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Strategies For Enhancing Utilization of Innovative Crop Production Techniques by Households in Kwara State

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Abstract

The study focused on strategies for enhancing utilization of innovative crop production techniques among households in Kwara State.Specifically, the study determined innovative crop production techniques that could be adopted by households; modalities households could utilize for adopting the techniques; possible challenges households could experience in adopting the techniques and ways of enhancing utilization of innovative techniques. The study adopted survey research design. Population for the study was 83 university lecturers consisting of 48 Agricultural Extension lecturers and 35 Agricultural extension agents in Kwara State. Questionnaire was utilized for data collection. Data were analyzed using mean and standard deviation. Findings reveal 13 innovative crop production techniques including: utilizing neem oil for controlling crop pests ($\overline{X}$ = 3.42), flame weeder for controlling weed ($\overline{X}$ = 3.52), and farm-to-market food systems to reduce cost of transportation ($\overline{X}$ = 3.37). Other findings are10 modalities households could utilize for applying the innovative crop production techniques. These include, among others, utilizing demonstration plots ($\overline{X}$ = 3.15), utilizing digital platforms like WhatsApp and Facebook ($\overline{X}$ = 3.54). other findings are 11 possible challenges households could experience in adopting the innovative crop production techniques such as lack of supportive policies and regulations ($\overline{X}$ = 3.60), lack of extension services and support ($\overline{X}$ = 3.44) and others. Also 12 ways of enhancing utilization of innovative crop production techniques were found, such as: develop supportive policies, regulations, and incentives that encourage the adoption of innovative techniques ($\overline{X}$ = 3.25), among others. Five recommendations were made based on the findings.

Key words: Innovation, Crop, Production, Techniques, Households, Utilization, Adoption, Challenges.

Introduction

In many developing countries including Nigeria, crop production is carried out on a subsistence basis. Subsistence crop production according to (Ikelegbe and Edokpa, 2013), involves the cultivation of plants, tree crops, row crops or field crops on a small scale mainly for feeding one's self and family with little or nothing left for sale. To Adegbenga (2019), many households in developing countries utilize subsistence crop production to tackle food insecurity but this has overtime proven to not be

enough. Hence, Altieri, Funes-Monzote, andPetersen (2012) posit that there is need for households to adopt innovative crop production practices.

Innovative crop production techniques refer to new and advanced methods used in agriculture to enhance crop yield, improve resource efficiency, and mitigate environmental impact (Hossain, 2021). Innovative crop production techniques have led to improvement in crop production in many developed countries. These techniques often incorporate the use of modern technologies, scientific research, and sustainable practices. According to Godfray (2020), an example of an innovative crop production practice is precision agriculture which involves the use of technologies like global positioning systems (GPS), remote sensing, and geographic information systems (GIS) to optimize the management of crops. It allows farmers to make data-driven decisions regarding fertilization, irrigation, and pest control, resulting in improved crop health and productivity. In the opinion of Parhizkar (2020), an innovative crop production practice is vertical farming which is a technique that involves growing crops in vertically stacked layers or structures so as to maximize space utilization while utilizing artificial lighting, climate control, and hydroponic or aeroponic systems to provide optimal growing conditions for plants. Other innovative crop production techniques include hydroponics, agro forestry, and integrated pest management (Thapa, 2019).

Hydroponics is a soil-less cultivation method that utilizes nutrient-rich water solutions to grow crops (Timsina, 2020). Timsina further posited that it has gained popularity in regions with limited arable land and water resources, such as the Netherlands, Israel, and parts of the United Arab Emirates. To Smyth, Phillips and Kerr (2015), agro forestry integrates trees with crops or livestock, promoting ecological balance and increasing overall productivity. It is widely practiced in countries like India, Brazil, and Kenya, where it contributes to sustainable land use and biodiversity conservation. Integrated pest management (IPM) is a holistic approach that combines various pest control methods, such as biological control, cultural practices, and targeted pesticide application (International Food Policy Research institute (2018). IPM is used globally, with successful implementations in countries like China, Australia, and the United Kingdom. The adoption and utilization of innovation crop production techniques are influenced by a range of factors referred to as modalities (Parhizkar, 2020).

Such factors include the availability of supportive infrastructure, such as access to technology, information, and financial resources, greatly facilitates adoption (Gavrilova, 2020). Additionally, favourable policy frameworks, government support, and institutional capacity play a significant role in promoting the uptake of these techniques (Lipper, 2014). The education and training of farmers and extension workers also contribute to their successful adoption. Furthermore, Otsuka(2013) posits that to effectively apply innovative crop production techniques, certain modalities such as training and education, access to information and technology and collaborative networks can be utilized. According to Doss(2018), providing training programs and educational resources to farmers and households is

crucial for disseminating knowledge about innovative techniques. Workshops, seminars, and demonstration plots can help individuals understand the benefits, principles, and practical aspects of implementing these techniques. In the opinion of Lipper(2014), access to information and technology through digital platforms, agricultural extension services, mobile applications, and farmer helplinesis a vital modality for efficiently using crop production techniques. Despite the modalities, certain challenges could hinder the adoption of innovative crop production techniques.

Despite the benefits of innovative crop production techniques, there can be several challenges in adopting innovative crop production techniques. According to Timsina (2020), a challenge is lack of awareness and knowledge. Limited awareness and knowledge about innovative techniques can be a significant barrier to adoption. Many farmers and households may be unfamiliar with the benefits, application methods, or technical requirements of these techniques. Furthermore, financial constraint is a major challenge that can affect the implementation of innovative crop production techniques. Implementing innovative techniques often requires investment in new technologies, infrastructure, and inputs. Limited financial resources may hinder adoption, particularly for smallholder farmers who face difficulties in accessing credit or securing capital for initial investments (Corps, 2015). Furthermore, Davies(2019) posits that inadequate technical capacity and skills could also hinder the adoption of innovative crop production. Despite these challenges, some authors have suggested possible solutions.

Financial support is one way of ensuring that innovative crop production practices are utilized. According to Dhruba (2014), Governments, NGOs, and financial institutions can offer financial support mechanisms such as subsidies, grants, and low-interest loans to facilitate the adoption of innovative techniques. Accessible credit options can help farmers overcome financial constraints. Furthermore, knowledge transfer through extension agents can also help to improve the extent to which innovative crop production practices are adopted. According to Ekenta el at, (2020), establishing effective knowledge-sharing platforms and extension services that provide up-to-date information on innovative techniques enhances the adoption of innovative crop production practices. Furthermore, setting up demonstration farms or pilot projects where farmers can observe and learn from successful implementation of innovative techniques is another strategy. However, the low utilization utilization of innovative crop production techniques by households in Kwara state as posited by Gavrilova (2020) and observed by the researcher leads to the need for strategies for enhancing utilization of innovative crop production techniques by households in Kwara State.

Kwara is one of the states in the North Central Nigerian region. International Food Policy Research institute (IFPRI) (2018) estimated that about 823,234 people in Kwara State out of a population of 2,371,089 people in the state representing 34.7 percent of its entire population were food insecure. Despite the fact that many individuals and households in the area are into farming, food insecurity in the area is

very high. Evidence from literature (Adegbenga, 2019; Gavrilova, 2020) showed that many of the households have small gardens within their compounds where they grow crops like maize and vegetables on a small scale. Despite their efforts, the high level of food security in the area could be attributed to subsistence agriculture using traditional farming techniques such as cutlass and hoe for cultivation. This is in line with IFPRI (2018) observation that utilizing innovative technologies in crop production has the tendency to improve food security among households. FAO (2015) posits that innovation refers to the implementation of a new or significantly improved product or process. Innovative crop production techniques in the context of this study refers to new processes and technologies such as technologies like global positioning systems (GPS), remote sensing, and geographic information systems (GIS) amongst others used for crop production which would increase output and food security. Adoption of innovative crop production techniques would likely lead to increased food security among households which would reduce malnutrition and hunger observed in the area. Efforts have been made by agricultural extension services in Kwara State to promote the adoption of innovation crop production techniques by households. Agricultural extension services play a critical role in disseminating information, providing training, and offering technical support to farmers. These services aim to bridge the knowledge gap and facilitate the adoption of new technologies. However, the utilization of innovative crop production techniques still seems low leading to the need to identify areas for improvement. However, there is a dearth of literature on the strategies for enhancing innovative crop production techniques that can be adopted by households in the area. It is against his backdrop that the current study seeks to ascertain the strategies for enhancing utilization of innovative crop production techniques by households in Kwara State

Purpose of the Study

The study focused on strategies for enhancing utilization of innovative crop production techniques among households in Kwara state. Specifically, the study dtermined:

1. innovative crop production techniques that could be adopted by households in Kwara State
2. modalities households could utilize for adopting the innovative crop production techniques in Kwara State
3. possible challenges households experience in adopting the innovative crop production techniques in Kwara State
4. ways of enhancing utilization of innovative crop production techniques by households in Kwara State

Methodology

***Design of the Study*:** The study adopted a survey research design.

Area of the Study: The study was carried out in Kwara State. Kwara is one of the states in the North Central Nigerian region. Kwara state was chosen as the area for the study because of the high level of food insecurity in the area as evidenced by International Food Policy Research institute (IFPRI) (2018) report that about 823,234 people in Kwara State out of a population of 2,371,089people representing 34.7 percent of its entire population were food insecure.

***Population* for the Study**: The population for the study was 83 individuals consisting of 48 Agricultural Extension university lecturers and 35 Agricultural extension agents in Kwara State. Information on the population of the lecturers were drawn from the three tertiary institutions in the area that offer Agricultural Extension. Information of the extension officers was obtained from the Kwara State Ministry of Agriculture in 2022. No sampling or sampling was carried out due to the manageable size of the population.

Instrument for Data Collection: The instrument for data collection was questionnaire. It was developed based on literature review based on the specific purposes of the study. The instrument was face-validated by five experts from the Department of Agricultural Extension, University of Nigeria, Nsukka. The internal consistency of the instrument was determined using Cronbach Alpha reliability coefficient which yielded a coefficient index of 0.76. the instrument had four parts. Items on parts I, II, III and IV of the questionnaires had a 4-point response options in accordance with the four specific purposes of the study.

Data Collection Technique: A total of 83 copies of the instrument were administered to the respondents by hand with the help of four trained research assistants. Out of 83 copies of questionnaire that were distributed, only 75 (45 lecturers and 30 extension agents) were properly filled and retrieved. This yielded a return rate of approximately 90.1 percent.

Data Analysis Technique: The data were analyzed using mean and standard deviation (SD). Mean cut off of 2.50 was applied in decision making. Any item with mean of 2.50 or above was interpreted as "Could be Adopted (CA) /Modality (M)", /Challenge (C), and Way of Enhancing (WE) for Tables 1, 2, 3 and 4 respectively. Items with mean ($\bar{X}$) score less than 2.50 were interpreted as, "Could not be adopted (CNA)",/Not Modality (NM),/Not Challenge(NC) and Not Way of Enhancing(NWE)Tables 1, 2, 3 and 4 respectively. Furthermore, any item with SD value of 1.96 or below indicated that the respondents were near to the mean and to each other in their responses. On the other hand, any item with SD value above 1.96 indicated that the respondents were far from the mean and to each other in their responses.

Results

Table 1: Mean Ratings and Standard Deviations on Innovative Crop Production Techniques that Could be Adopted by Households

S/N	Innovative Crop Production Techniques	$\overline{X}$	SD	Remarks
1	No-till cultivation for land preparation	3.56	0.49	CA
2	Push-pull farming technique	3.50	0.64	CA
3	Neem oil for controlling crop pests	3.42	0.63	CA
4	Flame weeder for controlling weeds	3.52	0.60	CA
5	Farm-to-market food systems to reduce cost of transportation	3.37	0.68	CA
6	Crop rotation calendar to choose best combination of crops	3.35	0.70	CA
7	Recycled farm wastes to be used as manure	3.46	0.60	CA
8	Water management techniques such as channeling	3.46	0.54	CA
9	Herbage mass estimate to monitor growth rate	3.35	0.68	CA

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10	Beneficial insects like lady bug to control pests	3.21	0.79	CA
11	Weed control calendar to control weeds	3.06	0.87	CA
12	Agroforestry in crop cultivation	3.21	0.84	CA
13	Utilization of precision agriculture	3.10	0.77	CA

N (Population) = 75, $\overline{X}$ = Mean, SD = Standard deviation, CA = Could be Adopted, CBA = Could not be Accepted

Table 1 reveals that all 13 items had mean values ranged from 3.06 – 3.56. All the 13 items had means greater than 2.50 indicating that they were the innovative crop production techniques that could be adopted (CA)by households in Kwara State. The standard deviation of all the 13 items ranged from 0.49 – 0.87. Each of the values was below 1.96 indicating that the respondents were near to the mean and to each other in their responses.

Table 2: Mean Ratings and Standard Deviations on Modalities Households can Utilize for Applying the Innovative Crop Production Techniques

S/N	Modalities	$\overline{X}$	SD	Remarks
1	Providing training programs/educational resources to households	3.46	0.77	M
2	Utilizing workshops and seminars	3.48	0.67	M
3	Utilizing demonstration plots	3.15	1.03	M
4	Utilizing digital platforms like WhatsApp and Facebook	3.54	0.57	M
5	Agricultural extension services	3.56	0.56	M
6	Farmer Helplines	3.42	0.58	M
7	Collaboration between farmers and research institutions	3.30	0.70	M
8	Utilizing mobile applications	3.25	0.68	M
9	Farmer cooperatives	3.31	0.64	M
10	Farmer field schools	3.29	0.74	M

N (Population) = 75, $\overline{X}$ = Mean, SD = Standard deviation, M = Modality, NM = Not Modality

Table 2 reveals that all the 10 items had mean values ranged 3.15 – 3.56. The values were all above 2.50 indicating that the items were modalities (M) households can utilize for applying the innovative crop production techniques in Kwara State. The standard deviation of all the 10 items ranged from 0.56 – 1.03. Each of the values were below 1.96 indicating that the respondents were near to the mean and to each other in their responses.

Table 3: Mean Ratings and Standard Deviations on Possible Challenges Households Could Experience in Adopting the Innovative Crop Production Techniques

S/N	Possible challenges	$\overline{X}$	SD	Remarks
1	Limited awareness and knowledge about innovative crop production techniques	3.75	0.66	C
2	Limited financial resources may hinder adoption, particularly for household into small scale production	3.40	0.77	C

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3	Lack of adequate training and technical know-how discourages households from adopting innovative crop production techniques	3.10	0.80	C
4	Resistance to change particularly among the old	3.35	0.68	C
5	Lack of supportive policies and regulations	3.60	0.59	C
6	Innovative agricultural production methods dissuade households from using them due to price uncertainty.	3.40	0.58	C
7	Limited Access to Inputs and Resources	2.80	0.70	C
8	Social and cultural norms, practices, and traditions act as barriers to the adoption of innovative techniques	3.20	0.78	C
9	Lack of extension services and support	3.44	0.64	C
10	Households may perceive adopting innovative techniques as risky due to uncertainties related to crop performance	3.50	0.84	C
11	Implementing innovative techniques may require adjustments in resource management and environmental practices	3.32	0.98	C

N (Population) = 75, $\overline{X}$ = Mean, SD = Standard deviation, C = Challenge, NC = Not Challenge

Table 3 reveals that all the 11 items had mean values ranged 2.80 – 3.75. The values were all above 2.50 indicating that the items were possible challenges (PC) households could experience in adopting the innovative crop production techniques in Kwara State. The standard deviation of all the 11 items ranged from 0.58 – 0.98. Each of the values were below 1.96 indicating that the respondents were near to the mean and to each other in their responses

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Table 4: Mean Ratings and Standard Deviations on Ways of Enhancing Utilization of Innovative Crop Production Techniques by Households

S/N	Way of Enhancing	$\overline{X}$	SD	Remarks
1	Conduct training programs and workshops to educate households about the benefits and practical application of innovative crop production techniques	3.45	0.52	WE
2	Improve access to information through digital platforms, agricultural extension services, mobile applications, and farmer helplines	3.35	0.62	WE
3	Facilitate peer-to-peer learning and knowledge sharing among farmers by organizing farmer field schools, study tours, and farmer networks	3.10	0.74	WE
4	Establish demonstration farms where households can observe and learn first-hand about the implementation and outcomes of innovative techniques	3.30	0.68	WE
5	Provide financial support mechanisms such as subsidies, grants, and low-interest loans to help households overcome financial barriers	3.60	0.62	WE
6	Offer technical support and capacity-building programs to enhance households' technical skills and knowledge required for implementing innovative techniques	3.20	0.58	WE

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7	Facilitate market linkages and create incentives for households adopting innovative techniques	3.30	0.70	WE
8	Develop supportive policies, regulations, and incentives that encourage the adoption of innovative techniques	3.25	0.68	WE
9	Invest in research and development initiatives to adapt and improve innovative techniques according to local contexts	3.24	0.96	WE
10	Invest in necessary infrastructure, such as irrigation systems, access to quality inputs, and storage facilities	3.40	0.72	WE
11	Establish monitoring and evaluation systems to assess the impact and effectiveness of innovative techniques	3.08	0.70	WE
12	Advocate for the importance of innovative crop production techniques at the policy level	3.16	0.65	WE

N (Population) = 75, $\overline{X}$ = Mean, SD = Standard deviation, Way of Enhancing (WE), Not a Way of Enhancing (NWE)

Table 4 reveals that all the 12 items had mean values ranged 3.08 – 3.60. The values were all above 2.50 indicating that the items were the ways of enhancing (WE) utilization of innovative crop production techniques by households in Kwara State. The standard deviation of all the 12 items ranged from 0.52 – 0.96. Each of the values were below 1.96 indicating that the respondents were near to the mean and to each other in their responses.

Discussion of the Findings

The findings of the study on the innovative crop production techniques that could be adopted by households in Kwara State revealed that the the innovative crop production practices include: no-till cultivation for land preparation, push-pull farming technique, neem oil for controlling crop pests, flame weeder for controlling weeds, farm-to-market food systems to reduce cost of transporting crop produce, crop rotation calendar to reduce choose best combination of crops to maintain soil fertility organically, recycled farm wastes to be used as manure, water management techniques such as channeling to prevent water erosion, herbage mass estimate to monitor growth rate, beneficial insects like lady bug to control pests, weed control calendar to control weeds and agroforestry in crop cultivation. Improvements in agricultural land management, such as conservation tillage, multiple crop rotations,agro-forestry, integrated plant-animal systems and rehabilitation of degraded crop and pasture land,can improve soil productivity. Another innovative crop production practice is the push pull farming which is a technique that combines several crops (i.e. maize, desmodium and napier grass) in an integrated,intercropping arrangement that provides a natural barrier to insect and weed infestation while simultaneously enriching the soil. The findings are in line with Mrabet and Brahli (2005) who found out that aggregate yields were forty-two per cent higher than conventionally tilled farms. When farm yields are higher, it would lead to more available food which is an important part of enhancing food security. The findings are in agreement with Godfray (2020) who found out that implementation of push pull has significantly increased maize yields and

thecultivation of N-fixing Desmodium has provided both nutrients to the soil and forage crops forlivestock. A significant higher crop yield and total farm outputs would result in higher earnings per day of labor onthe Push Pull farms. The findings are also in agreement with Hossain (2021). WHO found that global food loss accounts for more than 56% of total edible crop harvests, leaving less than half available for household consumption, hence improved farm-to-market food systems would help to solve this.

The findings of the study on modalities households could utilize for applying the innovative crop production techniques in Kwara State revealed that the modalities include: Providing training programs/educational resources to households, utilizing workshops and seminars, utilizing demonstration plots, utilizing digital platforms like WhatsApp and Facebook, agricultural extension services, farmer helplines, collaboration among farmers and research institutions, utilizing mobile applications, farmer cooperatives and farmer field schools. The findings are in agreement with Parhizkar (2020) who found that individuals can be educated about innovative crop production techniques through demonstration plots. The findings are also in cognizance with Sanyal (2019) who found out that a modality for applying innovative crop production techniques is collaboration between farmers and research institutions. The findings are also in agreement with Timsina (2020) who found out that utilizing workshops and seminars, utilizing demonstration plots, utilizing digital platforms like WhatsApp and Facebook are approaches individuals and households could utilize for applying the innovative crop production techniques.

The findings of the study on possible challenges households experience in adopting the innovative crop production techniques in Kwara State revealed that the challenges include: Limited awareness and knowledge about innovative crop production techniques; limited financial resources may hinder adoption, particularly for household into small scale production; lack of adequate training and technical know-how discourages households from adopting innovative crop production techniques; resistance to change particularly among the old; lack of supportive policies and regulations; innovative agricultural production methods dissuade households from using them due to price uncertainty; limited access to inputs and resources; social and cultural norms, practices, and traditions act as barriers to the adoption of innovative techniques; lack of extension services and support; households may perceive adopting innovative techniques as risky due to uncertainties related to crop performance; and implementing innovative techniques may require adjustments in resource management and environmental practices. The findings are in agreement with Doss (2018) who found that adopting innovative crop production practices is difficult due to resistance to change particularly among the old members of household and lack of supportive policies and regulations favouring the adoption of innovative crop production practices. The findings are also in agreement with Lipper (2014) who found out that limited access to inputs and resources; social and cultural norms, practices, and traditions act as barriers to the adoption of innovative techniques.

The findings are also in agreement with Hossain (2021) who found that limited access to inputs and resources; social and cultural norms, practices, and traditions act as barriers to the adoption of innovative techniques.

The findings of the study on ways of enhancing utilization of innovative crop production techniques by households in Kwara State revealed that the ways include: Conduct training programs and workshops to educate households about the benefits and practical application of innovative crop production techniques; improve access to information through digital platforms, agricultural extension services, mobile applications, and farmer helplines; facilitate peer-to-peer learning and knowledge sharing among farmers by organizing farmer field schools, study tours, and farmer networks; establish demonstration farms where households can observe and learn first-hand about the implementation and outcomes of innovative techniques; provide financial support mechanisms such as subsidies, grants, and low-interest loans to help households overcome financial barriers; offer technical support and capacity-building programs to enhance households' technical skills and knowledge required for implementing innovative techniques; facilitate market linkages and create incentives for households adopting innovative techniques; develop supportive policies, regulations, and incentives that encourage the adoption of innovative techniques; invest in research and development initiatives to adapt and improve innovative techniques according to local contexts; invest in necessary infrastructure, such as irrigation systems, access to quality inputs, and storage facilities; establish monitoring and evaluation systems to assess the impact and effectiveness of innovative techniques; and advocate for the importance of innovative crop production techniques at the policy level. The findings are in agreement with Thapa (2019) who found out that establishing demonstration farms where households can observe and learn first-hand about the implementation and outcomes of innovative techniques can enhance the adoption of crop production practices. The findings are also in agreement with Timsina (2020) who found out that offering technical support and capacity-building programs to enhance households' technical skills and knowledge is required for implementing innovative crop production techniques. The findings also support that of Lipper (2014) who found that improving access to information through digital platforms, agricultural extension services, mobile applications, and farmer helplines are ways to improve utilization of innovative crop production techniques**.**

Conclusion

The study was carried out to evolve strategies for enhancing utilization of innovative crop production techniques in Kwara state. The study highlighted the innovative crop production techniques that could be adopted, such as precision agriculture and agro forestry. The adoption and utilization of these techniques are influenced by modalities such as supportive infrastructure, favorable policy frameworks, access to technology and information, financial resources, and education and training. Despite the potential benefits, there are challenges to the adoption of innovative crop production techniques, including limited awareness and knowledge,

financial constraints, and inadequate technical capacity. To overcome these challenges, the study proposed strategies such as providing financial support through subsidies and loans, facilitating knowledge transfer through extension services, and establishing demonstration farms or pilots. These strategies can help households in Kwara State enhance their utilization of innovative crop production techniques which would enhance food security.

Recommendations

Based on the findings of the study, the following recommendations were made;

1. Extension agents should inculcate innovative crop production techniques in members of households to enhance household food security
2. Government should provide grants, loans and subsidies to household farmers to enable them purchase some of the innovative crop production technologies to enhance food security.
3. Members of households should avail themselves to workshops and trainings organized in town halls of various communities by the ministry of agriculture where the benefits and procedures for adopting innovative crop production techniques would be discussed.
4. Extension agents should set up demonstration farms where farmers can observe and learn from successful implementation of innovative crop production techniques.

References

Adegbenga, E. A. (2019). Food insecurity and coping strategies among rural households in Oyo State, Nigeria. *Journal of Food, Agriculture & Environment, 7* (3), 187-191. Retrieved from www.world-food.net.

Altieri, M. A., Funes-Monzote, F. R. &Petersen, P. (2012). A groecologically efficient agricultural systems for smallholder farmers: contributions to food sovereignty, *Agron. Sustain. Dev, 32*, 1–13.

Corps, M. (2015). *The economic costs of conflict: Evidence on violence, livelihoods and resilience in Nigeria's middle belt.* https://www.mercycorps.org/research-resources/economic-costs-conflict-nigeria

Davies, A. E. (2019). Food security initiatives in Nigeria: Prospects and challenges. *Journal of Sustainable Development in Africa, 11*(1), 186-202.

Dhruba, R.G. (2014). Household food security and coping strategies: Vulnerabilities and capacities in rural communities. *International Journal of Scientific and Research Publications, 4* (9), 1-8.

Doss, C. R.(2018). The role of innovation in transforming smallholder agriculture. *World Development, 104*, 298-311. doi: 10.1016/j.worlddev.2017.11.010

Ekenta, L.U., Nwakile, T.C., Onah, F.C. & Ekwueme, S.U. (2020). Strategies households adopt to ensure food security in South-East, Nigeria. *International Journal of Advance Research and Innovative Ideas in Education, 6*(5), 1717-1724.http://ijariie.com/ Currentissue. aspx

FAO (2015). *Mapping the vulnerability of mountain peoples to food insecurity*. FAO, Rome.

Gavrilova, N. (2020). Improving food security in Nigeria through livestock innovation. *E3S Web of Conferences, 176*, 1 – 7. https://doi.org/10.1051/e3sconf/202017601010

Godfray, H. C. J. (2020). Food Security: The challenge of feeding 9 billion people. *Science, 32*, 812-818. doi: 10.1126/science.1185383

Hossain, M. E. (2021). Innovative crop production techniques in sustainable agriculture: A review. *Agricultural Systems, 193*, 103 - 132. doi: 10.1016/j.agsy.2021.103132

Ikelegbe, O. O. &Edokpa, D. A. (2013). Agricultural production, food and nutrition security in rural Benin, Nigeria. *African Journal of food, agriculture, nutrition and development, 13*(5), 8388-8400

International Food Policy Research institute (2018). Food security statistics in Nigeria. Retrieved fromhttp://www.ifpri.org.

Lipper, L (2014). Climate-smart agriculture for food security. *Nature Climate Change, 4*(12), 1068-1072. doi: 10.1038/nclimate2437

Mrabet, R. and A. El Brahli (2005). Soil and crop productivity under contrasting tillage management systems in semiarid Morocco. *III World Congress on Conservation Agriculture: Linking Production, Livelihoods and Conservation*, 3rd to 7th October 2005, Nairobi, Kenya. 6p.http://www.act.org.zw/postcongress/theme_09_11.asp.

Parhizkar, A. (2020). Strategies to enhance farmers' adoption of precision agriculture technologies: A review. *Computers and Electronics in Agriculture, 177*, 105 - 114. doi: 10.1016/j.compag.2020.105729

Sanyal, D. (2019). Challenges and opportunities for scaling-up hydroponics in smallholder agriculture. *Agricultural Water Management, 221*, 260-270. doi: 10.1016/j.agwat.2019.04.031

Thapa, G. B. (2019). Promoting the adoption of innovative agricultural technologies: Evidence from a randomized controlled trial in Nepal. *World Development, 115*, 258-272. doi: 10.1016/j.worlddev.2018.11.007

Timsina, J. (2020). Innovations in sustainable intensification of rice production systems in Asia. *Frontiers in Sustainable Food Systems, 4*, 118. doi: 10.3389/fsufs.2020.00118