, feed for animals and raw materials for industries (Anyawa et al, 1997). It involves cropping, livestock, forestry, fishery, processing and marketing of these agricultural products. Before the colonial era, the Nigerian community is predominantly a farming community made up of peasant farmers producing a variety of commodities mostly to satisfy their needs with little surpluses for exchange with other communities through trade by barter. Colonialism brought in the money economy which provided more cash crops for sale and eventual export to Western Europe. Food crops include yam, cocoyam, beans, cassava, and rice while cash crops include oil palm in the east, cocoa from the west and cotton and groundnut from north. The agricultural sector experience a boom between 1945 and 1954 which led to the establishment of marketing boards with monopolistic powers to buy crops from farmers and sell overseas (Anyawu et al, 1997).

The agricultural sector became a principal source of food and livelihood for millions of Nigerians, a key revenue earner for the government and employs nearly three quarter of the nation's work force (Eze, 2013). Before the discovery of oil, the country was self-sufficient in food production of one or two cash crops. There was the groundnut pyramid and cotton in the north, cocoa in the west, oil palm and kernel heaps in east and rubber plantation in the mid-west (Tell, 2009). The discovery of oil during the late 1950s and the high revenue accruing from its sales changed the dynamics. Since independence, the agricultural sector was officially neglected for oil and its role in food

production and contribution to GDP began to decline. Rapid annual population growth over the last decades has seen domestic demand for food outweigh supply despite several interventions by the government. Climate change, conflicts and insecurity has brought Nigeria to the brink of food crisis. Furthermore, the over dependence on traditional technologies characterized by poor yield and inefficiency is the major problem of agricultural development in Nigeria (Oyewole et al, 2023).

Table 1: Major Crops Grown in Nigeria by Region

Crop category	Southern Zone	Middle belt zone	Northern zone
Cash Crops	Cocoa	Beniseed	Groundnut
	Rubber	Rubber	Cotton
	Oil Palm	Cocoa	Beniseed
Food Crops	Yam	Yam	Sorghum
	Cassava	Cassava	Millet
	Maize	Maize	Rice
	Rice	Rice	Soya beans
	Cocoyam	Cocoyam	Pigeon pea
	Plantain	Plantain	Potatoes
	Sweet Potatoes	Sorghum potatoes	
		Millet	
		Soya Beans	
		Beniseed	
		Cowpeas	
		Pigeon pea	
		Sweet Potatoes	

Source: (A. &Asadu, 2015)

Table 2: Major Livestock Distribution by Major Production Regions

Regions	*livestock*
Southern region	Sheep
	Goat
	Pigs
	Poultry
	Some Tryps-resistant cattle
Northern Region	Sheep
	Goat
	Pigs
	Poultry
	Cattle
	Horses
	Donkeys
	Camels

Source: (A. &Asadu, 2015)

a. Agricultural Technology

Technology is the application of knowledge for practical purposes. It can be classified into two major categories which include material and knowledge based technology. Material technology involves knowledge that is embodied in a technology product such as tool, equipments, improved plant varieties or hybrids and improved breed of animals. Knowledge based technology includes technical knowledge, managerial skills and other processes that farmers need to successfully grow crops or livestock management practices (Umar, 2022).

Agricultural technology includes all kinds of improved techniques and practices which affects the growth of agricultural output (Jain et al 2009). For the purpose of this study, agricultural technology can be defined as the application of improved techniques and skillful practices to agricultural production with the aim of increasing productivity. The role of modern technology is significant in agricultural development; and with the advent of digital technology, the scope has widened. Challa, (2013) opined that improved technologies tend to raise output level and reduce average cost of production which in turn, results in substantial gains in farm income. It has been reported that appropriate land use patterns and intensification of technology give opportunity to higher increase in farm productivity and income levels (Olagunju and Salimonu, 2010). Productivity increases in agriculture can reduce food prices, thereby enhancing increment in consumption (Diagne et al, 2009). Consistent with this argument, the Department for International Development, (2003) estimated that 1% increase in agricultural productivity reduces the percentage of poor people living on less than 1 dollar a day by between 0.6 and 2%, and no other economic activity generates the same benefit for the poor. However, increase agricultural productivity cannot be achieved without the use of improved and modern approach to food production (Oyadelele et al, 2023; Challa 2013).

It is important to note that new innovations in agricultural development are of the little value until they can be put to use for the economic and social benefit of the people involved (Sennuga & Oyewole, 2020).

The Role of Technology in The Transformation of The Agricultural Sector

One of overarching goals of Nigerian agricultural development programs and policies is increasing agricultural productivity for accelerated economic growth. Since majority of Nigerians live in rural areas and depend on agriculture for survival, the agricultural sector has been identified as a key sector for speeding growth, overcoming poverty and enhancing food security.

Agricultural technology has not only impacted the methods of production but has also transformed general activities including engagement and interaction within the agricultural sector in Nigeria. Timmer (1998) presented transformation of the economy as a result of agricultural transformation in four phases. According to him, agricultural labour productivity increases in each phase of transformation leads to high level of agricultural surplus. This surplus enables growth in other non-agricultural sectors by mobilizing labour, savings and tax revenues from the agricultural sector. This then leads to the integration phase where there is an increase in significance of non-agricultural sectors, therefore, agriculture development can be linked to the rest of the economy through improved infrastructure and the development of markets, and incase where the integration results in a positive outcome, then the economy can be said to be industrialized.

No doubts, agricultural performance has been linked to economic growth over the years and the technological transformation of the sector will yield positive outcome for the Nigerian economy in the following ways:-

1. Improved Agricultural productivity.

Agricultural technology adoption in Nigeria can lead to improved agricultural productivity across the country. With proper education and training in agricultural technology, farmers can learn modern techniques and technologies to increase crop yields and improve farming practices. This can result in higher productivity, better quality crops, increase farmers income and improve farmers welfare.

2. Poverty Alleviation and Food Security

Agricultural technology can play a significant role in alleviating poverty and ensuring food security in Nigeria. By equipping farmers with relevant knowledge and skills, they can effectively increase their agricultural outputs. This can help meet the rising food demand of a growing population, reducing the reliance on food imports and boosting local food production.

3. Job Creation and Economic Growth

Agricultural technology can stimulate economic growth and create new job opportunities in Nigeria. According to Trendov et al, (2019) digitalization of the agricultural sector will significantly alter the nature of work and the demand for labour skills. As farmers adopt advance agricultural techniques, there will be need for skilled professionals to operate and maintain the system. This can lead to the creation of new jobs in the sector and also stimulate more job creation in other sectors that have direct link with the agricultural sector.

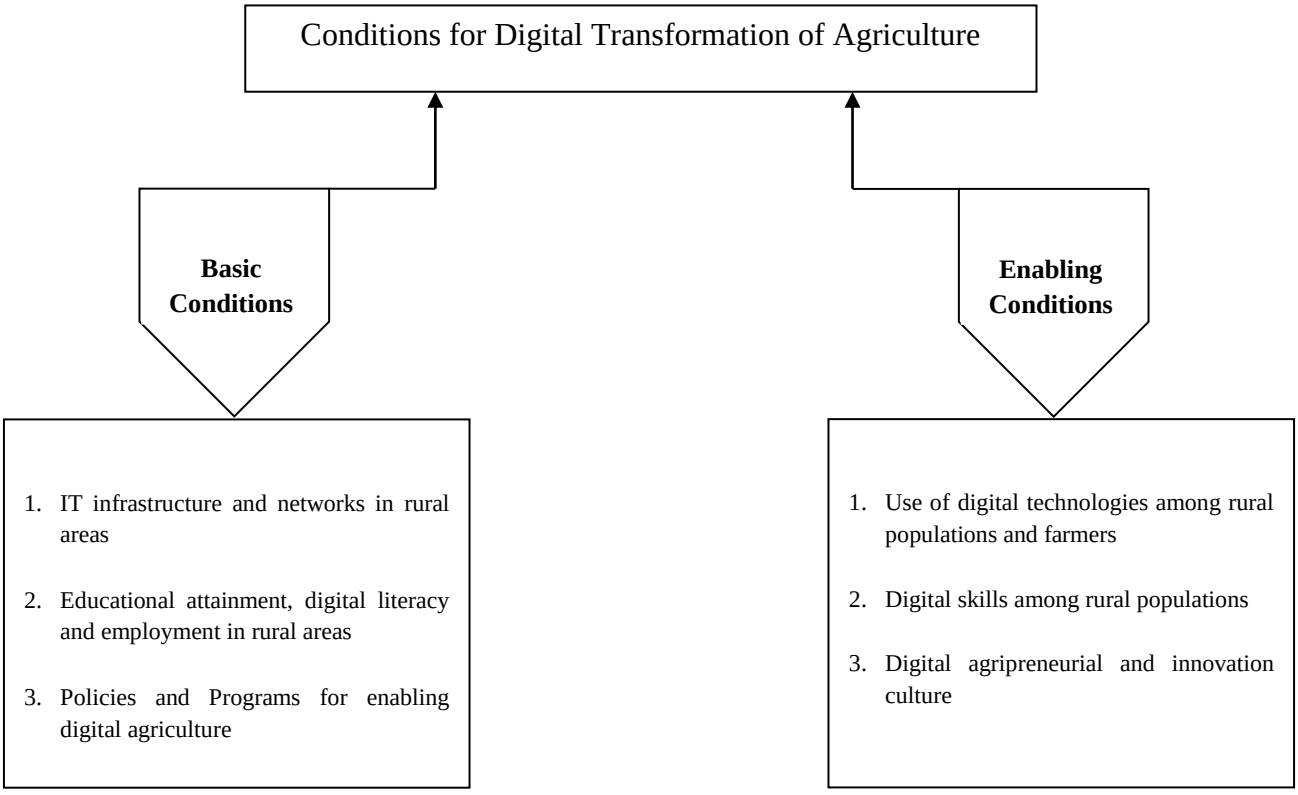
4. **Technological Advancement and Innovation**

Agricultural technology has the potential to drive technological advancement and innovation in Nigeria's agricultural sector. By training students and famers in cutting-edge technologies such as precision farming, remote sensing and data analytics, they can develop new innovative solutions to address challenges in agriculture. This can lead to breakthrough in sustainable farming practices and contribute to overall sector growth and eventually transforming the entire economy.

Technological Transformation of the Agricultural Sector in Nigeria

a. Conditions for Technological Transformation of the Agricultural Sector in Nigeria.

Trendov, Veras and Zeng (2019) provided a two way condition for digital transformation of the agricultural sector; they are the basic conditions and the enabling condition.



Source: (Trendov, et, al., 2019)

It is important to know that the basic and the enabling conditions are in conjunction and the enabling condition cannot be attained without fully attaining the basic condition.

i. Information and Communication Technology (ICT)/Networks in Rural Areas. There has always been a digital divide between the rural and urban areas in Nigeria. The application of ICT and provision of telecommunication infrastructure in rural areas for connectivity within and outside the community has been ongoing. Nigeria has made great progress in expanding GSM signal and coverage over the years, however the awareness remains limited. According to Nnenna (2013), there is no doubt, there exists a presence of ICTs but the respondents were not fully aware of them. The challenges now become the utilization and accessibility of these ICTs as most people in rural areas cannot afford the network coverage prices and therefore cannot gain access to the internet.

ii. Educational Attainment and Digital Literacy in Rural Areas. The utilization of digital technologies demands fundamental literacy as well as digital knowledge and skills (Ogunsolu, 2021). It has been established that there is lack of relevant and technological skills among farmer and people in rural areas. Samuel and Ayeni (2017), asserted that the accessibility to shared ICT facilities remain poor in rural areas and a suggestion was made to the government to consider innovative service delivery options to improve shared ICT facilities as well as to promote inclusiveness in the new information society on the part of people living in rural areas in Nigeria. Digital literacy has always been a key obstacle in the adoption of digital technology, therefore transforming the sector has been difficult so far.

The people that have the technological knowledge and skills in Nigeria are mostly youths who often migrate to urban areas in search of jobs that match their skills because they believe that agriculture has nothing to offer, but in reality, agro-business have been flourishing. For instance, top business companies in Nigeria such as Flour Mills of Nigeria, Olam, Stallion Group, Seedco Nigeria Limited etc. which through the manipulation of technology and innovation in their vision to provide better livelihood for the people in Nigeria have led to increase profit (Ignitia Tropical Weather Forecasting, 2020). It is going to be a great challenge for the government to create an educational platform that would be responsible for training farmers in rural areas. The possibility for this to result into a positive outcome is really thin and given the unsuccessful tract record of embarking on vigorous training for farmers, it can be inferred that going down this road can most likely prove to be futile (Ogunsohi, 2021).

Policies and Programs for Enabling Digital Technological in Agriculture: In several countries, government policies and programs are the driving forces of technological transformation. According to Hanna (2018), government is very significant in creating a digital economy by providing policies that will nurture a traditional digital ecosystem and build innovative and inclusive digital economy. The creation of these policies and programs by the government will create an environment for competitive digital markets and e-services. There also has to be a form of reform that allows for only eligible individuals that fit the technological transformation agenda to head and to be among members of the various departments in not only the agricultural sector but also in the Nigerian government. The individuals in government and the agricultural sector will be saddled with the responsibilities of spearheading the digital revolution of the agricultural sector, creating policies and programs that would aid and lead the agenda, employing other like-minded educated people that have the desired level of literacy to help implement these policies and manage adoption of these policies.

Increased Funding and Scholarships: Increased funding and scholarships play a vital role in promoting agricultural technology education. Encouraging private and public sector investment in agricultural technology can help secure financial resources needed for infrastructure development, research activities and curriculum enhancement. Furthermore, creating more scholarships and grants for students pursing agricultural technology programs can remove financial barriers and serve as incentive for young people to choose the field of study.

Capacity Building and Training for Educators: Offering training for educators to enhance their skills in agricultural technology is crucial. It ensures high quality teaching and learning experiences. Collaboration with international institutions can provide opportunities for educators to receive specialized training on the latest technology and teaching methodologies.

b. Uses of Modern Technology in Agricultural Development:

The uses of modern technology in agriculture are very significant and it affects many areas which farmers can leverage to enhance crop yield and keep themselves abreast with cutting-edge methods of farming. SEHGAL Foundation identified the uses of agricultural technology as follows:

i. Improved Productivity from the Mechanization of Agriculture: Manual labour and hand tools used in agriculture have limitations in terms of energy and output. Resistance to agricultural mechanization, especially among small-holder farmers due to accessibility, cost and maintenance issues often act as a detrimental factor. Artificial Intelligence (AI) which finds slow acceptance in Nigeria where marginal farming, fragmented landholdings and other reasons act as impediments. But there is no doubt that technology based AI can bring precision to large scale farming and lead to an exponential rise in productivity.

ii. Resilient Crops Developed via Advanced Bio-technology: Generally, generic engineering uses the understanding of DNA to identify and work with genes to increase crop resistance to pest, and the development of high yielding varieties in the improvement of livestock. Although bio-technology in agriculture has resulted in all round benefits for farmers and end users, some controversial approaches have led to resistance to its adoption. However, there is no doubt that the future of agriculture is heavily dependent on safe bio-technology, given the changing climate and increase in population.

iii. Sensors are now being used in agriculture to provide data to farmers to monitor and optimize crops given the environmental conditions and challenges and find application in many areas such as deteriorating soil composition and moist content, nutrient detector, location for precision, airflow e.t.c. Sensors help farmers save on pesticides and labour and result in efficient fertilizer application. They allow farmers to maximize yields using minimal natural resources.

iv. Livestock Monitoring: The use of chips and body sensors can help prevent disease outbreak and are crucial in large scale livestock management. They measure vital parameters and indicator that could detect illness early and prevent herd infection. Similarly, ultra-sound are a useful tool to judge the quality of meat. This helps control and improve the quality of meat.

v. Monitor and Control Crop Irrigation Systems through Smart-phones: Mobile technology can also play a vital role in monitoring and controlling crop irrigation systems.

v. Big Data Optimizing Yield and Supply Chain: Big data is slated to play a major role in smart farming and the benefits percolate across the entire supply chain and the markets. Data can be from external sources such as social media, supplier networks, market or from sensor/machine data from the field. Transformation of agriculture from using big data is affecting crop yield, supply management, yield perdition etc.

Conclusion

Feeding an ever growing Nigerian population, addressing the issues of hunger, malnutrition and poverty is a serious challenge for the government. The increasing role of technology in agriculture to address these issues is the only way forward to a food-secured future. Technology can help save foreign exchange, increase productivity and lead to an improvement in the overall standard of living of farmer communities. Nigeria has a long way to go in the adoption of modern technologies, the pace is very slow and path breaking efforts need to be made to educate farmers about the benefits to be had with technology. Transcending the barriers of archaic farming practices and medieval mindset is a challenge that needs to be overcome for a better tomorrow.

Recommendations

i. Government initiatives such as awareness campaigns and funding programs can help

create more awareness about the potential of agricultural technology

ii. Investment by both government and the private sector in infrastructural development and the recruitment of skilled educators can further enhance the quality of agricultural technology education.

iii. The establishment of more scholarships and grants specifically for agricultural technology education can encourage more young professionals in the sector.

iv. There should be collaboration between educational institutions and industry players to facilitate the sharing of information, expertise and resources in other to strengthen the agricultural technology education ecosystem.

References

CBN, (2009).Central Bank of Nigeria Statistical Bulletin on Food Crop Production in Nigeria.

Challa M., (2013). Determining Factors and Impacts of Modern Agriculture Technology Adoption in West Wollega, Munich, GRIN Publishing GmbH.

Dontsop-Nguezet, PM; Diagne, A; Okoruwa, VO; Ojehomon, V (2011).Impact of Improved Rice Technology Adoption on Income Poverty among Ice Farming Households in Nigeria; a Local Average Treatment Effect Approach.*Quarterly J. Inter. Agric. 50: 267-291*

Idoko N., (2024). *Challenges and Solutions: Agri-Tech Education in Nigeria*

Investopedia, (2020).*National Bureau of Economic Research (NBER)*

Jain R; Arora A; Raju S. (2009).*A Novel Adoption Index of Selected Agricultural Technologies: Linkages with Infrastructure and Productivity:* Agricultural Economics Research Review 22, 1009-120 Kariyasa

Mendola M. (2007). *Agricultural Technology Adoption and Poverty Reduction*: A Propensity Score Matching Analysis for Rural Bangladesh. Food Policy Elsevier 32(3), 372-393

Mwangi, M; Kariuki, S., (2015).*Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries.J. Econ. Sustain. Develop. 65(5):208-216*

Nnenna E.A., (2013). Access and application of *Information and Communication Technology (ICT) among Farming Households of South East Nigeria.Agriculture and Biology Journal of North America,* iv (6), 605-616.

Nweke F; Akorhe, G., (2002). Adoption Behavior of Farmers Towards Yam Mini Sets Technology in Imo State Nigeria, Oweri: Federal University of Technology.

Ogunsolu O., (2021). *Technological Transformation of the Agricultural Sector in Nigeria*: An Antidote for Economic Recession. M.A. Thesis, RagnarNuske Department of Innovation and Governance, School of Business Studies and Governance, Tallin University of Technology in Agriculture

Owotide B.A Diagne A.; Omonona B.T (2012).*Impact of Improve Agricultural Technology Adoption on Sustainable Rice Productivity and Rural Farmers' Welfare in Nigeria:* A Local Average Treatment Effect (Late) Technique. A Paper Presented at the African Economic Conference, Kigalin, Rwanda.

Oyewole, A.L; Ayanrinde, F.A; Oyawole, S.O &Ayarinde, O.A (2023).*Effect of Improved Farm Technologies Adoption on Productivity Among Stable Crop Farmer in Nigeria Agricultural Transformation Agenda. J. Appl. Sci. Environ. Manage* 27 (10) 2251-2256

SEHGAL Foundation (2023).*Role of Modern Technology in Agriculture*.

Sennuga, S.O.; Oyewole, S.O., (2020): Exploring the Effectiveness of Agricultural Technologies Training among Smallholder Farmers in Sub-Saharan African Communities, *EuropeanJ. Training. Develop. Stu* (7)4:1-15

Statista, (2020).*Leading Natural Rubber Producing Countries Worldwide in 2018 and 2019.*(online) Available at https://www.statista.com/statistics/275397/caouhouc-production-in-leading-countries/ (Accessed 24 November, 2020).

Timmer, C.A., (1998). The Agricultural Transformation. In: H. Cheneo& T. Srinivasan, eds. *Handbook of Development Economics.* Havard University: Elsevier Science Publishers B.V., 2760338

Trendov, N.M., Varas, S. &Zeng, M., (2019).*Digital Technologies in Agriculture and Rural Areas,* Rome: Food and Agriculture Organization of the United Nations.

United Nations, (2008).*Cocoa Study: Industry Structures and Competition.* S. I., United Nations Conference on Trade and Development, pp. 1-62

World Economic Forum, (2022).*How Technology can Address Challenges in Agriculture.* https://www.weforum.org.