Eurasian Journal of Agricultural Research

Volume 6, Issue 1, June 2022

ISSN: 2636 – 8226

https://dergipark.org.tr/en/pub/ejar

INTERNATIONAL INDEXING

CONTENTS

Promoting Youth Engagement and Employment in the Agricultural Sector in Kenya

Benson NJORA[1*], Hasan YILMAZ[2]

[1,2] Isparta University of Applied Sciences, Faculty of Agriculture, Department of Agricultural Economics, Isparta, Turkey

[*]Corresponding author: wanduben12@gmail.com

ORCID : 0000-0001-7082-488X[1]-, 0000-0002-0487-8449[2]

Abstract

The study aimed to assess the challenges hindering Kenyan youth from participation in the agricultural sector. In this study, qualitative analysis was used as a basic research tool. Youth unemployment in Kenya is higher than the overall national unemployment rate. Kenya's economy is not creating enough jobs to increase the number of young people entering the labor market. Despite the increasing youth unemployment, the number of young people in the agricultural sector has been declining. In contrast, the service and manufacturing sectors are growing significantly but are far from creating enough jobs for Kenya's young workforce. This can have negative implications as it increases unemployment and underemployment rates in Kenya and also undermines government efforts to drive economic growth through agriculture. Therefore, the agricultural sector is critical in creating employment and raising the living standards of Kenyan youth. The agricultural sector offers excellent opportunities to employ young people and to ensure food security. However, the sector has not yet fully utilized the potential of the young workforce and remains largely unattractive to them. Young people have a negative perception of agriculture, they perceive working in the agricultural sector as a last resort, as an activity for the elderly, and they do not see farming as a profitable business, which makes the situation even worse. The paper also highlights the employment opportunities in the agricultural sector, policies, strategies, and other initiatives to help position youths at the forefront of agricultural growth and transformation to achieving sustainable food systems.

Keywords: Agricultural policy, Youths, Employment, Rural labor, Rural development

Research article
Received Date: 2 December 2021
Accepted Date: 28 December 2021

INTRODUCTION

The global population is expected to grow from 7 billion to 9 billion by 2050. The United Nations population estimates in 2020 indicated that there were 1.3 billion people between the ages of 15 and 24; referred to as youths by the World Bank's definition of youth. By 2030, the target date for achieving the Sustainable Development Goals (SDGs), the world's youth population is estimated to increase by 7% to 1.4 billion youths (United Nations 2020).

With the rapidly increasing population, there is an increase in the demand for foodstuffs in an already food insecure world thus the global food insecurity is getting worse, especially in developing countries. Agriculture is an important sector in every country that plays a key role in providing food, employment opportunities and also contributes to economic growth and development.

By 2030, the world aims at achieving the Sustainable Development Goals and agriculture is a key sector to achieving these goals for instance Goal 1 - Ending poverty in all its forms and Goal 2 - Ending hunger to ensure food and nutrition security. To achieve the Sustainable Development Goals by 2030, young people need to be actively involved in the agricultural sector. Globally, the agricultural sector accounts for 32% of total employment (ILO, 2019). It is important to focus on youth as the critical group to help address the future of agriculture and food insecurity and other related issues in the agricultural sector. The global youth population growth is not proportional to the employment and entrepreneurship opportunities available, especially for young people living in developing countries (Yami et al., 2019). In most African countries, youth unemployment is reported to be more than double that of adult unemployment." (World Bank, 2020). The agricultural sector plays a vital role in Africa's economic growth and social development. Agricultural labor is the highest percentage of the total population mostly in Africa (Africa Agricultural Situation Report, 2019). Rural population, young people and employment are important dynamics for economic and rural development. Young people leaving or losing interest in farming can result in a loss of productive workforce for the rural economy (Başaranoglu and Yılmaz, 2020). Also, young people can bring new skills and energy, and a more professional management to the agriculture sector. Against the context of an ageing agricultural workforce, the future of the farmers' profession must be ensured (Redigor, 2012).

Kenya is a developing country with a GDP of $95.5 billion. The agricultural sector plays a key role in the Kenyan economy, contributing 51 percent to the total GDP (World Bank, 2019). 60% of the total workforce in Kenya is employed in the agricultural sector. According to the 2019 census data of the Kenya National Bureau of Statistics (KNBS), 35.7 million Kenyans (75.1%) are under the age of 35. It is estimated that 64% of unemployed Kenyans are young, with the majority moving from the agricultural sector to urban areas to look for better opportunities as they still view agriculture as an activity for the elderly and can't make a good living from it. In urban areas, there are limited job opportunities for the youths thus rural-to-urban migration has increased the youth unemployment rate in Kenya. The shifting of young people from the agricultural sector to other sectors is largely attributed to the strength of various push and pull factors based on global economic trends that favor the non-agricultural sector over the agricultural sector, thus shifting the workforce from agriculture (Njeru, 2017). To solve youth unemployment in Kenya, the agricultural sector possess the highest potential, and youths need to be brought to the discussion table, get involved, and be made part of the food systems if Kenya is to increase youth employment and achieve food security by 2030 (Himaja, 2020).

MATERIALS AND METHODS

In this work, qualitative analysis was used as a basic research tool. The study used data to assess Kenya's youth engagement in the agricultural sector, factors hindering youths' participation and employment in the agricultural sector, and also different ways to promote youths' participation in the agricultural sector. Research data were collected by reviewing policy documents, journals, articles, and other relevant materials.

In addition, data were obtained from the Kenya National Bureau of Statistics (KNBS), the Ministry of Agriculture, Fisheries and Livestock, the Ministry of Planning and National Development, and the Food and Agriculture Organization (FAO). The average, the absolute and relative distributions were calculated in the analysis of the data. The obtained findings were interpreted with tables and graphics and recommendations have been developed.

RESULTS AND DISCUSSION

Youth Unemployment Situation in Kenya

Kenya's 2010 National Constitution defines youth as "all individuals who have attained the age of 18 years but below the age of 35 years". Kenya has a young population, according to the most recent data from the 2019 census by the Kenya National Bureau of Statistics (KNBS) revealed that 35.7 million Kenyans (75.1%) are under the age of 35. The growing number of young people has created a labor supply that is far greater than the job market can accommodate. Currently, around 1 million young people enter the job market either having dropped out of school or having completed high school, college, or university (Kenya Youth Employment Report, 2020). To meet the country's job demand, a total of more than 1 million new jobs need to be created annually. It is also stated that the skills acquired by college and university graduates often do not meet the expectations of employers (Kenya Youth Employment Report, 2020).

The unemployment rate in Kenya is very high and an estimated 64% of the unemployed in the country are youth. It is recognized that the average age of farmers in the country is over 50 years old despite the country having a young population. According to Kenya Youth Employment Report (2020), few young people see a future for themselves in the agricultural sector. This has led to many young people shifting from the agricultural sector despite its high potential to provide good livelihoods, employment, income generation activities, and wealth creation opportunities. Despite government and private sector interventions, the agricultural sector has not yet fully utilized the potential of youths. Working in the agricultural sector is largely unattractive for young people and most have a negative perception of anything to do with farming. Among the main problems affecting youth participation in agriculture, including but are not limited to; inadequate access to land, difficulties in accessing agricultural financing and insurance, insufficient information, skills, and extension services, and poor technologies and accessibility to markets.

According to World Bank (2020), the estimated youth unemployment rate in Kenya was 7.27 percent. Data provided by the World Bank shows that the youth unemployment rate in Kenya is on the rise. Compared to 2019, 2020 recorded a higher youth unemployment rate (Figure 1). However, it is important to note that the figure below only captures individuals between the age of 15-24 years that’s why the unemployment is low. As indicated earlier, Kenya considers a youth to be between 18-35 years.

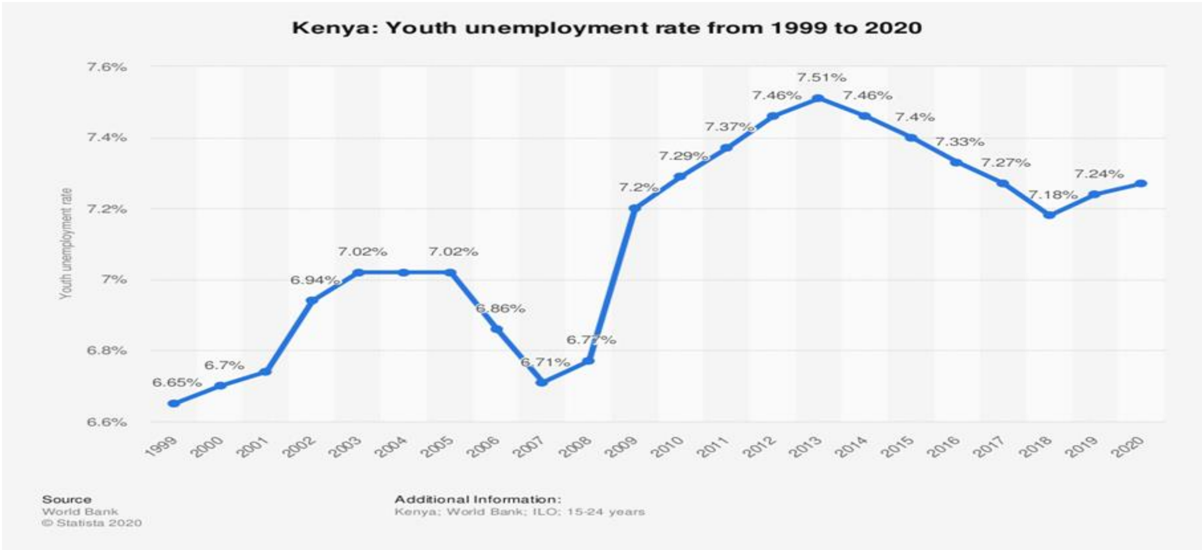

Figure 1. Kenya youth unemployment rate from 1990 to 2020
Source: World Bank @ Statista, 2020

Distribution of Employment in Kenya by Economic Sector

Agriculture is the main source of employment in Kenya. However, labor participation in agricultural activities has been decreasing in the country. As of 2020, employment in agriculture corresponded to 53.8 percent of the total employment in Kenya. In comparison, the share was at 59.8 percent in 2010. By contrast, the employment in manufacturing and services sectors has been following an upward tendency. Despite the growth of the manufacturing and services sectors' growth, the agricultural sector still remains the backbone of Kenya's economy, contributing 51 percent to the total GDP; 26% directly and around 26% indirectly (World Bank, 2019).

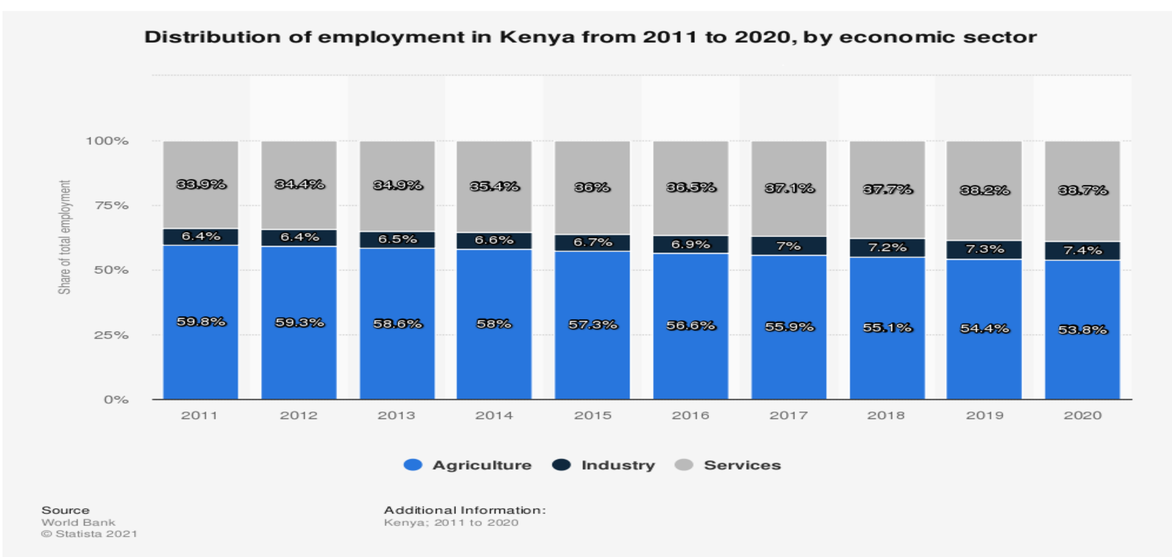

Figure 2. Distribution of employment in Kenya from 2011 to 2020, by economic sector
Source: World Bank @ Statista, 2021.

Kenya Population and Labor Force

Table 1 shows the population trend of Kenya from 1990 to 2020. The population has been increasing since 1990 with a population difference of 30,046,717. According to the data provided in the table, the rural population in 2020 was 72.15% of the total population whereas in 1990 it was 83.48%. On the other hand, considering Kenya's youth population, it has been in an increasing trend with only 44.06% of the total population in 1990 and 72.15% of the total population in 2020. Despite the rise of the young population, the rural young population has been decreasing due to high migration from rural to urban areas (KNBS 2020). While 75.78% of young people lived in rural areas in 1990, there were 53.41% young people living in rural areas in 2020, and the number is estimated to continue declining (KNBS 2020). From these data, the high rate of migration from rural to urban has led to the shift of agricultural labor to urban areas. However, most youths in urban areas are underemployed while others are unemployed. Agriculture provides great opportunities for the unemployed and underemployed youths if proper measures, strategies, and policies are implemented.

Table 1. Kenya Population Trend

Year	Total Population	Rural Population	Rural Population (%)	Youth Population	Youth Population (%)	Rural Youth Population	Rural Youth Population (%)
2020	53,771,296	38,796,237	72.15	37,903,312	70.49	20,243,289	53.41
2019	52,573,973	38,211,135	72.68	35,702,232	67.91	19,468,298	54.53
2018	51,392,565	37,620,760	73.20	32,468,768	63.18	18,098,666	55.74
2017	50,221,142	37,019,795	73.71	29,645,622	59.03	16,148,606	54.47
2016	49,051,534	36,400,700	74.20	28,589,675	58.28	15,876,918	55.53
2015	47,878,336	35,758,580	74.69	27,230,652	56.87	14,898,987	54.71
2010	42,030,676	32,284,007	76.81	23,670,789	56.31	13,245,768	55.96
2005	36,624,895	28,811,441	78.66	17,760,642	48.49	11,886,618	66.92
2000	31,964,557	25,708,372	80.43	14,576,844	45.60	10,99,672	75.41
1995	27,768,296	22,773,997	82.01	12,650,642	45.56	9,563,292	75.60
1990	23,724,579	19,805,142	83.48	10,452,600	44.06	7,920,782	75.78

Source:Worldometer (www.Worldometers.info), KNBS 2020.

Table 2 indicates Kenya's total labor force, active labor force, and also the workforce in the agricultural sector. The data provided by KNBS 2020, ILOSTAT 2020, Kenya Labor Force Participation Report, 2018, shows that the labor force in the agricultural sector has been in a declining trend since 1990. In 1990, the total workforce in the agricultural sector was 63.35 % of the total workforce whereas in 2020 it was at 53.26% of the total labor force. As the country has been developing, the growth of manufacturing and service industries continues to take in a share of the agriculture workforce. However, not all labor force moving away from the agricultural sector has been absorbed in the manufacturing and service industries, others remain unemployed when they could be working in the agricultural sector and making a good living for themselves (Himaja N. 2020).

Table 2. Kenya Labor force in the Agricultural Sector

Year	Total Labor Force	Active Labor Force	Labor Force in Agriculture	Labor Force in Agriculture (%)
1990	8,748,266	6,457,969	4,090,930	63.35
1995	10,651,520	7,862,952	4,909,201	62.43
2000	12,386,820	9,143,950	5,154,092	56.37
2001	12,566,730	9,276,760	5,202,176	56.08
2002	12,762,440	9,421,233	5,312,908	56.39
2003	12,959,670	9,566,828	5,301,231	55.41
2004	13,139,010	9,699,217	5,392,679	55.60
2005	13,292,860	9,812,789	5,440,926	55.45
2006	13,751,770	10,151,556	5,399,991	53.19
2007	14,218,330	10,495,971	5,916,154	56.37
2008	14,705,700	10,855,747	6,010,462	55.37
2009	15,205,210	11,224,486	6,120,432	54.53
2010	15,716,370	11,601,824	6,268,098	54.03
2011	16,248,100	11,994,347	6,590,913	54.95
2012	16,808,700	12,208,182	6,823,981	55.90
2013	17,388,330	12,436.065	6,921,824	55.66
2014	17,984,680	13,276,290	7,321,212	55.15
2015	18,592,920	13,725,293	7,320,219	53.33
2016	19,221,460	14,289,281	7,141,321	49.98
2017	19,864,850	14,064,232	7,345,011	52.22
2018	20,518,670	15,146,882	7,878,713	52.02
2019	21,190,310	15,942,686	8,145,167	51.09
2020	23,738,797	17,123,979	9,120,910	53.26

Source: KNBS 2020, ILOSTAT 2020, Kenya Labor Force Participation Report, 2018.

Kenya's youth labor force has been increasing since 1990 due to the high population growth rate of young people. As indicated in table 3, the youth labor force in the agricultural sector has been declining and currently stands at 28.47% of the total youth labor force (KNBS 2020, ILOSTAT 2020, Kenya Labor Force Participation Report, 2018). Though it may seem high, unemployment increases because the remaining 72% of the youth labor force cannot be absorbed in the manufacturing and service sectors. İn comparison with other sectors, agriculture has the highest potential to create employment opportunities and increase food security in Kenya thus calling for more promotion of youth engagement and employment in the agriculture food systems (Julia Faria, 2021).

Table 3. Youth Labor Force Engaged in Agriculture

Yeah	Total Youth Population	Total Youth Labor Force	Youth Labor Force in Agriculture	Youth Labor Force in Agriculture (%)
2020	37,903,312	27,669,418	10,791,073	28.47
2019	35,702,232	28,561,786	11,710,332	32.80
2018	30,468,768	23,765,639	9,743,912	31.98
2017	30,645,622	24,822,954	10,922,100	35.64
2016	28,989,675	23,191,740	10,668,200	36.80
2015	27,900,652	22,878,535	10,981,697	39.36
2010	24,670,789	19,489,923	9,628,022	39.03
2005	15,760,642	12,923,726	6,591,100	41.82
2000	14,576,844	12,536,086	6,769,486	46.44
1995	12,650,642	11,638,591	7,681,470	60.72
1990	11,452,600	10,536,392	6,743,291	58.88

Source: KNBS 2020, ILOSTAT 2020, Kenya Labor Force Participation Report, 2018.

Challenges Hindering Kenyan Youths from Engaging in the Agricultural Sector

Many factors contribute to the transition of youths from agriculture to non-farm jobs. In addition, many factors discourage young people from participating in any part of the agricultural sector despite availability of limited job opportunities in Kenya. Some of the most common challenges hindering youth participation in agriculture and related activities include:

Negative Perceptions and Attitudes Towards Agriculture and Agricultural Enterprises

Many young people in Kenya find agriculture unattractive because of the drudgery, low yields, and lack of market-oriented agricultural approaches. Additionally, many jobs in the agricultural sector have a strong seasonal component and are categorized as vulnerable, while young people need end-to-end income-generating jobs. There are many reasons why young people have a negative perception and attitude towards agriculture. According to Sambo, W. (2016), the absence of successful agricultural businesses not only drives young people away from the agricultural sector but also causes them to believe more that agriculture is not a profession a person can be proud of. It is also important to note that it negatively affects young people's view of agriculture (Masłoń-O., Wahome & Njiraini, 2021).

The negative image created around agricultural activities as a source of livelihood and the fact that the elderly, who are still engaged in traditional agricultural practices with little success, dominate agricultural production keep young people away from the sector. Young people have been found to like activities that are generating income at a faster rate while agriculture production takes some time. This has pushed youths to seek other income-generating activities away from agriculture (Wahome and Njiraini, 2021).

Limited Agricultural Innovation, Insufficient Research and Technology Development

Young people in Kenya do not find agriculture attractive because of the high use of traditional farming techniques. There is limited support for the development and acquisition of appropriate technologies to modernize agriculture. While the technology used in agricultural production in the world is developing, young people in Kenya still do not want to participate in agricultural food systems using traditional farming techniques. Some of the barriers to technology uptake are: inadequate agricultural research and technology development, insufficient awareness of current and improved technologies, low funding for youth-specific research, poor research-expansion linkage leading to low adoption of technologies, and the high cost of some technologies hinder most young people's access to important technology that could have made it easier for them to get involved in food systems (Sitawa et al., 2016). Also, they have less knowledge of the different ways they can be involved in the agricultural value chain.

Low Productivity

The agricultural sector in Kenya is characterized by declining soil fertility, low adoption of modern technologies, production inefficiencies due to low adoption of mechanization, high post-harvest losses, pest and disease outbreaks, limited access to relevant inputs and services, poor management, and inadequate skills (Njeru, Lucy & Gichimu, Bernard. 2014). Large farmland in Arid and Semi-Arid Soils (ASALs) continues to be underutilized due to over-reliance on rain-fed agriculture and limited use of modern technologies to unlock the potential. The subsistence farming approach to agriculture, in contrast to the commercialization approach and limited capital investment in the sector, exacerbates the problem (Cynthiah P. 2020). All of the above issues hinder the meaningful and sustainable participation of young people in the agricultural sector.

Limited Value Addition in the Agro-Processing Industry

The agro-processing industry in Kenya is yet to realize its full potential. It is still in its developing stage which limits job creation capacity that could have been created if there is effective and sustainable value addition on agricultural products. Most agricultural products are sold either in their raw form without further processing or in any other form of added value, such as packaging. This results in limited jobs and income for young people (FAO, 2020).
Factors hindering value addition in the agricultural sector in Kenya;

i. Limited knowledge and skills on how to add value to agricultural products.
ii. Limited knowledge of value-adding technologies.

iii. Insufficient capacity to meet customers' greater demands and expectations in terms of quality, standards, quantity, and consistency.

iv. High capital investment requirement, e.g. refrigeration and cold storage installation is expensive.

Limited Access to Markets

Access to agricultural markets in Kenya especially for small-scale farmers remains a big challenge. Young people face greater difficulties in accessing agricultural markets due to the following constraints: Limited access to marketing information, Non-compliance with the agricultural product and product standards, insufficient markets and marketing infrastructure, Poor post-harvest management, and insufficient skills in marketing and entrepreneurship. All these restrictions limit young people involved in the agricultural sector. Inconsistent quality and high input costs, and low product prices reduce agricultural profitability compared to other sectors. According to Maurice S., et al. (2019), inefficiencies and high transaction costs involved in the food value chain, weak farmers' organizations across, and unstructured markets also play an important role in driving youths away from the agricultural activities.

Inadequate Policies to Support Youth in Agribusiness

Implemented policies do not adequately address youth issues in agriculture and agribusinesses. According to FAO (2020), young people are not sufficiently engaged in policy dialogue, which makes the strategies developed less sensitive to the unique needs of youth. There have been policies and projects that have been implemented over time such as Youth Funds, Kazi Mtaani , National Youth Service, AjiraDigital Projects and many more projects, youths were not involved during decision making to present their interests and what can work for them and what can’t work for them. Also, there have been no major policies supporting youth engagement in agriculture and agri-enterprises (Himaja N. (2020).

Climate Change

Climate change is a global threat that imposes many constraints on the agricultural sector. Increases in temperatures, changes in precipitation patterns, changes in extreme weather events, and reductions in water availability result in reduced agricultural productivity. Climate change has been disrupting food systems in terms of production, availability, accessibility, and also affecting food quality. Putting climate change's effects on agriculture into consideration lowers profitability which discourages youths from engaging in agricultural-related activities (Ndungu, 2016). There is insufficient use of technologies and innovations that increase the resistance of young people to the negative effects of climate change on agriculture. Moreover, there is limited development and upscaling of skills and knowledge to match the dynamics of climate change for practitioners in agriculture (JC, U. 2019).

Strategıc Issues, Strategıc Objectıves and Strategıc Interventıons to Increase Youth Partıcıpatıon and Employment in the Agrıculture Sector.

This section identifies key strategic issues, with associated objectives and strategies designed to address challenges that prevent young people from participating effectively in the agricultural sector and its associated value chains. According to Kenya Youth Agribussiness Strategy 2017-2021, various objectives and interventions have been developed for each strategic issue.
Strategic issue 1: Negative perception and attitude towards agriculture
Strategic goal 1: Transforming the mindset and perception of youth to agriculture (Maurice S., et al. 2019).

Strategic interventions:

i. To create innovative information and knowledge sharing networks and platforms on agriculture
ii. To ensure the integration of agriculture as a subject in the education curriculum to enlighten the youth about the opportunities in the agricultural sector.
iii. Revitalizing and rebranding farming clubs in schools
iv. Establish a mechanism for industry players to provide feedback to learning institutions on performance and demand-based training .
v. Establishing campaign platforms to sensitize the general public on the urgent need for youth to participate in the agricultural sector.
vi. Establishing an awards scheme that rewards young champions in the agribusiness, ambassadors, and agro-journalism celebrities

Strategic issue 2: Insufficient agricultural knowledge and skills
Strategic objective 2: Equipping young people with appropriate agricultural business skills and knowledge

Strategic interventions:

i. Implementing youth agribusiness internships and mentoring programs
ii. Building youth capacity on existing and new technical and innovative agribusiness skills.
iii. Developing and operating district agricultural information sharing centers that will focus on youths
iv. Supporting education and research institutions to use the latest technologies, innovations, and emerging trends in the agricultural sector
v. Developing and supporting a modern youth-inclusive agricultural advisory service model
vi. Equipping young people with knowledge, skills, and knowledge on Good Agricultural Practices (GPA). This will help in improving agricultural productivity in returns high profitability in the sector.
vii. Supporting youth education through sponsorships of agricultural programs in higher education institutions

Strategic issue 3: Limited access to affordable financial Services
Strategic goal 3: Increase access to affordable and youth-friendly financial services for agricultural activities.

Strategic interventions:

i. Developing youth-specific financial models for agricultural enterprises
ii. Developing youth-friendly finance and insurance models to support young agribusinesses
iii. Making use of existing positive funds, such as the Youth fund, the Women's Enterprise Development Fund, and the Uwezo Fund, to support the participation of youths in agriculture
iv. Developing a participatory framework for contract farming, including the creation of cooperatives and groups to support youths to access agriculture financing easily.
v. Building the capacity of young agriculturists in resource mobilization and financial management skills for agricultural enterprises

Strategic issue 4: Limited access to agricultural land

Strategic goal 4: Increasing youth access, ownership, and effective use of agricultural lands

Strategic interventions:

i. Building and implementing alternative unique land lease models in partnership with county governments and other stakeholders
ii. Promoting innovative farming practices that optimize land use
iii. Supporting the development and implementation of policy initiatives that review land use and promote agricultural land consolidation
iv. Raising awareness of land use rights and build trust for young people to own farmland

Strategic issue 5: Limited agricultural innovations and research development

Strategic goal 5: Engaging youths in the research development, and use of innovative agricultural technologies (Maurice S., et al. 2019).

Strategic interventions:

i. Promoting and disseminating cost-effective and affordable agricultural technologies to youths
ii. Promoting the participation of young people in the mass production of modern agricultural machinery to make agricultural activities easier and to reduce post-harvest losses (Cynthiah P. 2020).
iii. Promote and provide sustainable incentives for Public-Private Partnership (PPP) in Agricultural Research and Development
iv. Developing, disseminating, and involving young people in the use of agricultural technologies that meet the needs of young people hence encouraging them to engage in agricultural activities.

v. To introduce Tech-labs and ICT centers in districts connected to mobile applications to facilitate access to information such as weather conditions, markets availability, product prices, and extension services available.

Strategic issue 6: Low Productivity

Strategic objective 6: Increasing access to production factors, use of modern technologies, and Good Agricultural Practices (GAP)

Strategic interventions:

i. To promote access and use of modern agricultural technologies and mechanization to increase productivity along selected value chains
ii. Supporting access to water, subsidized agricultural inputs, and services
iii. Promoting Good Agricultural Practices (GAP), including irrigation systems and soil testing, among others
iv. Improved pest and disease monitoring, surveillance, and control methods to help prevent crop destructions and food loss
v. Developing and implementing sustainable subsidy programs for youth in agriculture

Strategic issue 7: Low-value addition

Strategic goal 7: Empowering youth to participate effectively in agricultural value chain
Strategic interventions:

i. Conducting agricultural value chain analysis to identify potential products and value-adding processes that young people can easily get involved in
ii. Developing the capacity of young people to start agro-processing companies for value addition
iii. Establishing agricultural processing pilot units targeting youth in different counties
iv. Developing and scaling appropriate technologies that will help youths in processing agricultural raw materials, packaging, and transportation hence increasing profit margin (JC, U. 2019).
v. To provide value-added supportive services, incentives, and infrastructure services
vi. Supporting the establishment of youth-led Public-Private Partnerships (PPPs) to help to access affordable technologies that will increase agricultural produce value addition (Cynthiah P. 2020).

Strategic issue 8: Limited access to market information, insufficient market infrastructure, and entrepreneurial skills

Strategic goal 8: To improve young people's access to markets and market information.
Strategic interventions:

i. Developing and implementing sustainable market incentive programs for youth in agribusiness through Public-Private Partnerships

ii. Developing links/networks for young people to access good agricultural markets

iii. Support the creation and strengthening of structured market platforms where young people will be well promoted (Maurice S., et al. 2019).
iv. Supporting group formation by youths to increasing their purchasing and bargaining power and opportunities
v. Developing the capacities of young people in market-driven agricultural enterprises
vi. Support development and access to market infrastructure and information
vii. Collaborative review and integration of agricultural output information platforms
viii. Facilitate registration, standardization, and traceability of agricultural products to improve market efficiency.

Strategic issue 9: Adverse effects of climate change and poor environmental governance

Strategic goal 9: Promote youth adaption of climate-smart agriculture technologies and effective use of resources

Strategic interventions:

i. Raising youth awareness on climate change and global warming effects
ii. Developing and associating youth with coping strategies with climate change
iii. Promoting climate-smart technologies in the agricultural sector
iv. Building youth capacity on advocacy and environmental protection measures
v. Promote the dissemination of real-time information on weather-related issues and their impact on agribusiness.

CONCLUSION

Although a significant proportion of young people still earn their living from agriculture, the rate of youth withdrawal from agriculture to other sectors is very high. The workforce withdrawn from agriculture has gravitated towards the service sector, which is more evident among educated youth though it's not enough to accommodate all the workforce hence leading to high unemployment rates. Research findings reveal that youth should be targeted based on their aspirations and resource availability to increase their capacities and participation in the agricultural sector. A large number of young people are likely to stay on the family estate, such a category has access to land, but needs skills and capital to invest in high-value agricultural enterprises. Young people are disenfranchised in the ownership and management of critical assets in agricultural production, particularly land. The majority of young people use land without exclusive property rights. This not only limits their investment in the land but may also limit their access to loans that are secured against title deeds.The agricultural value chain can provide opportunities to empower youth in agriculture. A range of policies can be used to make the sector more attractive to young people, including farming and agribusiness based education, infrastructure improvements, mechanization programs, advanced storage to prevent post-harvest losses, financing and input subsidies, and export promotion programs that help young people to participate more in international agricultural markets. Digital technology is another important empowerment tool that can enable greater participation of youth in agriculture and increase agricultural productivity.

While digital innovation in agriculture will offer opportunities for young skilled people, technologies such as mobile money that expand financial service delivery are helping to bridge the gap in access to finance. The development of the agricultural sector will have positive effects on reducing the youth unemployment rate, increasing economic development, reducing migration from rural to urban areas, and strengthening peace and national security not only for Kenya but also for other African countries. However, to tap into these potentials, stakeholders must think beyond understanding youth as units of the workforce to be placed in jobs. Effective youth empowerment and participation in agriculture requires the industry's ability to meet the expectations, and aspirations of young people, and to incorporate technology and engage them at all stages of the agricultural value chain and agricultural policies development processes.

ACKNOWLEDGEMENTS

There was no funding involved.Both authors contributed substantially to the research design, data collection, data analysis, write-up and editing of the manuscript. The submitted version is checked and approved by both authors. The authors confirm that there are no conflicts of interest.

REFERENCES

Abwao M. 2014. Youths and agribusiness development in Kenya. *Studia Mundi - Economica, 1*. doi:10.18531/studia.mundi.2014.01.01.79-86

Afande F. O., Maina W. N. & Maina, M. P. 2015.*Youth engagement in agriculture in Kenya: challenges and prospects, Journal of Culture, Society and Development* 7, pp. 4-19.

Analytics, M. (n.d.). *Kenya agriculture employment | Moody's analytics*. Sign In. https://www.economy.com/kenya/agriculture-employment/

Başaranoğlu C. & Yılmaz H. 2020. Determination of the Farming Attributes of Young Farmers and their Tendencies of Engagement in Farming: A Case study in Isparta Province. *Turkish Journal of Agricultural Economics,* 26 (1), 19-28. DOI: 10.24181/tarekoder.588735

Cynthiah P. 2020. Kenyan youth urged to embrace agribusiness. (2020, August 19). The Star. https://www.the-star.co.ke/business/2020-08-19-kenyan-youth-urged-to-embrace-agribusiness/

FAO 2018. Youth and agriculture: Key challenges and concrete solutions. Food & Agriculture Org.

FAO 2019. Challenges and opportunities in a global world. Food & Agriculture Org.

FAO 2020. Agricultural finance and the youth: Prospects for financial inclusion in Kenya: Rural employment - Knowledge materials – *Rural finance*. Food & Agriculture Org.

H. Plecher 2020.Kenya - youth unemployment rate 2009-2019 | Statista. (n.d.). Statista. https://www.statista.com/statistics/812147/youth-unemployment-rate-in-kenya/

Himaja N. 2020. Youth-led agricultural initiatives in Kenya during COVID-19. (n.d.). Agrilinks. https://www.agrilinks.org/post/youth-led-agricultural-initiatives-kenya- during-covid-19

JC U. 2019. Agriculture for all; Constraints to youth participation in Africa. *Current Investigations in Agriculture and Current Research, 7*(2). doi:10.32474/ciacr.2019.07.000256

Julia Faria 2021. Kenya: Employment by economic sector 2011-2020. (2020, October 15). Statista. https://www.statista.com/statistics/1186971/employment-by-economic-sector-in-kenya/

Julia Faria 2021. Kenya: Share of employment in agriculture 2010-2020. (2020, December 16). Statista. https://www.statista.com/statistics/1204049/employment-in-agriculture-as- a-share-of-total-employmen-in-kenya/

Kenya - Labor force. (n.d.). IndexMundi - Country Facts. https://www.indexmundi.com/facts/kenya/labor-force

Kenya labour force participation rate. (2018, 1). Global Economic Data, Indicators, Charts & Forecasts | CEIC. https://www.ceicdata.com/en/indicator/kenya/labour-force-participation-rate

Kenya population 2020. (n.d.). Worldometer - real time world statistics. https://www.worldometers.info/world-population/kenya-population/

Kontogeorgos A., Tselempis D. & Karipidis P. 2014. Young Farmers' Perceived Service Quality of the Greek Ministry of Agriculture: A SERVQUAL Approach, Agricultural Economics Review, *Greek Association of Agricultural Economists*, vol. 15(1), pages 1-12. DOI: 10.22004/ag.econ.253676

Maurice S. et al. 2019. Strategies of integrating public participation governance for sustainable development in Kenya. Public Policy and Administration Research. doi:10.7176/ppar/9-7-06

Mibey M. C. 2015. Factors influencing youth involvement in agribusiness projects in Bomet Central Sub-county, Kenya, Unpublished project, University of Nairobi

Muhoma R. 2014. Factors influencing youth employment through involvement in the milk value chain: a case of Rongai/Nakuru sub- counties, in Nakuru county Kenya. Unpublished Master of Arts Project, University of Nairobi.

Ndungu A. G. 2016. A Kenyan youth perspective on climate change. Development, 59(3-4), 266-269. doi:10.1057/s41301-017-0116-7

Njeru L. & Gichimu B. 2014. Influence of Access to Land And Finances on Kenyan Youth Participation in Agriculture: A Review. 2. 1-8.

Njeru L. K. 2017. Youth in agriculture; Perceptions and challenges for enhanced participation in Kajiado north Sub-County, Kenya. Greener Journal of Agricultural Sciences, 7(8), 203-209. doi:10.15580/gjas.2017.8.100117141

OECD. 2018. The future of rural youth in developing countries tapping the potential of local value chains: Tapping the potential of local value chains. OECD Publishing.

Piselli D., Loni S. S., Colyard K. & Nordquist S. 2019. The role of youth in achieving the SDGs: Supporting youth-led solutions for sustainable food systems. Achieving the Sustainable Development Goals Through Sustainable Food Systems, 229-245. doi:10.1007/978-3-030-23969-5_13

Rose K. N. & Nyanchama M. 2019. Evaluation of Microfinance indicators in actualizing vision 2030 in the agricultural sector, Kenya. Research Journal of Finance and Accounting. doi:10.7176/rjfa/10-4-15

Sambo W. 2016. Factors affecting youth entrepreneurship development in Kibera district, Kenya. Problems and Perspectives in Management, 14(3), 154-161. doi:10.21511/ppm.14(3-1).2016.02

Schmidt E. & Woldeyes F. B. 2019. Rural youth and employment in Ethiopia. Youth and Jobs in Rural Africa, 109-136. https://doi.org/10.1093/oso/9780198848059.003.0005

Sitawa M., Mugasia E. & Songoro A. 2016. Challenges faced by youth engaging in agriculture. A study of Peri-urban Kiambu in Kenya. GRIN Verlag.

United Nations. 2020. World youth report: Youth social entrepreneurship and the 2030 agenda.

Wahome A. & Njiraini A. 2021. Challenges of the agribusiness sector in Kenya and opportunities from smart specialisation policies. Entrepreneurship, Technology Commercialisation, and Innovation Policy in Africa, 137-152. doi:10.1007/978-3-030- 58240-1_6

World Bank. 2020. Youth employment programs in Ghana: Options for effective policy making and implementation. International Development in F.

Wossen T. & Ayele S. 2018. Ethiopia's agricultural transformation: Agribusiness' contribution to reducing youth unemployment. IDS Bulletin, 49(5). doi:10.19088/1968- 2018.171

Yami M., Feleke S., Abdoulaye T., Alene A., Bamba Z. & Manyong V. 2019. African rural youth engagement in agribusiness: Achievements, limitations, and lessons. *Sustainability, 11(1),* 185. https://doi.org/10.3390/su11010185

Eurasian Journal of Agricultural Research 2022; Vol: 6, Issue: 1, pp:17-33

Analysis of Sources and Socio-Economic Determinants of Acccess to Loan by Smallscale Rice Farmers in Gwagwalada Area Council, Federal Capital Territory, Nigeria

Anthony, Luka[1*], Alabuja, Funso Omolayo[2], Ebukiba, Samuel Elizabeth[3]

[1]*Department of Agricultural Economics, Faculty of Agriculture, University of Abuja, PMB 117, Gwagwalada, Federal Capital Territory, Nigeria*
[2]*Department of Agricultural Economics, Faculty of Agriculture, University of Abuja, PMB 117, Gwagwalada, Federal Capital Territory, Nigeria*
[3]*Department of Agricultural Economics, Faculty of Agriculture, University of Abuja, PMB 117, Gwagwalada, Federal Capital Territory, Nigeria*

[*]*Corresponding author: gqluka11@gmail.com*

ORCID: 0000-0001-8337-2341

Abstract

This study evaluated the analysis of sources and socio-economic determinants of access to loan by smallscale rice farmers in Gwagwalada Area Council, Federal Capital Territory, Nigeria. Multi-stage sampling technique was adopted and used. Data were collected through the use of well-structured questionnaires administered to 100 sampled smallscale rice farmers. The following analytical tools were used to achieve the stated objectives: descriptive statistics, gross margin analysis, financial analysis, Cobb-Douglas Production Function, and Probit Regression Model Analysis. The results of the analysis of the socio-economic characteristics of the respondents revealed that the mean age of the sampled small scale rice farmers was 43 years. About 34% could not access formal education and 62% of the farmers had formal education and they can adopt new innovations quickly and also understands the guidelines involved in accessing formal loans. Most of the sampled smallscale rice farmers had less than 2 hectares of farm size. Also, 69% of the farmers had their capital through their personal savings, while 21% through credit borrowing. The average loan accessed from formal sources by smallscale rice farmers was ₦200.754.2 with the maximum interest rate of 36% charged. The average amount of loan accessed from informal sources by the small scale rice farmers was ₦129.558.82 with maximum interest rate of 20%. The study show that rice production is a profitable enterprise in the study area. The results of the Cobb Douglass Production Function analysis revealed that the statistically and significant factors influencing rice production were labour input ($P < 0.01$), chemical input ($P < 0.05$) and fertilizer input ($P < 0.05$). The value of the coefficient of the multiple determinations (R^2) was 0.642. This implies that 64% of the variations in the output of rice was explained by the explanatory variables included in the Cobb-Douglass production model. The results of the Probit model to determine the socio-economic factors influencing access to loan reveal that the significant variables influencing access to loan by smallscale rice farmers were education level ($P < 0.10$) and cooperative memberships ($P < 0.05$). The major constraints faced by smallscale rice farmers were; long distance to financial institutions, high interest rate, cumbersome administrative procedures, short re-payment period, lack of collateral securities and small amount of loan given.

Therefore, the study recommends that loans should be made available to farmers at affordable interest rate preferably single digit. Provision should be made for farmers to have access to tractors, farm machineries and other farm inputs. To encourage them to upgrade and involve in large scale rice production to be able to fill the high demand and supply gap of rice in Nigeria. The education of farmers should be given serious priority, training should be organised for farmers through extension agents in order for them to know the guidelines involved in accessing loans and how to use farm inputs efficiently. Also, farmers should be encouraged to join cooperative organisations in order for them to have access to loan easily, Government should make a provision for special agricultural microfinance banks that should be located in rural areas to meet the need of farmers' loan demand.

Keywords: Analysis, determinants, loan, Nigeria, rice, smallscale farmers

Research article
Received Date: 29 March 2022
Accepted Date: 25 May 2022

INTRODUCTION

Agricultural sector still maintained its position as the major stay of the Nigerian Economy though the performance of the agricultural sector in Nigeria has been relatively poor considering the attitude of the existing financial systems to the support of the agriculture in the country. The Formal institutions that provide loans to the smallscale farmers are usually not located in the areas where rural farmers can reach and there is inadequate information on the sources of formal agricultural credit sector among the rural farming populace (Alabi et al, 2021). Small scale farmers are oftern referred to those that cultivate not more than two hectares of land. They are often limited by inadequate fund among other things. Government has come up with various macroeconomic policies to promote growth of the agricultural sector. Credit-channeling financial policies, price stabilizing monetary and exchange rate policies, and farm incentive-laden fiscal policies including tax exemptions for agricultural businesses, duty-free import of farm machinery are among those the government intend to expand production. Nigerian agricultural policy provides, among others, for adequate financing of agriculture. Just like in the industrial and service sectors the significant of fund in agriculture cannot be over-emphasized, it is just like the oil that lubricates production. Public expenditure on agriculture has, however, been shown not to be substantial enough to meet the objective of the Government agricultural policies (IFPRI, 2008). For a developing country with a mono-product oil economy such as Nigeria's, inadequate financing of agriculture portends great danger for many reasons; continuing inadequate food production, poor youths' engagement in agriculture can lead to hunger and prolong insecurity as experienced in our nation today. So, small scale farmers need loan and not necessarily grant to improve their production.

A loan is money, property, or other material goods given to another party in exchange for future repayment of the loan value or principal amount, along with interest or finance charges. A loan may be specific, one-time amount, or it can be available up to a specific limit (Kagan, 2019). Access to loan by smallscale farmers could increase the willingness of the farming households to adopt and utilize more farming technologies that would result in increased production as well as increased income of the smallscale farmers (Ajah et al., 2017).

Access to agricultural credit facilities is considered as one of the best and key elements in uplifting and raising agricultural productivity. Availability of adequate and timely credit facilities to farmers always help in expanding and increasing the scope of farm operation and adoption of new and modern technologies, it can also enhance to purchase and use of improved seed varieties and other inputs by the smallscale farmers (Kuye and Ogiri, 2019).

The two most important and critical periods that credit is needed by the smallscale farmers is during pre-planting and harvesting periods (Akpokodje et al., 2001), hence, the acuteness of credit facilities is needed at different times during the cultivation season by the farmers. Furthermore, credit facilities are not only needed by the farmers for farming purposes alone, but also for household needs and consumption expenditure, especially during the off-season period when farmers are mostly idle. Rice *(Oryza sativa)* is a unique crop which can be grown virtually in all geological zones all over the country, because the required temperature ranges between 20^{o}C and 38^{o}C during its growth and a long period of sunshine which is obtainable all over Nigeria. The most prevalent type of the rice production systems in Nigeria are the rainfed upland system, rainfed lowland system and irrigated lowland system (Ajah et al., 2017 and Inakwu, 2011). In Nigeria the demand for rice has been on increase at a faster rate than in any other country in Africa since from the time period of mid 1970 (Ajah et al., 2017; Food and Agriculture Organization (FAO 2001; Odoemenem and Inakwu 2011; Ohen and Ajah 2015). Agricultural loan or credit facilities is a very important ingredient for sustainable agricultural development achievement in any country of the world (Ololade and Olagunju, 2013). An agricultural credit facility from formal sources can be defined as money given or extended to farmers for agricultural activities, which enhances productivity, increases production, and improves the living standard and wellbeing of the farmer (Alabi et al., 2021). Loan or credit given to smallscale farmers as a rural loan has proven to be one of the powerful instruments used against poverty reduction, eradication and development in rural areas. Farmers particularly smallscale farmers are actually in need of such instrument (i.e. credits), due to the seasonal nature and pattern of their farming activities and the uncertainty and risk they face in the process of production. Agricultural loan or credit facilities enhances farm productivity, efficiency and also promotes standard of living of the farmers by breaking the vicious cycle of poverty among small scale farmers. Access to loan or credit facilities by these group of poor rural people has the potential and the capacity of making the difference between grinding poverty and economically secured life style as well as the ability for enhancing agricultural productivity.Despite the fact that about 80% of Nigeria's population lives in rural areas and under abject poverty, those majorities are the ones involved in agricultural activities and produce food for the nation, there are no efforts to facilitate credit facilities to farmers which is crucial in rapid development for this dominant group of the population (Obisesan, 2013).

Agricultural efficiency, productivity and growth are hindered by access to loan facilities (Odoemenem and Obinne 2012), only few smallscale farmers have access to rural credit facilities. According to Enhancing Financial Innovation and Access ElnA (2008), 23% of adult population in Nigeria has access to formal financial institution, 24% to the informal services, while 53% are financially excluded from having access to loan or credit facilities. Preliminary observation shows that most new innovations in agriculture inevitably increase the capital requirements of farmers in acquiring the innovation. Improving access to finance and credit facilities is an important aspect that could lead to foster the development in rice sub-sector in Nigeria. Relevant literatures have confirmed that agriculture in Nigeria and many developing countries is constrained by lack of loan (Alabi et al, 2021).

Nigeria has over 40 million smallholder farmers in production line and over 90% of these farmers can't have access to loan facilities from the commercial banks for acquiring inputs, yet agricultural credit is very imperative in small scale farming as it enables them to secure viable inputs such as seeds, equipment and chemicals needed to run a successful farm which in turns yields an increase in agricultural production and poverty reduction.

According to Ogah et al., (2015), loan accessibility and utilization is influenced by farmers' socioeconomic characteristics, the challenges of covering long distance to the bank, insistence on provision of collateral, inadequate loan granted, unwillingness of bank in granting agricultural the loan, high rate of interest charged by private money lenders, delay and difficulty in communication with bank officials in acquiring loan and management cost. Farmers, especially smallholder farmers are faced with different problems among which is the inadequate or restricted access to capital and limited access to loan facilities. Adegbite et al, (2007) noted that loan is required to break the vicious cycle of low productivity in agriculture. Therefore, farm loan or credit facilities remains one of the major means of improving farm capital investment and enterprises. It is generally agreed among researchers, scholars and policymakers that lack of access to adequate loan and credit facilities by smallscale farmers can have significant negative effects and consequences for various individuals and aggregate smallscale farmers' outcome levels, technology adoption by farmers, agricultural productivity, food security, nutrition, health, and overall household welfare in the society. Availability and accessibility to loan and credit facilities by farmers can lead to alleviation of capital constraints faced in agricultural rice production. Most smallscale farmers cash flow is negative during planting season reason is because of expenditures on agricultural inputs is higher than what they earn, and couple with that on food and essential non-food items. Therefore, to finance the purchase of essential production inputs, farm households need to obtain loan. Thus, access to adequate loan and credit facilities can significantly lead to increase in the ability of poor smallscale farmers with little or no savings to acquire production inputs. Without loan accessibility, most smallscale rice farmers have a chance of substantially increasing their production level. This brings to the fore, the importance of poverty level among the farming population as a vital factor in organizing agricultural loan for smallscale rice farmers. Most often this factor is not fully acknowledged and dully implemented. Poverty level has a direct role in technological improvement because its adoption comes with more capital investments implication when incomes of the farmers are low, such risks appear to be great and unbearable. The relative low level of farm income from small scale level of production has limitation and restriction to the operations of the smallscale rice farmers to small enterprises. As a result, this establishes the vicious cycle whereby smallscale farmers always remain as small producers and relatively poor. Therefore, there is need for production loan and credit facilities from formal financial institutions to break the vicious cycle of low income and poverty among smallscale rice farmers. With this in mind therefore, there is need for more realistic and determined efforts to modernize the rice sub-sector through extension of easy access to credit facilities to smallscale rice farmers that fall into this group. Consequently, it will lead to the transformation of their smallholdings to modern commercial production level with increased capacity of the farmer beneficiaries to enhance their repayment performance. Findings from this study will be useful to the academic World and also helpful in policy formulation by policy makers to improve rice production in Nigeria. Hence it is on this background that this study was undertaken.

Research Questions

This study provides answers to the following research questions:

(i) What are the socio-economic characteristics of smallscale rice farmers' loan beneficiaries and non-beneficiaries in the study area?
(ii) What are the sources and amount of loan accessed by smallscale rice farmers in the study area?
(iii) What is the cost and returns analysis of smallscale rice production in the study area?
(iv) What are factors influencing output of smallscale rice production in the study area?
(v) What are the socio-economic factors influencing access to loan by smallscale rice farmers in the study area?
(vi) What are the constraints encountered by smallscale rice farmers in accessing loan in the study area?

Objectives of the Study

The broad objective of this study is to evaluate analysis of sources and socio-economic determinants of access to loan by smallscale rice farmers' in Gwagwalada Area Council, Federal Capital Territory, Nigeria. The specific objectives were to:

(i) determine the socio-economic characteristics of smallscale rice farmers' loan beneficiaries or non-beneficiaries,
(ii) identify the sources and amount of loan accessed by smallscale rice farmers,
(iii) analyze the costs and returns of smallscale rice production,
(iv) evaluate factors influencing output of smallscale rice production,
(v) evaluate socio-economic factors influencing access to loan by smallscale rice farmers', and
(vi) determine the constraints encountered by smallscale rice farmers in accessing loan in the study area

MATERIAL and METHOD

The Study Area

This study was carried out in Gwagwalada Area Council of Federal Capital Territory Abuja, Nigeria. Before the creation of Federal Capital Territory, Gwagwalada was under the Kwali District of the former Abuja emirate now Suleja emirate. The council was created on 15th October, 1984. It is located at the extreme south west near the flood plain of river Gurara which transverses the territory from North to South at an elevation of 70m above sea level. The area lies between Latitudes $8°56^{1}29^{11}$N and Longitudes $7°05^{1}29^{11}$E. It has a land area of 1,043Km^2. The total population of the Area Council is 158,618 people comprising 80,182 males and 78,436 females (NPC, 2006). The population of the Area Council has grown to over 1,000,000 people (Balogun,2006). The vegetation combines the best features of the southern tropical rain forest and guinea savanna of the North. This reflects the full transitional nature of the area as between the Southern forest and Northern grassland which have the woods and shrubs respectively. The soil is reddish with isolated hills filled by plains and well drained sandy clay loams which supports farming of the major crops such as sorghum, millet, melon, yam, soybean, benniseed, cassava and rice cultivation (Abuja ADP, 2004).

The duration of sunshine ranges from 8 to 10 hours per day. The average rainfall per annum is 163.2mm. The original settlers are Gwari, Koro, Bassa, Gade and the Hausa Fulani as well as immigrants population of other Nigerians and expatriates.

Sampling Technique and Sample Size

A multi-stage sampling technique was adopted and used to select target respondents (smallscale rice farmers) for the study. In the first stage, Purposive sampling technique was used to select Gwagwalada Area Council. because of the predominance of smallscale rice production in the area. Second stage five (5) wards were randomly selected using ballot box raffle draw method, they are: Dobi, Ikwa, Ibwa, Paiko, and Gwako. In the third stage, two (2) villages per ward were randomly selected using ballot box raffle draw method making a total of ten (10) villages.

In the fourth and final stage, ten (10) smallscale rice farmers were randomly selected per village using ballot box raffle draw method making a total sample size of one hundred (100) smallscale rice farmers selected for the study.

Method of Data Collection

Data for this study were obtained from primary source. Primary sources of information were obtained using well- structured questionnaires. The questionnaires were designed to collect information on; socio-economic characteristics, these ranges from age, sex, marital status, household size, level of education; sources and amount of loan obtained, farm size, and farming experience. The questionnaires were supported with personal and group interviews needed. The questionnaire comprises of Section A, socio-economic characteristics of rice farmers Section B, sources and the amount of loan accessed by smallscale rice farmers; Section C, costs and returns analysis of smallscale rice production; Section D, labour use in smallcale rice production; Section E, production of output of rice, and Section F, constraints in smallscale rice production and suggested solutions

Method of Data Analysis

The following analytical tools was used to achieve stated objectives:

(i) Descriptive Statistics
(ii) Gross Margin Analysis
(iii) Financial Analysis
(iv) Cobb-Douglas Production Function
(v) Probit Regression Model Analysis
(vi)t-Test Analysis
(vii) Z-Test Analysis

Descriptive Statistics

Descriptive statistics was employed to have summary descriptions of data collected. This include: mean, minimum, and maximum values, frequencies distribution, percentages, and standard-deviation. Descriptive statistics was used to determine the socio-economic characteristics, sources, and amount of loan accessed, and identify the constraints facing smallscale rice farmers in accessing loan. This was used to achieve specific objectives one (i), two (ii), and six (vi)

Gross Margin Analysis

To determine the costs and returns analysis of smallscale rice production in Gwagwalada Area Council, the Gross Margin Model was employed. The gross margin (GM) is the difference between the total revenue (TR) and the total variable cost (TVC). The total revenue was the product of rice quantity (100Kg Bag) and the price of rice per 100Kg bag.
Mathematically, in line with Ben- Chendo *et al.* (2007) and Nwele (2016), the gross margin analysis is stated thus:

GM= TR-TVC------------------ (1)

Where, GM = Gross Margin (Naira)
TR= Total Revenue (Naira)
TVC= Total Variable Cost (Naira)
This will be used to achieve specific objective three (iii)

Financial Analysis

In order to evaluate the strength and financial position of the rice production, operating ratio, and rate of return per Naira invested was considered. An Operating Ratio (OR) according to Olukosi and Erhabor (2005) is status thus:

$$\mathrm{OR} = \frac{\mathrm{TVC}}{\mathrm{GI}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (2)$$

Where:
OR= Operating Ratio (Unit)
TVC= Total Variable Cost (Naira)
GI= Gross Income (Naira)
An Operating Ratio that is less than one (1) implies that the total revenue obtained from rice production will be able to pay the cost of variable inputs used in the enterprise (Olukosi and Erhabor 2005). The Rate of Return per Naira Invested (RORI) in rice production is stated thus:

$$\mathrm{RORI} = \frac{\mathrm{NI}}{\mathrm{TC}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.. (3)$$

Where,
RORI= Rate of Return per Naira Investment (Units)
NT= Net Income from Rice Production (Naira)
TC=Total Cost (Naira)
The financial analysis was used to achieve part of specific objective three (iii)

Cobb-Douglas Production Function

Cobb-Douglas Production Function is stated thus:

$$\mathrm{Y} = \mathrm{F}(\mathrm{X}_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, U_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

$$\mathrm{LogY} = \beta_0 + \beta_1 LogX_1 + \beta_2 LogX_2 + \beta_3 LogX_3 + \beta_4 LogX_4 + \beta_5 LogX_5 + \beta_6 LogX_6 + \beta_7 LogX_7 + \beta_8 LogX_8 + \beta_9 LogX_9 + U_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

Where,
Y= Output of Rice (kg)
X_1 = Age (Years)
X_2 = Fertilizer($Naira/kg$)
X_3 = Farming Experience(Years)
X_4 = Labour Input(Mandays)
X_5 = Seed Input $\left({}^{\mathrm{Naira}}/_{\mathrm{kg}}\right)$

X_6 = Chemical Input$(\text{Naira}/_{\text{Litre}})$
X_6 = Marital Status(1, Married, 0, Otherwise)
X_8 = Farm Size(Hectares)
X_9 = Household Size(Units)
U_i = Error Term
β_0 = Constant Term
$\beta_1 - \beta_8$ = Regression Coefficients
This was used to achieve specific objective four (iv)

Probit Regression Model Analysis

The Probit Regression Model is stated thus:

$$Y = F(X_1, X_2, X_3, X_4, X_5, X_6, X_7, U_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + U_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where,
Y= Dichotomus Response Variable (1, Access to Loan; 0, Otherwise)
X_1=Age (Years)
X_2= Households Size (Units)
X_3= Level of Education (0, Non-Formal; 1, Primary; 2, Secondary; 3, Tertiary).
X_4= Marital Status (1, Married; 0, Otherwise)
X_5= Farm Size (Hectares)
X_6= Membership of Cooperative Organisations (1, Member; 0, Otherwise)
X_7= Access to Extension Services (1, Access; 0, Otherwise)
U_i= Error Term
β_0= Constant Term
β_1-β_7= Regression Coefficients
This was used to achieve specific objective five (v)

RESULTS and DISCUSSION

Socio-Economic Characteristics of the SmallScale Rice Farmers Loan Beneficiaries or Non-Beneficiaries

Table 1 shows the analysis of the socio-economic characteristics of the sampled smallscale rice farmers. The results revealed that 68% of the farmers were less than 50 years. The mean age of the sampled rice farmers was 43 years. This implies that smallscale rice farmers were mostly young, active and energetic farmers that were in the range of productive age. Majority (83%) of the smallscale farmers were married. This result is consistent with Kuye and Ogiri (2019) who indicated that married respondents are likely to incur more expenditure on family upkeep. About 34% could not access formal education and 66% of the rice farmers had formal education. Educated farmers adopt new innovations and research findings quickly and also understand the guidelines involved in accessing formal loans.

This result is in agreement with Alabi *et al*, (2020a) who reported that education is an important factor that can influence farmers' adoption of new innovations and research findings. About 45% of the smallscale rice farmers had less than 11 years experience in rice farming. The average farming experience of the farmers was 15 years. This finding is in line with Maurice *et al* (2015). Most of the sampled rice farmers had less than 2 hectares of farm size, while 36% of the farmers had between 3-4 hectares of rice farm land. The mean value of the farm size was 2.39 hectares.

This is in line with Kuye and Ogiri (2019) who reported that the sampled farmers in their study were generally smallscale farmers, which fall within the active age of farming productivity with long years of farming experience. The results of sampled smallscale rice farmers shows that most of the farmers had less than 5 hectares of land. This implies and confirms that they are mostly smallscale farmers. The average members per household were 6 people. This is in consonant with findings of Alabi *et al* (2020b) who reported that the rural rice farmers on the average had 7 people in the households. Majority (60%) of the sampled rice farmers were members of cooperative organization, only 22% of the sampled rice farmers had access to loan. More so, because majorities were married with large household size and low annual income they need to gain access to adequate loan facility. Furthermore, sampled farmers accessed loan through formal source while 31% had access to loan through informal sources. Also, 69% of the smalscale rice farmers obtained their capital through their personal savings, while 21% obtained their capital through credit borrowing.

Table1. Socio-Economic Characteristics of the Sampled SmallScale Rice Farmers

Variables	Frequency	Percentage	Mean
Age (Years)			43.07
21-30	11	11.0	
31-40	30	30.0	
41-50	38	38.0	
51 and above	21	21.0	
Sex			
Female	29	29.0	
Male	71	71.0	
Marital Status			
Single	5	5.0	
Married	83	83.0	
Divorced	1	1.0	
Widow/widower	8	8.0	
Separated	3	3.0	
Educational Level			
Non Formal Education	34	34.0	
Primary Education	14	14.0	
Secondary Education	21	21.0	
Tertiary Education	31	31.0	
Farming Experience (Years)			14.61
1 – 10	45	45.0	
11 – 20	35	35.0	
21 and above	20	20.0	
Farm Size (Ha)			2.39
1-2	62	62.0	
3-4	36	36.0	
5 and above	2	2.0	
Household Size (Number)			6.47
1-10	85	85.0	
11-20	15	15.0	
Cooperative Membership			
No	40	40.0	
Yes	60	60.0	
Access to Loan (₦)			
No	78	78.0	
Yes	22	22.0	

Source: Field Survey (2022)

Table1. Socio-Economic Characteristics of the Sampled SmallScale Rice Farmers Continued

Variables	Frequency	Percentage	Mean
Extension Access			
No	12	12.0	
Yes	88	88.0	
Method of Land Acquisition			
Inheritance	46	46.0	
Purchase	30	30.0	
Rent	14	14.0	
Gift	8	8.0	
Lease	2	2.0	
Major Source of Loan			
Formal Sources	62	62.0	
Informal Source	31	31.0	
Major Source of Capital			
Personal Savings	69	69.0	
Credit Borrow	21	21.0	
Friends and Family	3	3.0	
Money Lenders	3	3.0	
None	4	4.0	

Source: Field Survey (2022)

Sources and Amount of Loan Accessed by SmallScale Rice Farmers

The sources and amount of loan accessed by smallscale rice farmers is presented in Table 2. The major sources of loan by farmers were through formal and informal sources. The average loan accessed from formal sources by smallscale rice farmers was ₦200,754.2 with the maximum interest rate of 36% charged.

The minimum and maximum amount accessed from formal sources by smallscale rice farmers were ₦30,000 and N500,000 respectively. The average amount of loan accessed from informal sources by the smallscale rice farmers was ₦129,558.82 with maximum interest rate of 20%, while the minimum and maximum amount of loan accessed by smallscale rice farmers were ₦25,000 and ₦400,000 respectively. This is in line with findings of Kuye and Ogiri (2019) who reported in their study that the average values of loan applied and received were ₦169,583.33 in Cross River State, Nigeria.

This result implies that the formal sources of loan provide capital to smallscale rice farmers at a higher interest rate which makes it difficult for farmers to access the agricultural loan. Since the interest rate of formal source is high and unaffordable, the loan from informal sources are more affordable because their interest rate charged is lower than that of formal sources.

Table 2. Sources and Amount of Loan Accessed by SmallScale Rice Farmers

Sources of Loan	**Mean (Naira)**	**Maximum Interest Rate (%)**	**Minimum Amount Accessed (Naira)**	**Maximum Amount Accessed(Naira)**
Formal Sources	200,754.72	**36**	30,000	500,000
Commercial Bank		**22**	-	-
Microfinance Bank		36	-	-
Bank of Agriculture		12.5	-	-
Cooperative Society		10	-	-
Bank of Industry		0	-	-
Government Institutions		7	-	-
Informal Sources	129,558.82	20	25,000	400,000
Money Lenders		10	-	-
Friends		20	-	-
Relatives		10	-	-
Others		-	-	-

Source: Field Survey (2022)

Costs and Returns in SmallScale Rice Production

Table 3 present the results of the gross margin analysis which shows the costs and returns involved in rice production by smallscale farmers. The total variable cost was ₦98, 569.06. This accounted for 56.73% of the total cost of production. The estimated cost of seeds and fertilizer inputs were ₦12.546 and N20.288.66 and they represent 7.22% and 11.68% of total cost of production respectively. The estimated cost of labour was ₦86,.651, this represent 49.87% of the total cost of production. Labour carries the largest share of the total cost of rice production by smallscale farmers.

The total fixed cost was ₦75. 192.851, this accounted for 43.27% of the total cost of rice production. The depreciation on the farm assets was ₦19, 884.791 this accounted for 11.444% of the total cost of rice production. The estimated value of land rent incurred was ₦8, 565 this accounted for 4.93% of the total cost of rice production. The interest rate paid on loan was ₦46, 243.91 and this accounted for 26.613% of the total cost of rice production. The total cost of production estimated was ₦173.761.851. The total revenue realized was ₦375,255, while the gross margin was estimated to be ₦201. 493.149. The net farm income was ₦126,300.

This implies that rice production by smallscale farmers was profitable. The gross margin ratio, operating ratio, and the rate of return on investments were 0.53, 0.489 and 0.727 respectively. The gross margin ratio of 0.534 implies that for every one naira invested in rice production by smallscale rice farmers, 53 kobo covered profits, depreciation, interest and all other expenses in rice production. This result is consistent with Alabi *et al.*, (2020a) who reported that the estimated gross margin ratio, covered the profits, interest, taxes, expenses, operation cost and depreciation on assets.

Table 3. Costs and Returns Involved in Rice Production by Small Scale Rice Farmers

Variable	Value (N)	Percentage
(a) Variable Cost		
Seed Input	12,546	7.22
Fertilizer Input	20,288.66	11.68
Chemical Input	13,711	7.89
Labour Input	86,651.66	49.87
Bags/Sacks	4,051.4	2.33
Bagging	2,592	1.49
Loading/Offloading	1,476.5	0.84
Transportation	3,797.5	2.185
Total Variable Cost	98,569.06	56.73
(b) Fixed Cost		
Depreciation on Farm Assets	19,884.791	11.444
Land Rent Incurred	8,565.00	4.93
Interest	46,243.91	26.613
Fess/Commission	500	0.28
Total Fixed Cost	75,192.791	43.27
Total Cost of Production	173,761.851	100
Total Revenue	375,255	
Gross Margin		201,493.149
Net Farm Income		126,300
Gross Margin Ratio		0.534
Operating Ratio		0.489
Rate of Return on Investment		0.727

Source: Field Survey (2022)

Factors Influencing Output of SmallScale Rice Production

Table 4 present the results of the evaluation of the Cobb-Douglass production function model. The variables included in the model were: age, fertilizer input, farming experience, labour input, seed input, chemical input, marital status, farm size, and household size. The statistically and significant factors influencing rice output production were labour input (P<0.01), fertilizer input (P < 0.01) and chemical input (P<0.05). The coefficient of fertilizer input was negative and statistically significant at (P<0.05). The coefficient of labour input 0.542 implies that a unit increase in labour input will result in likelihood of 0.542 increases in the output of rice production. The coefficient of the chemical input was 0.682. This implies that a unit increase in the use of chemical input leads to likelihood of 0.682 increases in the output of rice production by the smallscale rice farmers. The coefficient of fertilizer input was -0.514. This implies that a unit increase in the use of fertilizer input by smallscale rice farmers will results in 0.514 decreases in the output of rice production. This result is in line with Alabi *et al* (2020a) who reported that the factors that were positive and significantly influencing agricultural product output include: family labour, hired labour, and volume of pesticides used. The value of the coefficient of the multiple determinations (R^2) was 0.642. This implies that 64% of the variations in the output of rice were explained by the explanatory variables included in the Cobb-Douglass production model. The joint contributions of the explanatory variables (F = 12.78) to the variation in the output of rice was statistically significant at (P < 0.01) probability level.

Table 4. Factors Influencing Output of Rice (Cobb Douglass Production Model)

Variable	Regression Coefficient.	Std. Err.	t-Value
Age	-0.0739076	0.5494516	-0.13
Fertilizer Input	-0.5136386**	0.1861237	-2.76
Farming Experience	0.1041263	0.1333288	0.78
Labour Input	0.541824***	0.1601303	3.38
Seed Input	-0.0390949	0.4226708	-0.09
Chemical Input	0.6822296**	0.2720754	2.51
Marital status	0.3148554	0.2917829	1.08
Farm Size	0.224502	0.1510091	1.49
Household Size	-0.0202883	0.2625072	-0.08
Constant	3.444572	1.341634	2.57
R-Squared =	0.6424		
F Value = 12.78			
Adj R-Squared = 0.5921			

*Source: Field Survey (2022) ***-Significant at 1 % Probability Level, **-Significant at 5% Probability Level, *-Significant at 10% Probability Level.*

Socio-Economic Factors Influencing Access to Loan by SmallScale Rice Farmers

Table 5 presents the results of the Probit regression model estimates of the socio-economic factors influencing access to loan by the smallscale rice farmers in the study area. The socio-economic variables included in the model were: age, household size, educational level, marital status, farm size, cooperative membership and extension visit. The results show that there were only two (2) of the explanatory variables statistically significant in influencing access to loan by smallscale rice farmers. Thee significant variables were education level (P<0.10) and cooperative memberships (P < 0.05). The positive values of the magnitude of the coefficients implies that a unit increase in educational level and cooperative memberships of the smallscale rice farmers will result in increase in the likelihood or probability of the smallscale rice farmers to have access to loan. The marginal effect of the education level of 0.055 implies that a unit increase in the level of education of smallscale rice farmers will lead to 0.055 marginal increase in the likelihood or probability of having access to loan by smallscale rice farmers. This is in line with the findings of Ameh & Iheanancho (2017) who reported that educated farmers has courage, boldness and the technical know-how required to approach financial institutions for loan. This also is in conformity with the findings of Asogwa, Abu and Ochoche (2014) who observed that education level raises smallscale farmers' knowledge and level of awareness about the needs for agricultural loan and leads them to seek for agricultural loan facilities for increased output. Likewise, the marginal effect of cooperative memberships 0.207 signifies that a unit increase in the cooperative memberships of smallscale rice farmers leads to 0.207 marginal likelihood or probability of having access to loan by smallscale rice farmers. The maximum likelihood estimates revealed that the Log Likelihood value was -144.796. The Chi Square value was 15.79 and was statistically significant at (P < 0.01) probability level. The Pseudo R square value was 0.1498. This implies that 15% of the variations in smallscale farmers access to loan were explained by the explanatory variables included in the Probit regression model.

Table 5. Results of the Estimated Probit Regression Model to Determine Socio-Economic Factors Influencing Access to Loan by SmallScale Rice Farmers

Variables	Coefficient.	Std. Err.	Z-Score	Marginal Effects
Age	0.006391	0.0242966	0.26	0.0016257
Household Size	0.0826468	0.0713751	1.16	0.0210228
Education Level	0.2187915	0.1338788	1.63	0.0556538
Marital Status	0.0459309	0.2200495	0.21	0.0116834
Farm Size	-0.0777221	0.1432863	-0.54	-0.0197701
Coop membership	0.8146234	0.362007	2.25	0.2072148
Extension Visit	0.4917283	0.5799097	0.85	0.1250804
Constant	-3.102106	1.33712	-2.32	
Log Likelihood	-44.796815			
LR $Chi^2(7)$	15.79			
Prob > Chi^2	0.0271			
Pseudo R^2	0.1498			

Source: Field Survey (2022), ***-Significant at 1 % Probability Level, **-Significant at 5% Probability Level, *-Significant at 10% Probability Level.

Constraints Encountered by Smallscale Rice Farmers in Accessing Loan in the Study Area

Table 6 presents the results of the constraints encountered by sampled smallscale rice farmers in accessing loans. The results show that 23% of the sampled respondents were faced by challenge of the lack of collateral securities for accessing the loan, while 38% encountered cumbersome administration procedures which could be a due to illicit behaviour of those involved in processing the loans. About 39% of the sampled smallscale farmers were faced with the challenge of high interest rate charged by the banks and the financial institutions. Furthermore, 40% of the sampled smallscale rice farmers encountered the constraint of long distance to financial institutions since most of the farmers are leaving in rural and remote areas, they may find it difficult to transport due to bad road infrastructures and how to locate the financial institutions which are mostly located in the urban areas and capital cities. This is in line with Ajah, Igiri and Ekpenyong (2017) who opined that the distance between home of farmers and source of credit affects the farmers from accessing loan because the borrower's home is far away from the source of credit. Also 22% and 20% of the sampled smallscale rice farmers encountered late disbursement of loan and the small amount of loan given to farmers as loan as their major challenge for accessing loan. This result is in line with Kuye and Ogiri (2019) who asserted that the major constraints for accessing loan by farmers are long period of processing loan applications. The long period of processing loan application always results in late disbursement of loan with concomitant effect of loan diversion and default. More so, 34% of the respondents expressed that short re-payment period are their major constraint for accessing loan. The implications of this could be because crop farming is a seasonal business which could take a period between 3-6 months before harvesting, crop output is very cheap at the time of harvest, when they are given short period of time for repayment of loans, they may not be able to cover all their expenses when they are forced to sell their crops for the purpose of paying the borrowed funds.

Table 6. Results of the Analysis of the Constraints Encountered by the Smallscale Rice Farmers

Variables	Frequency	Percentage	Rank
Lack of Collateral	23	23.0	5
Cumbersome Administrative Procedures	38	38.0	3rd
High Interest Rate	39	39.0	2nd
Long Distant to Financial Institutions	40	40.0	1st
Late Disbursement of Loan	22	22.0	6
Small Amount of Loan	20	20.0	7
Short Re-Payment Period	34	34.0	4th
Fragment of Loan Facilities	32	2.0	8
Others	1	1.0	9
Total	**100**	**100**	

Source: Field Survey (2022)

CONCLUSION

The study concludes that the rice production activities were profitable in the study area. Most of the smallscale rice farmers are male, and were married. Rice farmers were young energetic within the productive age. Most of the smallscale rice farmers could not have access to loan from formal sources because of high interest rate. Majority of the farmers had their capital through their personal savings, while few farmers acquired their capital through credit borrow. The study shows that rice production is a profitable enterprise in the study area. The statistically and significant factors influencing rice output production include labour input, chemical input, and fertilizer input. The significant socio-economic factors influencing access to loan by smallscale rice farmers were education level and cooperative memberships. The constraints faced by smallscale rice farmers in accessing loan were: long distance to financial institutions, high interest, cumbersome administrative procedures, short re-payment period, lack of collateral securities and small amount of loan.

RECOMMENDATIONS

Based on the findings of this study the following policy recommendations were made

(i) Policies towards provision of formal sources of loan to smallscale farmers should be implemented and encouraged. Loans should be made available to farmers by all financial institutions at affordable interest rate preferably single digit.

(ii) Provision should be made for farmers to have access to tractors farm machineries and other farm inputs. This will help them to overcome and elevate the problem of labour which is costly. Special consideration should be given to smallscale rice farmers in order to encourage them to upgrade and involve in large scale rice production to be able to fill the high demand and supply gap of rice in the Nigeria.

(iii) Policies that will reduce the cost of production of smallscale rice farmers should be implemented. Costly productive inputs and chemical and other farm inputs should be subsidized and made readily available.

(iv) The education of farmers should be given serious priority, training should be organised through extension agents in order for them to know the guidelines involved in accessing loans and monitoring team should be set up for proper accountability.

More farmers should also be encouraged to join cooperative organisations because aid their accessibility to loan disbursement, since government and non-governmental organisation prefer to deal with organised groups of farmers than individuals

(v) The cumbersome administrative procedures involved in accessing loan which serve as a bottle neck in accessing loan by farmers should be addressed. Government should make provisions for special agricultural microfinance banks that will be located in rural areas to meet the need of farmers' loan demand. This equally necessitate the development of rural areas as banks will not be able to function well where basic amenities are lacking.

REFERENCES

Adegbite D. A,, Momoh S. & Alade A. 2007. Determinants of Savings Mobilization in Ogun State, Nigeria. *Journal of Sustainable Development;* 4 (1 & 2), Pp. 43 –48

Ajah E. A,, Igiri J. A. & Ekpenyong B. 2017. Determinants of Access to Credit Among Rice Farmers in Biase local Government Area of Cross River State, *Nigeria Global Journal of Agricultural Sciences,* vol. 16, 2017: 43-51

Akpokodje G,, Lançon F. & Erenstein O. 2001. Nigeria's Rice Economy: State of the Art in NISER/WARDA Nigerian Rice Economy Stakeholders Workshop, Ibadan, 8-9.

Alabi O. O,, Oladele A. O. & Oladele N. O. 2020a. Economic Market Decisions Among Marginal Maize Farmers in Abuja, Nigeria: Applications of Double Hurdle Model and Factor Analysis *Russian Journal of Agricultural Sciences,* 8(104), August 2020 114 doi:10.18551/rjoas.2020-08.14

Alabi O. O,, Oladele A. O. & Oladele N. O. 2020b. socio-economic Factors Influencing Perceptions and Adaptability of Rural Rice Farmers to Climate change, Abuja, Nigeria: Applications of Heckman two-Stage Model. *Russian Journal of Agricultural Sciences*, 8(104), August 2020 45, doi:10.18551/rjoas.2020- 08.06

Alabi O. O,, Oladele A. O. & Usman M. B. 2021. Determinants of Agricultural Loan Decision Making Process for Rice (Oryza Sativa) Farmers in Abuja, Nigeria. Applications of Heckman Two-Stage Model and Factor Analysis, *Journal of Agribusiness and Rural Development* 1(59) 2021, 29–38

Ameh M. & Iheanancho A. C. 2017. Socio-Economic Factors Influencing Agricultural Loan Acquisition Among Small-Scale Rice Farmers in Benue State, Nigeria. *International Journal of Innovative Agriculture & Biology Research* 5(4):8-17, Oct.-Dec., 2017

Asogwa B.C,, Abu O. & Ochoche G.E. 2014. Analysis of Peasant Farmers' Access to Agricultural Credit in Benue State, Nigeria. *European Journal of Economics, Management & Trade*, 4(10): 1525-1543.

Balogun O. 2006. The Federal Capital Territory of Nigeria: A Geography of Its Development University of Ibadan press Limited.

Ben-chendo G.N,, Lawal N. & Osuji M.N. 2017. Cost and Returns Paddy Rice Production in Kaduna State. *European Journal of Agriculture and Forestry Research* 5(3):41-48

EFLnA (Enhancing Financial Innovation and Access)., 2008. Access to financial services in Nigeria: Ileyfridingi

FAO 2001. Food and Agricultural Organization. "Workshop on Policy Support for Rapid Adoption of Hybrid Rice on Large Scale Production in Asia" Hanoi; Vietnam, final Report.:10

International Food Policy Research Institute 2008. *Agricultural Public Spending in Nigeria*, evelopment Strategy and Governance Division.IFPRI Discussion paper 00789. September

Kagan J. 2019. Banking: Loan Basics. Investopedia.www.investopedia.com/terms/l/loan.asp

Kuye O. O. & Ogiri Oyom M. 2019. Analysis of Factors Influencing Access to Formal Loan Among Small- scale Swamp Rice Farmers in Obubra Local Government Area, Cross River State, Nigeria. *International Journal of Agricultural Economics*. Vol. 4, No. 6). 307-313.

Kuye O. O. & Ogiri O. M. 2019. Analysis of Factors Influencing Access to Formal Loan Among Small-Scale Swamp Rice Farmers in Obubra Local Government Area, Cross River State, Nigeria. *International Journal of Agricultural Economics*. Vol. 4, No. 6, 2019, pp. 307-313. doi:10.11648/j.ijae.20190406.19

Maurice C,, Adamu Y. & Joseph M. 2015. Analysis of Cost Efficiency in Food Crop Production Among Small-Scale Farmers in Adamawa State, Nigeria. *Global Journal of Agricultural Science*s Vol. 14, 2015: 17-25

NPC 2006. National Population Commission of Nigeria, Sample Survey.

Obisesan A. 2013. Credit Accessibility and Poverty among small holder cassava farming households in south west Nigeria, Greener Journal of Agricultural Science. 3(2): 120–127.

Odoemenem I. U. & Obinne C. P. O. 2010. Accessing the Factor Influencing the utilization of Improved cereal crop production technologies by small farmers in Nigeria.

Odoemenem U. I. & Inakwu J. A. 2011. Economic analysis of rice production in Cross River State. *Journal*

Eurasian Journal of Agricultural Research 2022; Vol: 6, Issue: 1, pp:34-42

Identification of Agronomic Crops Grown in the Locality of Hinunangan, Southern Leyte, Philippines

Kassandra Natdem C. ISAAC[1], Ulysses A. CAGASAN[1*]

1Department of Agronomy, College of Agriculture and Food Science
Visayas State University, Visca, Baybay City, Leyte, Philippines
[*]Corresponding Author: ulycagasan@vsu.edu.ph

Abstract

This study was conducted to: (1) identify and describe some of the existing agronomic crops planted in the locality of Barangay Manalog and Bangcas, in Hinunangan, Southern Leyte, Philippines, (2) determine the cropping systems adopted by the farmers in their farms; and (3) determine the crops that grown for commercial purposes in the Barangay Manalog and Bangcas, in Hinunangan, Southern Leyte. Data were gathered through a series of documentation using a pen, bond paper, camera, and additional data were taken from the office of the Department of Agriculture in the Municipality of Hinunangan, Southern Leyte. The data gathered were supported by the Department of Agriculture (DA) files. The survey revealed only three crops grown under lowland conditions—likewise, 15 upland agronomic crops grown primarily annually. Among the crops identified, only rice, corn, cassava, coconut, and pineapple were commercially produced in Barangay Manalog and Bangcas. With rice having the largest production area using mono-cropping practices and intercropping for upland crops, both perennial and annual crops.

Keywords: Agronomic crops, commercial and subsistence, lowland and upland production

Research article
Received Date: 20 June 2021
Accepted Date: 9 September 2021

INTRODUCTION

Crop identification helps assess many important variables critical to proper management (Noble Research Institute, 2001). It allows farmers and agronomists to differentiate unwanted plants or weeds having similar appearance and growing in the same field from the crops [e.g., rice and *Echinochloa* weeds are morphologically similar but can be differentiated through the ligule and auricle structure of rice (FAO, 2021)]. Crops have different growth habits, growth requirements, growing season, adaptability, and management practices. Still, they can be classified or grouped based on: taxonomic classification (e.g., pulses belong to the Papilionoideae subfamily), range of cultivation (i.e., plantation crops), place of origin or distribution (i.e., temperate crops), commercial classification, and economic classification, among others (Singh, 2018). Thus, it is essential to identify and classify crops to know their uses and how to manipulate them (Noble Research Institute, 2001). The two Barangays Manalog and Bangcas, in Hinunangan, Southern Leyte was identified to be surveyed since this is one of the areas identified by the Department of Agriculture that produced crops sold in the market of Hinunangan. Southern Leyte.

This study aimed to identify and describe some of the existing agronomic crops planted in the locality of Barangay Manalog and Bangcas, determine the cropping systems adopted by the farmers, determine the crops that grown for commercial purposes in the Barangay Manalog and Bangcas, in Hinunangan, Southern Leyte, Philippines.

MATERIALS AND METHODS

A survey on agronomic crops was conducted at Hinunangan, Southern Leyte, on June 5-20, 2021. Two barangays (Manalog and Bangcas) were surveyed and documented as part of the study site. The typical lowland and upland crops in the areas visited were taken and documented. Documentation of some of the crops was done with the use of the camera. Data were gathered using a pen and bond paper, and additional data were taken from the office of the Department of Agriculture in the Municipality of Hinunangan, Southern Leyte, Philippines.

RESULTS AND DISCUSSION

The results of the survey are presented in Table 1-3 and Figure 1-8. The study found that rice, corn, and cassava are among the crops grown for commercial purposes. The other crops like peanut, sweetpotato, eggplant, mungbean, string bean, and winged bean were grown for subsistence type of production. They are only grown for a small area.

Table 1. Common lowland agronomic crops grown Barangay Manalog and Bangcas, in Hinunangan, Southern Leyte

Common Name	**Scientific Name**	**Type of Production**	**Family Name**	**Primary use in the locality**	**Primary Use Internationally**	**Life Span**
Rice	*Oryza sativa* L.	Commercial	Poaceae/ Gramineae	Staple food and some used for the production of products such as suman, puto, and bebingka	Staple food. Used for the manufacture of flour, starch, and oil (CABI, 2019)	3-5 months
Gabi	*Colocasia esculenta*	Subsistence	Araceae	As food and vegetables and by-product for sagmani and budbud	primarily for its edible corms, a root vegetable most commonly known as taro	7-10 months
Kangkong	*Ipomoea Aquatica*	Subsistence	Convolvulaceae	Vegetable and feed to animal pigs	Vegetable	2-10 Months

Table 2. Upland agronomic crops grown in Barangay Manalog and Bangcas, in Hinunangan, Southern Leyte

Common Name	**Scientific Name**	**Type of production**	**Family name**	**Primary use in the locality**	**Primary Use**	**Life Span**
Coconut	*Cocos nucifera*	Commercial	Arecaceae	Commercially sold 'buko' to interested buyers, processed to copra.	Used for food (can be eaten fresh), copra production (for oil), and manufacture of ropes, mats, baskets, brushes, brooms, etc. (Brittanica, 2019).	60-80 years
Pineapple	*Ananas comosus*	Commercial	Bromeliaceae	Snacks items sold to interested clients	Fruit is edible and can be eaten raw or used as an ingredient in Pan-Asian cuisine and pastry (Britannica, Pineapple, 2020).	Commercial pineapples take 32-46 months (Grant, 2021).
Banana	*Musa* sp.	Subsistence	Musaceae	Cooked banana, other sold to the market	Fruit is widely consumed in the tropics, eaten fresh or cooked—an excellent source of dietary fiber and potassium (Britannica, 2020).	6-10 years
Corn	*Zea mays* L.	Commercial	Poaceae/Gramineae	For grains as food to human and animals	Used for food as cereal, flour/starch, oil/fat, vegetable (CABI, 2019)	3-4 months
Cassava	*Manihot esculenta* L.	Subsistence	Euphorbiaceae	Sold to interested clients, sold for chips, and proceed to starch by the commercial buyers	They are used for food as a primary carbohydrate source, used for animal feed, and industrial purposes like starch production (Waisundara, 2018).	6-7 months for fast-growing cultivars (Alves, 2002).
Peanut	*Arachis hypogaea* L.	Subsistence	Fabaceae	Processing into peanut butter by the commercial buyers	Good source of protein, fiber, magnesium, and phosphorus. Raw material for the manufacture of oil and bakery	3-4 months

					products (The Peanut Plant, n.d.).	
Sweetpotato	*Ipomoea batatas* Lam	Subsistence	Convolvulaceae	For food and processing, some are utilized for vegetables and animal feeds.	Vines and foliage can be used as animal feed, fodder, or forage, and human food (vegetable). Tubers are used as a staple food and for the manufacture of flour/ starch (CABI, 2019).	3-6 months
Eggplant	*Solanum melongena*	Subsistence	Solanaceae	For vegetables	Used in cuisine. Good source of fiber, folic acid, potassium, etc. (Perry, n.d.)	70-120 days
Mungbean	*Vigna radiata* L.	Subsistence	Fabaceae	For vegetables	They were used for food as a source of protein and vitamins—an excellent alternative to meat.	70 days
String bean	*Phaseolus vulgaris*	Subsistence	Fabaceae	For Vegetables	Used for food: pods are edible and cooked in many vegetable dishes. The primary source of protein and starch, and small amounts of carbohydrates, sugar, fiber, and fat.	50-70 days
Winged bean	*Psophocarpus tetragonolobus*	Subsistence	Fabaceae	For vegetables	Used for food: leaves, pods, flowers, and roots are edible. It is a good source of carbohydrates and dietary fiber.	70 days

Bitter gourd	*Momordica charantia*	Subsistence	Cucurbitaceae	For vegetables	Important vegetable crop with medicinal value, particularly anti-diabetic properties. Suitable for weight loss and cholesterol control.	110-130 days

Figure 1. Lowland rice in Manalog, Hinunangan, Southern Leyte

Figure 2. Sweet potato, cassava, and winged bean are grown in a backyard in Bangcas A, Hinunangan, Southern Leyte

Figure 3. Coconut in Bangcas A, Hinunangan, Southern Leyte

Figure 4 showed some intercropping systems adopted by the farmers Manalog, Hinunangan, Southern Leyte for perennial crops. Some farmers also intercropped rootcrops from corn and other agronomic crops.

Figure 4. Pineapple plants are grown under the perennial trees in Manalog, Hinunangan, So. Leyte

Figure 5 shows that vegetables like string beans, mungbean, bitter gourd, and eggplant are commonly sold in the market. These crops are grown in backyards and for family consumption only, but the surplus was sold to the middlemen and brought to the public market. The most significant commercial production in terms of area is rice since Hinunangan has vast plain lands and is known as the rice granary of Southern Leyte.

Figure 5. Some vegetables sold in Hinunangan public market

CONCLUSION

The common crops surveyed and identified had different growth habits ranging from herbs, shrubs, climbers, creepers, and trees. In upland conditions, the agronomic crops are mixed with annuals and perennials. On the other hand, in lowland conditions, all the crops grown were annuals. Among the crops grown, only rice, corn, coconut, cassava, and pineapple were commercially produced for the commercial market, with rice having the most significant area for production. The farmers adopted a mono-cropping system in lowland conditions, particularly rice and intercropping for upland conditions using perennial and annual crops.

REFERENCES

Allaire H. & Brady T. 2008. *Classification and Botanical Description of Legumes.* Hamilton College, New York City. Retrieved from https://academics.hamilton.edu/foodforthought/our_research_files/beans_peas.pdf

Alves A. C. 2002. Chapter 5: Cassava Botany and Physiology.

Bañoc D. M, Alcober E. L. & Escasinas R. O. 2020. Agro 122: Farming Systems (Learning guide). Baybay City, Leyte, Philippines: Visayas State University.

Bautista E. U. & Javier E. F. 2005. The Evolution of Rice Production Practices. *Philippines Institute for Development Studies (PIDS) Discussion Paper Series No. 2005-14.*

Beets W. C. 1982. *Multiple Cropping and Tropical Farming Systems.* Grower Pub. Co. Ltd.

Briones N. D. 2005. Environmental Sustainability Issues in Philippine Agriculture. *Asian Journal of Agriculture and Development, 2*(1-2).

Britannica T. E. 2020. *Banana*. Retrieved from Brittanica: https://www.britannica.com/plant/banana-plant

Britannica T. E. 2020. *Pineapple*. Retrieved from Brittanica: https://www.britannica.com/plant/pineapple

Brittanica T. E. 2019. *Coconut*. Retrieved from Britannica: https://www.britannica.com/plant/coconut

CABI 2014. Retrieved from CABI Invasive Species Compendium: https://www.cabi.org/isc/datasheet/10728

CABI 2019. *Ipomoea batatas (sweet potato)*. Retrieved from Invasive Species Compendium: https://www.cabi.org/isc/datasheet/28783

CABI 2019. *Oryza sativa (rice)*. Retrieved from Invasive Species Compendium: https://www.cabi.org/isc/datasheet/37964

CABI 2019. *Zea mays (maize)*. Retrieved from Invasive Species Compendium: https://www.cabi.org/isc/datasheet/57417

De Guzman L. P., Zamora O. B. & Bernardo D. H. 2015. Diversified and Integrated Farming Systems (DIFS): Philippine Experiences for Improved Livelihood and Nutrition. *Journal of Developments in Sustainable Agriculture, 10*(1), 19-33. doi:10.11178/jdsa.10.19

Dela Cruz R. T. 2004. *Madre de cacao and ipil-ipil: Cheap feast for hungry sheep*. Retrieved from BAR Research and Development DIGEST: https://www.bar.gov.ph/index.php/digest-home/digest-archives/83-2004-1st-quarter/3179-jan-mar04-madre-de-cacao-and-ipil-ipil

FAO 2021. *E*chinochloa crus-Galli (L.) Beauv. Retrieved from Food and Agriculture Organization of the United Nations: http://www.fao.org/agriculture/crops/thematic-sitemap/theme/biodiversity/weeds/listweeds/ech-cru/en/

Filipino Herbs Healing Wonders 2009. Retrieved from Healing Wonders of Philippine Medicinal Plants: A Guide to The Use of Philippine Medicinal Plants as an Alternative Medicine: http://www.filipinoherbshealingwonders.filipinovegetarianrecipe.com/kakawate.htm

Gomez S. M. & Kalamani A. 2003. Butterfly Pea (Clitoria ternatea): A Nutritive Multipurpose Forage Legume. *Pakistan Journal of Nutrition, 2*(6), 374-379.

Grant A. 2021. *Pineapple Plant Fruiting: Do Pineapple Plants Fruit More Than Once*. Retrieved from Gardening Know How: https://www.gardeningknowhow.com/edible/fruits/pineapples/pineapple-plant-fruiting.htm

IRRI 1992. *Soil and water conservation (SWC) technologies and agroforestry systems.*

Isely D. & Berry P. 2021. *Classification Of Fabaceae*. Retrieved from Britannica: https://www.britannica.com/plant/Fabales/Classification-of-Fabaceae

Milan P. P. 2012. *Greening with native trees.* Inquirer.

Noble Research Institute 2001. Plant Identification: Is It Worth the Effort? Retrieved from https://www.noble.org/news/publications/ag-news-and-views/2001/may/plant-identification-is-it-worth-the-effort/

Perry L. (n.d.). *The Many Uses of Eggplant*. Retrieved from University of Vermont Extension Department of Plant and Soil Science: https://pss.uvm.edu/ppp/articles/eggplant.html

PROSEA 2018. *Pterocarpus indicus Willd.* Retrieved from https://uses.plantnet-project.org/en/Pterocarpus_indicus_(PROSEA)

Sarkar S., Aziz F. B., Hasan M. & Islam R. 2018. Effect of Ipil Ipil and Bean Leaves Supplementation on Egg Production, Egg Quality and Growth Performance of Japanese Quail (Coturnix Japonica). *Asian Journal of Medical and Biological Research, 4*(2), 201-206. doi:10.3329/ajmbr.v4i2.38256

Simons A. J. & Stewart J. L 2007. *FAO.* Retrieved from Gliricidia sepium - A Multipurpose Forage Tree Legume: https://betuco-wp.be/Agroforestry/Tree/Gliricidia%20sepium%20-%20%20Multipurpose%20Forage%20Tree%20Legume%20FAO.pdf

Singh A. 2018. Classification of Crops. Retrieved from https://www.slideshare.net/AnkushSingh48/classification-of-crops-106024774

Stagnari F, Maggio A, Galieni A. & Pisante M. 2017. Multiple benefits of legumes for agriculture sustainability: an overview. *Chemical and Biological Technologies in Agriculture, 4*(2), 1-13. doi:10.1186/s40538-016-0085-1

Stuart Jr. G. U. 2019. Retrieved from Philippine Medicinal Plants: stuartxchange.org/Bataw

Stuart Jr. G. U. 2019. *Philippine Medicinal Plants*. Retrieved from http://www.stuartxchange.org/Acacia.html

The Peanut Plant. (n.d.). Retrieved from http://bpi.da.gov.ph/bpi/images/Production_guide/pdf/PEANUT.pdf

VN M. D., VN A. & Prasad N. P. 2013. Nutritional Value and Potential Uses of Leucaena Leucocephala as Biofuel – A Mini-Review. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences, 4*(1), 515-521.

Waisundara V. Y. 2018. Introductory Chapter: Cassava as a Staple Food. In V. Y. Waisundara, *Cassava* (pp. 3-10). Intech. doi:10.5772/intechopen.70324

Yusuf A. A., Mofio B. M. & Ahmed A. B. 2007. Nutrient Contents of Pride of Barbados (Caesalpinia pulcherrima Linn.) Seeds. *Pakistan Journal of Nutrition*, *6*(2), 117-121. doi:10.3923/pjn.2007.117.121

https://byjus.com/biology/plants/

Eurasian Journal of Agricultural Research 2022; Vol:6, Issue:1, pp:43-51

Assessment and Classification with GIS of Land Use, Capability Classes and Land Types in Kayseri Province of Turkey

M. Cüneyt BAĞDATLI[1*], Yiğitcan BALLI[2]

[1]Nevsehir Hacı Bektas Veli University, Engineering and Architecture Faculty, Department of Biosystem Engineering, Nevsehir, Turkey

[2]Graduated from MSc Programme from Nevsehir Haci Bektas Veli University, Institute of Science, Department of Environmental Engineering, Nevsehir, Turkey

[*]Corresponding author: cuneytbagdatli@gmail.com

ORCID: 0000-0003-0276-4437[1]

Abstract

This study was carried out to determine land use capability, current land use and subclasses, land types in Kayseri province of Tukey. Arc GIS 10.3.1 program from Geographical Information Systems software was used in classification processes. For spatial analysis, 1/25.000 scaled digital soil maps were used as digital base maps. As a result of classification; The highest land class in Kayseri is VI. class land and its total area is calculated as 9210.79 km^2. Considering the current land use, it is dry marginal agricultural areas with the highest surface area and its total area is 4850.69 km^2. The lowest surface area is the area covered by the vineyards, which is 102.91 km^2. The areas exposed to slope and erosion damage due to soil insufficiency cover an area of 10525.67 km^2. The areas with soil insufficiency with flood damage were seen in an area of 93.32 km^2. The areas with bare rocks and debris are 16789.13 km^2. The areas with river floodplains, reed marshes and coastal dunes with the lowest surface area were observed in an area of 21.76 km^2. As a result of the study, digital base maps were created showing the land use capabilities, current land use, land use capability subclasses and land types of Kayseri province.

Keywords: GIS, Spatial Assessment, Land Use, Kayseri Province, Turkey

Research article
Received Date: 08 May 2022
Accepted Date: 1 June 2022

1.INTRODUCTION

Agricultural lands, the formation of which took thousands of years, is the only resource that cannot be produced and is almost impossible to renew. For the development of countries and raising the living standards of people, there is an obligation to use and manage agricultural lands in a sustainable way. Sustainability of soils is possible by examining and monitoring soil resources adequately and defining the characteristics of these areas in the best way (Özyazıcı et al., 2016).

On the other hand, it has become a necessity to know the physical and chemical properties of the soils well and to take the necessary measures according to these properties for the sustainability of our agricultural lands, which are getting narrower and rapidly polluted as a result of industrialization and unplanned urbanization (Taban et al., 2004). In the total area of 510,072,000 km^2 in the world, 148,940,000 km^2 of land is formed, while 361,132,000 km^2 of water is water. Relative to the total area of the Earth, the water area constitutes 70.8%.

Turkey's total surface area is 783,577 km^2, in other words, it is 78 million hectares. When the dam and natural lakes are removed, the remaining area is 769,600 km^2. Mountains cover more than half of Turkey's territory. The remaining part is plain, plateau, rough terrain and flat hills. Turkey's 190,000 km^2 area consists of plains of varying heights, which are covered with alluvial plains. Plateaus cover an area of 80,000 km^2. The sum of the plains and plateaus corresponds to an area of 270,000 km^2, which is 1/3 of the surface area of Turkey. It can be said that there are 370,000 km^2 of plains in Turkey, apart from the mountainous areas, with 100,000 km^2 of rough and flat hills that are relatively easy to cultivate. The total of agricultural lands is 280,000 km^2, that is, around 28 million hectares. Soil resources in Turkey, while the agricultural area is 28.05 million hectares, the irrigable area is 25.75 million hectares. While the dry agricultural area is 7.25 million hectares, the irrigated area is 5.90 million hectares (Anonymous, 2014).

Turkey is not rich enough in terms of soil and water resources. When the data showing the characteristics and distribution of the land capability classes determined according to the interpretations of the soil surveys updated in 1982-1984 are examined; It is seen that the lands that need to be protected constitute approximately one fourth of our country, while the lands suitable for all kinds of agriculture remain only 6.5% (Tomar, 2009). In Turkey, all of the 77 million hectares of country lands suitable for cultivated agriculture have been taken into agricultural use, and even the 5.5 million decares VI. and VII. class lands have been opened for agricultural use (Canpolat, 1981).

The most important problem in the agricultural planning studies carried out to date has been the lack of some national soil data, the lack of updateability or the inability to access the existing data on a regular basis. The European Union, which is in the process of harmonization, has to prepare up-to-date databases that will be integrated into international information systems related to natural resources, especially soil. For this purpose, it is necessary to establish bases and databases of different scales, which will enable the exchange of information on our soil resources at national and international level. With the use of Geographic Information Systems (GIS) and Remote Sensing (UA) techniques; It will also be possible to make quick, accurate and objective decisions in the planning of the management and use activities of agricultural lands (Özyazıcı et al., 2016).

The main function of information systems is to facilitate the decision-making process and to shorten this process (Yomralıoğlu, 2000). Difference of Geography Information Systems from information systems; The system includes location information in addition to the attribute information of different objects (Sağlam et al., 2004).

Geography Information Systems (GIS) is an information system created for collecting, entering, storing, querying, spatial analysis, displaying and outputting spatially based information (graphics and attributes) in computer environment (Aranoff, 1989).

While GIS was developed mostly for computer aided map assembly in the early 1960s, it has turned into a technology that serves different purposes in many fields today (Yomralıoğlu, 2000).

This study includes important information that will shed light on the strategies that can be formed in terms of agricultural areas and soil fertility related to the soil data of Kayseri province. The spatial distribution of land use capabilities, current land use, land use capability subclasses and land types has been revealed in this research, which is based on the province of Kayseri in the Central Anatolian region.

2.MATERIALS and METHODS

The study area, the province of Kayseri, is located in the Middle Kızılırmak section, where the southern part of the Central Anatolian Region and the Taurus Mountains converge. It is located between 37°45' and 38°18' north latitudes and 34°56' and 36°58' east longitudes. It is surrounded by Sivas in the east and northeast, Yozgat in the north, Nevşehir in the west, Niğde in the southwest, Adana and Kahramanmaraş in the south. The area of the province is 17,109 km² (Anonymous, 2018).

Agriculture; In the economy of Kayseri, it comes after industry, trade and transportation sectors. 671,000 hectares of land is used in agriculture. This amount corresponds to 40% of the provincial territory. 13% of the provincial industry is non-agricultural, 6% is meadow-pasture, 41% is forest heathland. 48% of the agricultural land is reserved for grain cultivation and 42% is left fallow. The remainder is devoted to legumes, industrial crops, oilseeds, tubers, vegetables and fruit growing. 150,000 hectares of 607,000 hectares of irrigable land can be irrigated economically. As the irrigation capacity increases, the productivity in irrigated agriculture will increase 5-6 times, and the construction of irrigation projects continues (Anonymous, 2018).

While the province of Kayseri consists of 16 districts, namely Akkışla, Bünyan, Develi, Hacılar, İncesu, Kocasinan, Melikgazi, Pınarbaşı, Sarıoğlan, Sarız, Tomarza, Yahyalı, Talas, Özvatan, Felahiye and Yeşilhisar, there are also 395 villages connected to the province and district (Anonymous, 2018). The location and location of the province of Kayseri, which is the subject of the research, is shown on the map given in Figure 1.

Figure 1. The location of Research Area in Kayseri Province

Arc GIS 10.3.1 program, one of the Geography Information Systems software, was used in order to classify some land use characteristics of Kayseri province. In addition, the basic base data regarding the razi structure of the province of Kayseri were provided with the help of 1/25.000 scaled digital soil maps. (Anonymous, 2000; Anonymous, 2010).

In the study, all classification processes were evaluated according to the "Soil and Land Classification Standards Technical Instruction" published by the Ministry of Agriculture and Rural Affairs in 2005 (Anonymous, 2005). The numerical layers used in spatial analysis of land use are given in Table 1 and the classification process steps are given in Figure 2.

Table 1. Classification layers (Anonymous, 2005).

Land Use Capabilities	
I	Flat surface, deep, fertile and easily cultivable soils
II	Easily processed, moderate erosion, moderately thick soil
III	Moderate terrain, moderate inclination, excess sand
IV	Bad drainage, bad soil characters, too inclined
V	Good soil cover for grazing and tree felling
VI	It is highly prone and subject to severe erosion
VII	Very batter, stoned, dry, some other unfavorable lands
VIII	Highlands, stony lands, very deep cove

Current Land Use
Forest Areas
Water Surfaces
Settlements
Fruit Trees
Meadow and Pasture Areas
Industry and Mining Areas
Prairies
Dry Marginal Agricultural Areas
Dry Absolute Agricultural Areas
Watery Absolute Agricultural Areas
Vineyards
Watery Marginal Farmland
Juicy Special Product

Land Types
Naked Rock and Rubble
River Floodplains Beds
Reeds Marshes
Coastal Dunes
Other

Land Use Capability Subclasses
Slope and erosion damage
Soil Insufficiency
Wetness , Gizzard Disorder

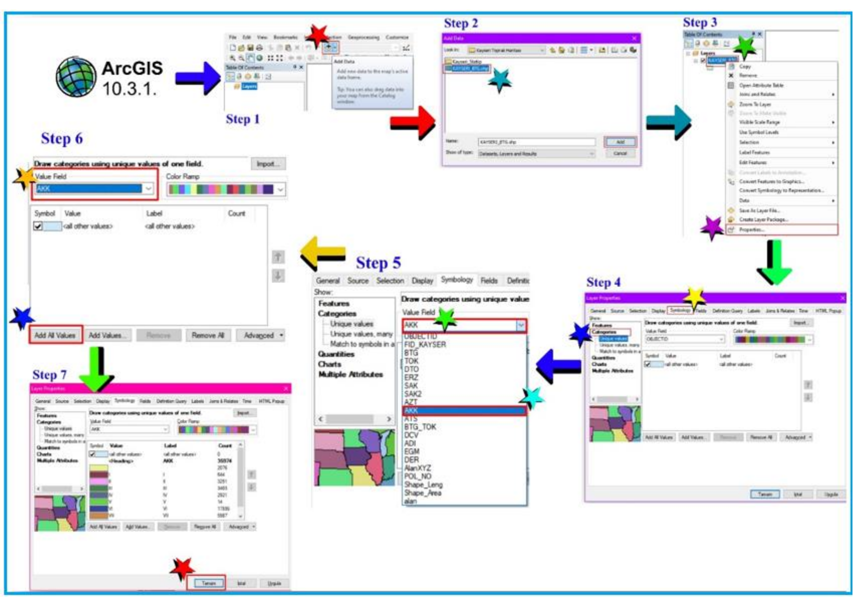

Figure 2. Spatial Analysis Steps in Classification of Land Use Capability

3. RESEARCH FINDINGS

In this research, land use capability classes, existing land uses, land use capability subclasses and land types layers were analyzed by using 1/25.000 scaled digital soil maps of Kayseri province and the results are presented below under headings.

3.1. Spatial Analysis Results of Land Use Capabilities

The distribution of land use capability classes obtained in the spatial analysis results made in the Arc GIS using digital soil maps of Kayseri province is given in Figure 3.

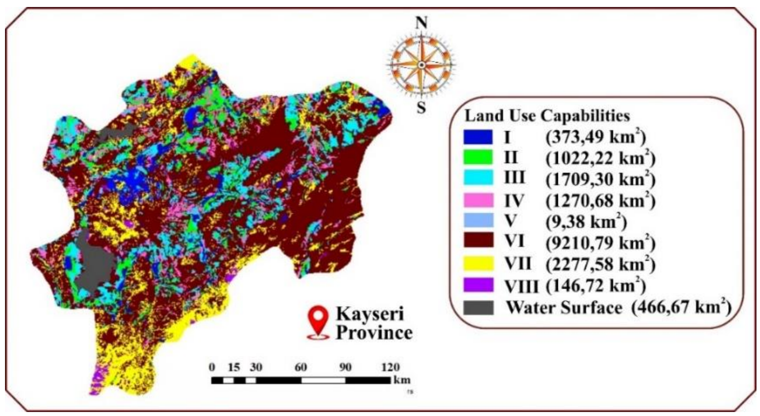

Figure 3. Spatial analysis of land use capability

Class I land in the province of Kayseri is calculated as 373.49 km^2. II. Class land area was determined as 1022.22 km^2 and the area covered by water surfaces throughout the province was determined as 466.67 km^2. VI. Class land covers the largest area and its total area is calculated as 9210.79 km^2.

3.2. Spatial Analysis Results of Current Land Use

The spatial distribution of land use in the results of spatial analysis using digital soil maps of Kayseri province is shown in Figure 4.

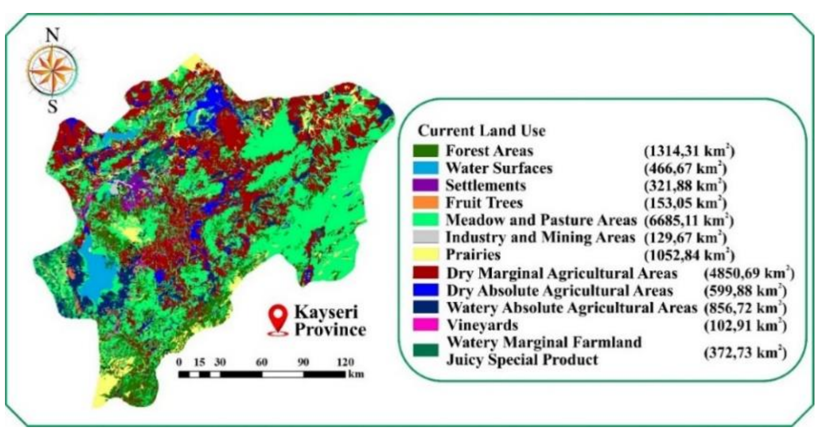

Figure 4. Spatial Analysis of Current Land Use

The surface area covered by forest areas in Kayseri is 1314.31 km^2. Settlements are 321.88 km^2, Fruit trees are 153.05 km^2 Meadows and pasture areas cover an area of 6685.11 km^2. The surface area of industry and mining areas is 129.67 km^2. Steppe areas are 1052.84 km^2, dry marginal agricultural areas are 4850.69 km^2, dry absolute agricultural areas are 599.88 km^2, and irrigated absolute agricultural areas are 856.72 km^2. The surface area of the vineyards has been calculated as 102.91 km^2 and the irrigated marginal agricultural areas and irrigated special crop areas as 372.73 km^2.

3.3. Spatial Analysis Results of the Land Use Capability Subclass

The spatial analysis distributions of the land use capability subclasses obtained in the spatial analysis results using 1/25.000 scaled digital soil maps are shown in Figure 5.

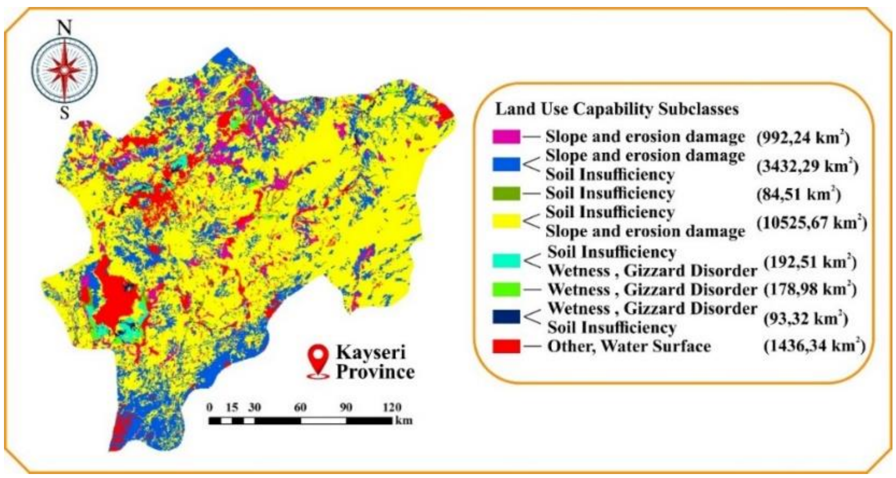

Figure 5. Spatial Analysis of Land Use Capability Subclasses

The areas with slope and erosion damage were determined as 992.24 km^2, the areas with soil deficiency with slope and erosion damage were determined as 3432.29 km^2, and the areas with soil failure were determined as 84.51 km^2. The surface area of the slope and erosion damage class with soil insufficiency is 10525.67 km^2. With soil insufficiency, the surface area of wetness, drainage disorder or flood damage class is 192.51 km^2. The surface area of the flood damage class is 178.98 km^2, and the surface area of the flood damage class is 93.32 km^2. The surface area of other and water surfaces is 1436.34 km^2.

3.4. Spatial Analysis Results of Land Types

The distribution of land types obtained from the spatial analysis results of Kayseri province is shown in Figure 6.

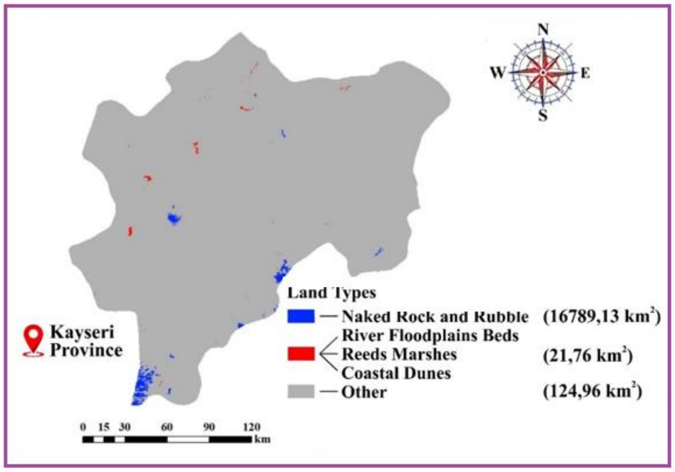

Figure 6. Spatial Analysis of Land Types

When Kayseri province examines the geographical-spatial analysis of land types, the areas with bare rocks and debris are 16789.13 km^2. The surface area of the class, which has river floodplains, reed marshes and coastal dunes, is 21.76 km^2.

CONCLUSION and RECOMMENDATIONS

In this study, analyzes of land use and land types of Kayseri province were carried out. In the analyzes made, the land uses, land use tribes subclasses and land types and existing land uses of the province of Kayseri were spatially analyzed. As a result of the study, a database on land uses was created in the GIS. The schematic view of the created database is shown in Figure 7.

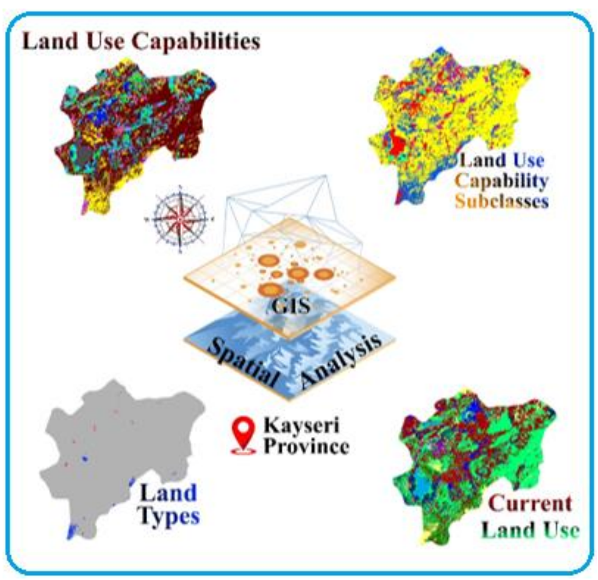

Figure 7. Kayseri Province Land use and land types database

The lowest surface area of land use capability of the province of Kayseri, Class V land area was seen as 9.38 km^2. The highest VI. class land area is calculated as 9210.79 km^2. Considering the current land use, the surface area of dry marginal agricultural areas with the highest surface area is 4850.69 km^2. The lowest surface area is the vineyards and the surface area is 102.91 km^2.

The area with the highest surface area according to the subclass of land use capability is the areas exposed to soil failure, slope and erosion damage. The lowest surface area is the soil failure class with flood damage and its surface area is 93.32 km^2.

The areas with bare rocks and debris cover an area of 16789.13 km^2. The surface area of the class, which has the lowest surface area, river floodplains, reed marshes and coastal dunes, is 21.76 km^2.

This and similar studies are frequently encountered in the literature. For example, studies have been carried out in the provinces of Niğde, Nevşehir, Kırşehir and Kayseri to evaluate the land and soil characteristics in the GIS environment. In the aforementioned studies, 1/25.000 scale digital soil maps were used and Arc GIS program, which is one of the Geography Information Systems software, was used effectively in these studies. (Bağdatlı and Arslan, 2020; Bağdatlı and Can, 2021a; Bağdatlı and Arslan, 2021; Bağdatlı and Ballı, 2021; Bağdatlı and Can; 2021b; Bağdatlı and Arıkan, 2021; Bağdatlı and Öztekin, 2021).

As a result of this research, a database of land use in Kayseri province was created. It will be inevitable that the results obtained will make important contributions to the investor organizations that are or will display agricultural activities in the region.

REFERENCES

Anonymous 2000. Sayısal Toprak Haritaları, Mülga Köy Hizmetleri Genel Müdürlüğü, Ankara (in Turkish)

Anonymous 2010. Arc GIS 10.3.1 software, ESRI Environmental System Research Institute, Redland, CA, USA

Anonymous 2005. Toprak ve Arazi Sınıflaması Standartları Teknik Talimatı, https://www.mevzuat.gov.tr/MevzuatMetin/1.5.5403.pdf (Access Date: 16.04.2020) (in Turkish)

Anonymous 2014. Türkiye Toprak Su Kaynakları, http://www.dsi.gov.tr/toprak-ve-su-kaynaklari, Erişim Tarihi (08.04.2020) (in Turkish)

Anonymous 2018. Kayseri İli Hakkında, ,https://kayseri.csb.gov.tr/ilimiz-hakkinda-i-768 Erişim Tarihi (11.04.2020) (in Turkish)

Aranoff S. 1989. Geographical Information Systems: A Management Perspective", WDL Publications, Ottawa, Canada.

Bağdatlı M. C. & Arslan O. 2020. GIS Mapping of Large Soil Groups, Current Land Use, Soil Depths and Slopes, Soil Erosian in Kırsehir Province of Turkey, *World Research Journal of Agricultural Science (WRJAS)*, 8(1):265-277

Bağdatlı M.C. & Can E. 2021a. Spatial Evaluation of Land and Soil Properties in the Example of Nevşehir Province, Turkey, *International Journal of Engineering Technologies and Management Research (IJETMR), 8(7):90-103*, doi:10.29121/ijetmr.v8.i7.2021.1007

Bağdatlı M.C. & Arslan O. 2021. Classification and Mapping of Land Use and Some Soil Properties in Kırşehir Province, Turkey, *International Journal of Engineering Technologies and Management Research (IJETMR), 8(8):81-93*, doi: 10.29121/ijetmr.v8.i8.2021.1022

Bağdatlı M.C. & Ballı Y. 2021. GIS Mapping of Land Slopes, Soil Depths, Erosian Classes, Large Soil Groups and Some Soil Properties: A Case Study of Kayseri Province in Turkey, *Universal Journal of Agricultural Research, 9(5):166-175,* doi:10.13189/ujar.2021.090503

Bağdatlı M.C. & Can E. 2021b. Spatial Analysis of Soil Resources Potential by Using Geography Information Systems (GIS): A Case Study from Thrace Region, Turkey, *International Journal of Innovative Research and Reviews (INJIRR),* 5(2): 45-50

Bağdatlı M.C. & Arıkan E.N. 2021. Assessment of Some Land Properties by Using GIS in Niğde Province of Turkey, *International Journal of Recent Development in Engineering and Technology (IJRDET),* 10(11):1-9

Bağdatlı M.C. & Öztekin M. E. 2021. Determination of Land Use Capabilities by GIS Analysis in Nigde Province, Turkey, *Eurasian Journal of Agricultural Research (EJAR), 5(2):121-129,* ISSN: 2636-8226

Canpolat O. 1981. Türkiye Topraklarının Tarımsal Kullanıma Uygunluk Bakımından İncelenmesi. *DSİ Toprak ve Su Kaynaklarının Geliştirilmesi Konferansı Bildirileri,* Cilt 1, s. 326-336, Ankara. (in Turkish)

Sağlam A., Düzgün H.S.B. & Usul N. 2004. Çanakkale Savaşlarına Farklı Bir Yaklaşım: Coğrafi Bilgi Sistemlerinde Gelibolu 1915, Çanakkale Araştırmaları Türk Yıllığı - The Turkish Yearbook of Gallipoli Studies, Çanakkale Onsekiz Mart Üniversitesi Atatürk ve Çanakkale Savaşları Araştırma Merkezi, Sayı 2, Sayfa:117-133, Çanakkale (in Turkish)

Özyazıcı M.E., Dengiz O., Aydoğan M., Bayraklı B., Kesim E., Urla Ö. ,Yıldız H. & Ünal E. 2016. Orta ve Doğu Karadeniz Bölgesi Tarım Topraklarının Temel Verimlilik Düzeyleri ve Alansal Dağılımları, *Anadolu Tarım Bilim. Dergisi, s.136-14* (in Turkish)

Taban S., Çıkılı Y., Cebeci F., Taban N. & Sezer S.M. 2004. Taşköprü Yöresinde Sarımsak Tarımı Yapılan Toprakların Verimlilik Durumu ve Potansiyel Beslenme Problemlerinin Ortaya Konulması, *Tarım Bilimleri Dergisi, 10(3): 297-304*. (in Turkish)

Tomar A. 2009. Toprak ve Su Kirliliği ve Su Havzalarının Korunması, *TMMOB İzmir Kent Sempozyumu,* Page 333 – 345 (in Turkish)

Yomralıoğlu T. 2000. Coğrafi Bilgi Sistemleri Temel Kavramlar ve Uygulamalar, *Akademi Kitabevi,* 2. Baskı. (in Turkish)

Eurasian Journal of Agricultural Research 2022; Vol: 6, Issue: 1, pp:52-61

A Review on the Impact of Climate Change on Agriculture Sector: Its Implication to Crop Production and Management

Roel C. LADRERA[1], Ulysses A. CAGASAN[2*]

[1]634 Ang Mo Kio Ave 6 Singapore 560634
[2]Department of Agronomy, Visayas State University,
Visca, Baybay City, Leyte Philippines

[*]Corresponding Author: ulycagasan@vsu.edu.ph

Abstract

CO_2 levels in the atmosphere grow because of global greenhouse gas emissions, causing global temperatures to rise due to the greenhouse effect. Terrestrial temperatures, on the other hand, have risen quicker than those at sea. Due to a shift in the precipitation pattern, more weather extremes are forecast in the coming weeks. Climate change is projected to result in a drop in agricultural productivity. The beneficial effects of increasing CO_2 on plants are most likely to be counterbalanced by higher temperatures and irregular precipitation. Climate change has resulted in a hotter, more humid climate, which has increased the risk of pest infestation. To avoid climate change, climate-resilient technology that is both technically sound and financially viable must be developed in an interdisciplinary manner.

Keywords: Climate change, pest infestations, temperature, greenhouse effect

Research article
Received Date: 11 February 2022
Accepted Date: 30 May 2022

INTRODUCTION

One of the primary sources of climate change and the greenhouse effect is agriculture, which releases a lot of greenhouse gases. Climate change, on the other hand, has a major impact on agricultural production, putting food security in jeopardy. People should always be able to access enough, safe, and healthy food to suit their dietary needs and food choices, according to the World Food Programme (FAO, 1996). At present moment, the biggest danger to food security is a food shortage. Even though there is enough food to feed the existing population, more than 10% of the world's population is malnourished. Climate change is predicted to exacerbate food insecurity by rising food prices and reducing production. As a result of climate change mitigation initiatives, food may become more expensive. Drought and increased agricultural water demand are placing strain on a limited supply of water needed for food production. In areas where the climate is unfavorable for agriculture, competition for land may grow. As a result of extreme weather events linked to climate change, this might lead to a rise in agricultural prices. Heatwaves, for example, caused productivity losses in key producing areas such as Russia, Ukraine, and Kazakhstan in the summer of 2010, resulting in a significant increase in the price of essential products. As a result of rising costs, an increasing number of households have fallen into poverty, demonstrating how climate change can lead to food insecurity.

According to the Intergovernmental Panel on Climate Change (IPCC), global mean surface air temperature rose by 0.4 to 2.6 degrees Celsius in the second half of this century (depending on future greenhouse gas emissions). Agriculture, like the food processing industry, is already a major contributor to greenhouse gas emissions.

Agricultural intensification to compensate for declining productivity (partially due to climate change) and growing demand for animal products may result in even higher emissions in the future. Between 2005 and 2050, the worldwide market for animal products is expected to rise by 70%. Long-term increases in temperature and carbon dioxide may boost agricultural output, but extreme weather events, such as intense heat and drought during crop flowering, may limit these advantages. In the next century, climate change is expected to have a detrimental influence on food harvests in numerous parts of the world. Figure 1.1 shows an increasing trend toward widespread yield losses by combining average crop production estimates for all emission scenarios, locations, and with or without farmer adaptation. Climate change is anticipated to increase the frequency and severity of heatwaves (extended periods of high heat), which pose a danger to agriculture. Animals and plants may suffer from heat exhaustion and food production may suffer because of heatwaves. When the plants are in bloom, extreme temperatures can have a devastating effect on agricultural production; if this key phase is disrupted, the plants may not produce any seeds at all. As a result of heat exhaustion, animals are unable to perform at their best and are more vulnerable to disease. Because of global warming, heat waves have become more frequent and bigger.

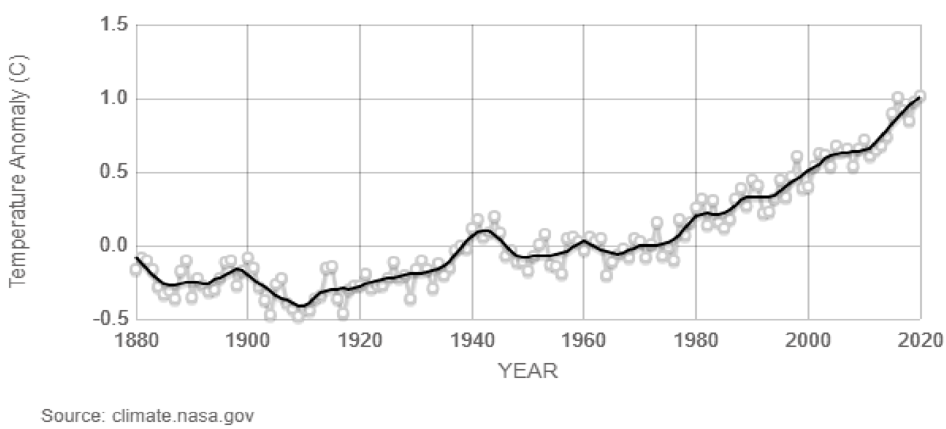

Figure 1. Trends toward widespread yield losses by combining average crop production estimates for all emissions (1880-2020)

The UK, Europe, and the rest of the globe may expect an increase in the frequency and severity of heatwaves. Underdeveloped countries are more likely to be affected by heat waves than their more developed counterparts. Droughts may become more frequent because of climate change, which may exacerbate present food security issues. Temperature, heat waves, and rainfall patterns are projected to vary because of climate change. Some areas may see a resurgence of drought, while others may see an increase in the frequency of heavy rainfall and flooding. The loss of all coastal agricultural land might be the result of rising sea levels. Insect dispersal patterns can shift with rising temperatures.

Insects, such as those that carry diseases, may be able to move north. Experiments with numerous crops have revealed that crop yields respond to environmental conditions.

We can better prepare for climate change by tracking reactions and identifying vulnerable agriculture sectors. Crop cultivars, planting dates, cultivating practices, and irrigation systems may all be adapted to climate change. In the face of climate change, scientists are researching food preservation. There are answers to the problems of climate change and extreme weather. Part of this endeavor involves reintroducing farm type, crop, or cultivar size diversity. Preparing for food shortages can also help prevent price shocks that restrict people's access to food.

The Goal of the Article

The project's primary goal is to provide a full understanding of climate effects as well as a development framework that lays out norms and standards for more effective and comprehensive crop production by identifying factors that influence crop output. In addition, the framework for implementing enhancements will be outlined.

DISCUSSION

Climate Change and Agriculture

Agriculture is the most vulnerable industry to climate change because of its size and how sensitive it is to changes in the weather. Temperature and rainfall changes have a big impact on how much food can be grown. Temperature, precipitation, and CO_2 fertilization all have different effects on different crops, places, and things that change. Warmer temperatures cut yield, but more rain is expected to make this less of a problem. Agriculture in Iran is affected by the weather, the type of crops, and CO_2 fertilization. Cameroon farmers lose money when it rains, or the temperature goes up. Because of poor policymaking and a lack of markets for agricultural exports, Cameroon's income has changed a lot. In Veracruz, Mexico, the temperature influences how much coffee can be made. It may not be profitable for growers to make coffee in the next few years, because the amount of coffee being made now is expected to drop by 34%.

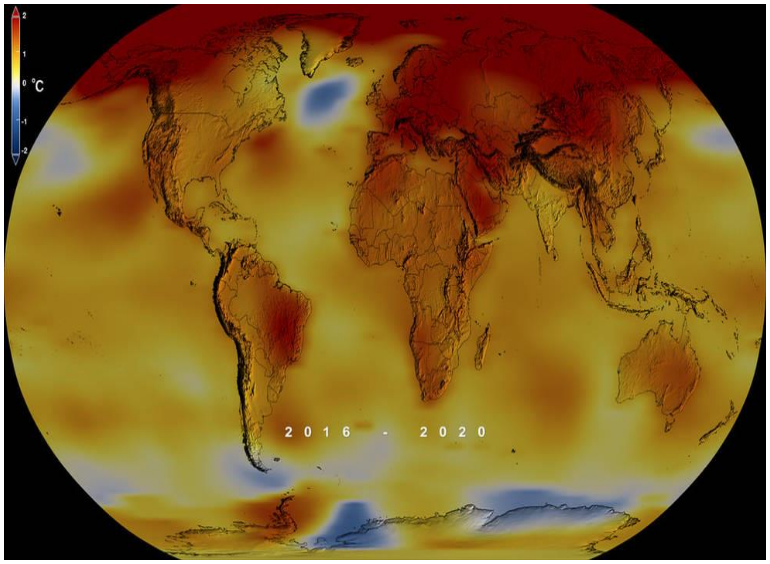

Figure 2. Global warming scenarios

Climate change affects agricultural output in different ways depending on where you live and what kind of irrigation you use. It could be bad for the environment to expand irrigated areas, but it could also make farming more productive. Temperature rises are very likely to shorten the length of crops, which will cut down on agricultural production. Wheat, rice, and maize production in both temperate and tropical countries are expected to drop by 2°C in the next few decades. This means that tropical crops are more at risk from climate change because they are closer to their high-temperature optimums, which means that they are more likely to be stressed by high temperatures. Insect pests and illnesses thrive in warm, wet places. They all affect how much food we can grow because of things like humidity, wind speed, temperature, and rainfall, and not having them could have led to an overestimation of climate change's costs. This will happen by 2100 because of the effects of climate change on wheat, corn, and rice crop yields in China. There have been more extreme weather events in the Netherlands since the 1900s, which has limited the amount of wheat that can be grown. People lost a lot of wheat because of a severe weather event. As a result of climate change, droughts are expected to get worse in most parts of the world. By 2100, drought-affected areas are expected to rise from 15.4 percent to 44 percent. The continent of Africa is thought to be the most vulnerable. Dry areas are expected to lose more than half of their food production by 2050, and more than 90% by 2100, because of the dry weather.

Many individuals in India may see temperature spikes ranging from 2.33 to 4.78 degrees Celsius this year. Climate change would reduce food production by 6–24% in many Sub-Saharan African populations over the next few decades. By 2050, Solomon Islanders are predicted to devour more fish than they produce. This is since they are expected to consume more fish than they produce. Increased CO_2 levels in the atmosphere should boost agricultural output. CO_2 levels will double during heat waves and remain higher for longer. This might harm the farming business. The severity of climate change's consequences on impoverished countries' tropical areas will be determined by where they are and how hot it is. The north and east of Sri Lanka will receive much less rain than the central highland region, which will remain constant or improve as temperatures rise. Wheat and rice yields in northwest India might increase by 28 percent and 15 percent, respectively, if CO_2 levels climbed twice as much as they do now, according to crop predictions based on resource and environmental research. Climate change will reduce agricultural production, according to many models that predict what would happen. This is seen in Table 1. Non-leguminous C3 crops cultivated in high CO_2 conditions include lower levels of N, Fe, Zn, and S, which are all found in proteins.

Weather changes have resulted in an increase in the number of bacteria and enzymes in the soil. When the temperature was 4–5°C higher than in the field, there were a lot more bacteria in the temperature gradient tunnel, but not as many in the field. This occurs when there is a high concentration of CO_2 in the atmosphere. Rice crops develop faster, both vegetatively and reproductively, and produce more seeds when temperatures reach 29 degrees Celsius. However, as the temperature climbed, the seeds did not set as effectively as before.

Causes of Climate Change

GHG concentrations have risen because of both natural and human-caused climate change. Human activity results in the emission of greenhouse gases into the atmosphere, including carbon dioxide, methane, and nitrous oxide. CO_2 levels in the air (463–780 parts per million) can increase nitrous oxide and methane emissions from upland soils and wetlands, so lowering the 16.6 percent reduction in carbon dioxide emissions projected from extending the terrestrial carbon sink.

Methane and nitrous oxide contribute 15% to agricultural emissions. Unless eating patterns and energy use in food are altered, non-agricultural greenhouse gas emissions are anticipated to continue to rise until 2055. As consumer tastes change toward higher-value commodities such as milk and meat, emissions are likely to grow significantly faster. Reduced meat consumption, mitigation of technology, or a combination of the two can be utilized to reduce greenhouse gas emissions. According to the IPCC, livestock contributes between 8% and 10% of total greenhouse gas emissions, however, a lifecycle analysis indicates that livestock might contribute up to 18% of total emissions. The cattle industry's primary sources of greenhouse gas emissions include enteric fermentation, N_2O emissions, liming, fossil fuels, organic farming, and fertilizer manufacturing. Nitrogen-based chemical fertilizers may contribute to the generation of greenhouse gases. Improved agricultural production management might result in a 38 percent reduction in nitrogen fertilizer consumption. Energy consumption is lowered by 11%, yields are enhanced by 33%, and greenhouse gas emissions are reduced by 20% because of improved crop management.

Mitigation and Adaptation to Climate Change

Concerns about climate change's impact on farming push farmers to act. As a result, adaptation requires knowledge. Mitigation initiatives will lessen water stress, but those who remain will need to adapt. Climate-resilient farming includes crop diversification, land preservation, and water collection. Because of this, farming systems are more resilient to climate change, providing food security. Human behavior is the best way to assess local, genuine, and practical elements of climate change education. Only a minority of farmers favor GHG reduction while the majority of farmers support adaptation, underscoring the significance of integrating adaptation and mitigation. Adaptive mitigation options include resource conservation, cropping system technology, and socio-economic or policy initiatives, (Cao et al. 2010). Small and marginal farmers suffer the most from ignorance. Climate change is putting African farmers at risk because of a lack of management and financial consequences. Agronomic practices including shifting planting dates have helped to prevent climate change. For the northeastern planting, October 22–28, October 24–30, and October 21–27 for the southwest planting in Punjab, India, Farmers in Sub-Saharan Africa who cultivated their crops sequentially lost the least amount of money. In Kenya, agroforestry can aid in the country's ability to adapt to climate change. Alternate rice drying, mid-season drainage, improved cow feeding, N-use efficiency, and soil carbon all have the potential to minimize greenhouse gas emissions. Changing planting dates and cultivars can help offset climate change. Farmers' responses to climate change are influenced by the distribution of technology. The focus is on market integration, public research, and capacity building.

Using ecologically friendly farming methods helps to prevent soil erosion and maintain soil cover. Decreases greenhouse gas emissions, reduce the amount of fertilizer needed and enhances the soil's ability to absorb carbon. Conservation agriculture relies heavily on crop rotation. Using no-till wheat farming in South Asia saves farmers 15–16 percent in cultivation costs. It is possible to increase yields while reducing risk by using dryland farming. No-till farming releases only a little quantity of carbon dioxide into the atmosphere. Partnerships between farmers and institutions have established an atmosphere that is conducive to CA adoption by providing the necessary resources. Climate variability and extremes, as well as social, political, and economic factors, have a significant impact on farming. The cost consequences of poor nutrient management are enormous.

By using no-till farming, cover crops, fertilizer management, and agroforestry, organic matter in the soil may be raised (SOC). Carbon sequestration reduces CO_2 emissions by 5–15%. Greenhouse gas emissions are reduced when rice is grown directly in the field. DSR provides 76.2 percent less global warming than transplanted rice while generating 60 percent fewer greenhouse gas emissions. It outperformed transplanted rice by 10.8%. Up to 73 percent of field preparation time and 56 percent of crop irrigation water can be saved with the use of aerobic rice. A long-term option is to micro-irrigate aerobic rice. Rice fields produce fewer methane emissions than previously thought. Lack of water reduces food production by 600–2900 pcal. Using drip irrigation will help to reduce groundwater overdraft and climatic stress. Groundwater is also saved as a result. Dripper irrigation is utilized in intensive farming, notwithstanding the paradox of Jevons. When it comes to saving money and preserving our natural resources, drip and sprinkler irrigation systems are ideal. Sprinkler irrigation may reduce GHG emissions by up to 80% (USD 476.03–691.64), but it needs a great deal of water pressure to work. Agrologists may cut back on the quantity of nitrogen they use without affecting their bottom lines. In the field, precision agriculture prevails. Nitrogen is being wasted by farmers in northwestern India. Climate change is expected to aggravate abiotic stress.

Rice cloning may be used to transfer the gene into high-yield rice cultivars in South Asia. After 18 days, these submersion-resistant variations exceed the original. Climate-smart agriculture conserves water reduces fertilizer usage, and stores carbon. Agricultural subsidies benefit local communities and support environmentally friendly practices. Technology is used to deliver nutrients, water, and the structure of the soil. Stone bunds, zai, half-moons, and other semiarid West African farming practices. CSR improved cotton output and resource utilization in Punjab. Crops of rice and wheat are under threat on the Indo-Gangetic plain.

According to (Boselloet et al., 2005) Climate-smart farming is being used by farmers to increase yields. The eastern Indo-Gangetic plains favor direct sowing, LLL, zero tillage, crop insurance, and irrigation scheduling. Everything from geography to culture to economics to technology affects them. These approaches complement one another as well.

Economic Impact of Climate Change and Climate-Smart Agriculture Technologies

Climate change, according to a recent study, might cost the world economy 10% of its overall value by 2050. According to a study conducted by the Swiss Re Institute, taking no action on climate change is not an option. The research assumes that present temperature rises will continue and that the Paris Agreement's and net-zero emission goals will not be realized. With a best-case GDP decrease of 5.5 percent and a worst-case GDP reduction of 26.5 percent, climate change is anticipated to have the largest impact on Asian countries. However, the studies revealed significant regional disparities. If temperatures drop below 2 degrees Celsius, advanced Asian economies are anticipated to lose 3.3 percent of GDP and 15.4 percent of GDP, respectively, while ASEAN nations are expected to lose 4.2 percent and 37.4 percent, respectively. In the worst-case scenario, China might lose more than a quarter of its GDP, compared to ten percent for the US, Canada, and the UK, and eleven percent for Europe.

According to the estimate, if temperature rises are kept below 2°C, the Middle East and Africa will face a 4.7 percent reduction, and 27.6°C in the worst-case scenario. According to (Shakooret et al., 2011) research, the economies of South and Southeast Asia are the most vulnerable to the physical difficulties provided by global warming.

Malaysia, Thailand, India, the Philippines, and Indonesia, for example, have the fewest resources for mitigating and adapting to the effects of global warming. According to the study, these countries will profit the most from global efforts to reduce global warming. According to the study, many industrialized countries in the northern hemisphere were less vulnerable to climate change than countries in the southern hemisphere because they were less exposed to bad weather patterns linked to global warming and had more resources to deal with climate change's effects. In reaction to climate change, climate-smart agriculture (CSA) is a technique for restructuring and reorienting agricultural production (Lipper et al. 2014). The most widely used definition is provided by the Food and Agricultural Organization of the United Nations (FAO), which states that CSA is agriculture that increases productivity, improves resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and improves national food security and development goals in a sustainable manner.

Food security and development are two of CSA's main goals with productivity, adaptation, and mitigation emphasized as the three interconnected pillars necessary to reach this goal (FAO 2013; 2 Lipper et al. 2014). CSA's mission is to increase agricultural output and revenue from crops, livestock, and fisheries in a way that is both sustainable and environmentally friendly. As a result, food and nutritional security will increase. A crucial concept for boosting productivity is sustainable intensification. Farmers' susceptibility to short-term risks is reduced, but their resilience is increased as CSA improves their capacity to adapt and survive in the face of shocks and longer-term pressures. The importance of safeguarding the ecological services that ecosystems provide to farmers and others is emphasized. These services are required to maintain manufacturing operations and adjust to climate change. Whenever and wherever possible, the CSA will work to reduce and/or eliminate greenhouse gas (GHG) emissions. This means that we cut emissions for every calorie or kilogram of food, fiber, or fuel generated. Deforestation caused by agriculture must be avoided. We must also ensure that soils and trees are managed in such a manner that their capacity to act as carbon sinks and absorb CO_2 from the atmosphere is maximized.

Implication and Recommendation

As the world's population grows, so does the need for agriculture to supply it with food and nourishment. The future climate and its probable repercussions are still shrouded in mystery, but various studies have concluded that agricultural output would decline as a result of climate change in the coming years. A pest infestation, soil fertility, irrigation resources, physiology, and metabolic processes in plants were all impeded by important climatic factors such as temperature, precipitation, and greenhouse gases. To counteract the negative effects of climate change on agricultural sustainability, several mitigation and adaptation measures have been developed. There are many ways to reduce greenhouse gas emissions, including using stress-tolerant varieties, using ICT-based agrometeorological services, reducing carbon emissions, using less water and increasing yields, and utilizing innovative irrigation techniques such as raised beds and direct-seeded rice.

According to (Deutsch et al. 2018), there are many ways to conserve water, including laser land leveling and rainwater harvesting, as well as micro-irrigation, crop diversification, and the use of micro-irrigation and raised-bed planting (agricultural extensions to enhance capacity-building). Reduced negative consequences of climate change are a major factor in increasing agricultural adaptability, which may be achieved in large part through these measures.

Climate change is expected to cause significant economic losses at the local and global levels, which can be mitigated by these initiatives, Bailey,et al. (2015). However, to be more effective, these interventions must be coordinated at the regional or local level. Farmers' income should rise as a result of mitigation and adaptation efforts without jeopardizing the long-term viability of agricultural output. However, because of the uncertainty surrounding the future effects of climate change, effective mitigation and adaptation strategies are now out of reach. A multidisciplinary regional strategy is used to produce climate-resilient technology. Adaptable cultivars, well-thought-out agronomic strategies, and effective pest control for crops are all necessities. Climate-smart technologies must be taught and educated to farmers to be applied in the field with ease.

REFERENCES

Adams R.M., Hurd B.H., Lenhart S. & Leary N. 1998. Effects of global climate change on agriculture: An interpretative review. *Clim. Res.* 11, 19–30.

Bailey R., Benton T.G., Challinor A., et al., 2015. Extreme weather and resilience of the global food system 2015. Final Project Report from the UK-US Taskforce on Extreme Weather and Global Food System Resilience, The Global Food Security program, UK.

Bosello F. & Zhang J. 2021. Assessing Climate Change Impacts: Agriculture; FEEM Working Paper No. 94.05; CMCC Research Paper No. 2; Elsevier: New York, NY, USA, 2005; Available online: https://ssrn.com/abstract=771245 (accessed on December 13, 2021).

Cao L., Bala G., Caldeira K., Nemani R. & Ban-Weiss, G. 2010. Importance of carbon dioxide physiological forcing to future climate change. Proc. *Natl. Acad. Sci.* USA 107, 9513–9518.

Challinor A.J., Watson J., Lobell D.B., Howden S.M., Smith D.R. & Chhetri N. 2014. A meta-analysis of crop yield under climate change and adaptation. *Nat. Clim. Chang.*, 4, 287–291.

Deutsch C.A., Tewksbury J.J., Tigchelaar M., Battisti D.S., Merrill S.C., Huey R.B. & Naylor R. 2018. Increase in crop losses to insect pests in a warming climate. *Science*, 361, 916–919.

Dey M.M., Gosh K., Valmonte-Santos R., Rosegrant M.W. & Chen O.L. 2016. Economic impact of climate change and climate change adaptation strategies for the fisheries sector in the Solomon Islands: Implication for food security. Mar. *Policy*, 67, 171–178.

Gay C., Estrada F., Conde C., Eakin H. & Villers L. 2006. Potential impacts of climate change on Agriculture: A case of study of coffee production in Veracruz, Mexico. *Clim. Chang.*, 79, 259–288.

Gray S.B. & Brady S.M. 2016. Plant developmental responses to climate change. *Dev. Biol.*, 419, 64–77.

Groenigen K.J.V., Osenberg C.W. & Hungate B.A. 2011. Increased soil emissions of potent greenhouse gases under increased atmospheric CO_2. Nature, 475, 214–216.

Kahrl F., Li Y., Su Y., Tennigkeit T., Wilkes A. & Xu J. 2010. Greenhouse gas emissions from nitrogen fertilizer use in China. *Environ. Sci. Policy*, 13, 688–694.

Kang Y., Khan S. & Ma X. 2009. Climate change impacts on crop yield, crop water productivity, and food security—A review. Prog. *Nat. Sci.*, 19, 1665–1674.

Karimi V., Karimi E. & Keshavarz M. 2018. Climate change, and agriculture: Impacts and adaptive responses in Iran. *J. Integr. Agric.*, 17, 1–15.

Kumar R. & Gautam H.R. 2014. Climate change and its impact on agricultural productivity in *India. J. Climatol. Weather Forecast*., 2, 1-3.

Lesschen J.P., Berg M.V.D., Westhoek H.J. & Oenema O. 2011. Greenhouse gas emission profiles of European livestock sectors. *Anim. Feed Sci. Technol.,* 166–167, 16-28.

Li Y., Ye W., Wang M. & Yan X. 2009. Climate change and drought: A risk assessment of crop-yield impacts. *Clim. Res.,* 39, 31–46.

Mahato A. 2014. Climate change and its impact on agriculture. *Int. J. Sci. Res. Publ.,* 4, 1–6.

Mendelsohn R. 2009. The impact of climate change on agriculture in developing countries. *J. Nat. Res. Policy Res*., 1, 5–19.

Molua E.L. & Lambi C.M. 2007. The Economic Impact of Climate Change on Agriculture in Cameroon; Policy Research Working Paper; The World Bank: Washington, DC, USA, pp.1-31.

Montzka S.A., Dlugokencky E.J. & Butler J.H. 2011. Non-CO_2 greenhouse gases and climate change. Nature, 476, 43–50.

O'Mara F.P. 2011. The significance of livestock as a contributor to global greenhouse gas emissions today and soon. *Anim. Feed Sci.* Technol., 166–167, 7–15.

Popp A., Lotze-Campen H. & Bodirsky B. 2010. Food consumption, diet shifts, and associated non-CO_2 greenhouse gases from agricultural production. *Glob. Environ. Chang.,* 20, 451–462.

Porter J.R., L Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell & Travasso M.I. 2014. Food security and food production systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Powell J.P.; Reinhard, S. 2016. Measuring the effects of extreme weather events on yields. Weather Clim. Extrem. 12, 69–79.

Reyer, C.P.O., Leuzinger S., Rammig A., Wolf A., Bartholomeus R.P., Bonfante A., Lorenzi F.D., Dury M., Cloning P., Jaoude R.A., et al. 2012. A plant's perspective of extremes: Terrestrial plant responses to changing climatic variability. *Glob. Chang. Biol,* 19,75–89.

Rosenzweig C. &Liverman D. 1992. Predicted effects of climate change on agriculture: A comparison of temperate and tropical regions. In Global Climate Change: Implications, Challenges and Mitigation Measures; Majumdar, S.K., Ed.; PA The Pennsylvania Academy of Sciences: Grove City, PA, USA, pp. 342–361.

Shakoor U., Saboor A., Ali I. & Mohsin A.Q. 2011. Impact of climate change on agriculture: Empirical evidence from the arid region. *Pak. J. Agri. Sci.,* 48, 327–333.

Soltani A., Rajabi M.H., Zeinali E. & Soltani E. 2013. Energy inputs and greenhouse gases emissions in wheat production in Gorgan, Iran. Energy, 50, 54–61.

Stern D.I. & Kaufmann R.K. 2014. Anthropogenic and natural causes of climate change. *Clim. Chang.*,122, 257–269.

Stevanovic M., Popp A., Campen H.L., Dietrich J.P., Muller C., Bonsch M., Schmitz C., Bodirsky B.L., Humpenoder F. & Weindl I. 2016. The impact of high-end climate change on agricultural welfare. *Sci. Adv.,* 2, e1501452.

Tubiello F. N., Soussana J. F. & Howden S. M. 2007. Crop and pasture response to climate change. Proceedings of the National Academy of Sciences, 104(50), 19686-19690.

Waha K., Muller C., Bondeau A., Dietrich J.P., Kurukulasuriya P., Heinke J. & Lotze-Campen H. 2013. Adaptation to climate change through the choice of cropping system and sowing date in sub-Saharan Africa. *Glob. Environ. Chang.*, 23, 130–143.

Wheeler T. & Von Braun J. 2013. Climate change impacts global food security. *Science*, 341(6145), 508-513.

Zhang P., Zhang J. & Chen M. 2017. Economic impacts of climate change on agriculture: The importance of additional climatic variables other than temperature and precipitation. *J. Environ. Econ. Manag*, 83, 8–31.