International Journal of Social and Education (INJOSEDU) e-ISSN: 3047-6151
Vol. 2 No. 2 February 2025, hal., 456-468

THE INFLUENCE OF MODERN AGRICULTURAL TECHNOLOGY ON THE PRODUCTIVITY OF LOCAL FOOD CROPS

Sulfiana *[1]
Universitas Islam Makassar
ardinsulfiana@gmail.com

Andi Tenri Fitriyah
Universitas Bosowa Makassar
tenri.fitriyah@universitasbosowa.ac.id

Baharuddin
Universitas Bosowa Makassar
baharuddin@universitasbosowa.ac.id

Abstract

In an effort to increase agricultural productivity, especially for local food crops, modern agricultural technology plays an important role. The research method conducted in this study uses the literature research method. The results show that modern technology in agriculture significantly increases the effectiveness of production through optimisation of water and soil use, as well as through the development of better crop varieties. Information technology assists farmers in making decisions based on accurate data, strengthening their position in the face of uncertain market and environmental conditions. However, cost, knowledge and infrastructure constraints are barriers to the adoption of these technologies.

Keywords: modern agricultural technology, local food crops, agricultural productivity, resource efficiency.

Introduction

In recent decades, the world has faced rapid population growth. This exponential population growth is putting enormous pressure on the global food system, where the need for food production must increase significantly to meet demand (Abdsattarovich, 2023). The need to increase the productivity of local food crops is becoming increasingly urgent. A world population expected to reach nearly 10 billion by 2050 demands a food production system that is not only efficient but also sustainable (Abdullahi et al., 2021). Local food crops, which are often more adaptive to local environmental conditions, have great potential to fulfil food needs in various regions, especially in developing countries. However, challenges such as limited agricultural land, declining soil fertility and reliance on traditional farming methods often limit the achievable production output of these crops (Abman & Carney, 2020).

[1] Correspondence author.

Strengthening the productivity of local food crops is not only important in the context of ensuring food supply, but also to improve the welfare of local farmers who depend on agriculture. This increased productivity can stimulate economic growth in rural areas, reduce poverty, and ensure food security on a broader scale (Abramova, 2023). Therefore, there is a real need to adopt more innovative and effective agricultural approaches that can overcome productivity bottlenecks while maintaining environmental integrity and sustainability of natural resources. Understanding and applying modern agricultural technologies could be the key to unlocking the full potential of these local food crops.

However, factors such as climate change, pests, plant diseases, and suboptimal farming methodologies often hamper the productivity of these local food crops (Addis & Sani, 2021).

On the other hand, technological advances provide new opportunities to increase efficiency and productivity in the agricultural sector. Modern agricultural technology, covering various aspects ranging from information technology, mechanisation, biotechnology, to integrated farm management, has demonstrated its ability to increase agricultural production output in several countries (Akalu & Mekonnen, 2021). Synergising science and innovation, such as the use of efficient irrigation systems, mapping farmland using drones, big data analytics to predict weather patterns and crop diseases, and planting using advanced robotics, can enable farmers to maximise crop yields while reducing adverse environmental impacts (Akbar et al., 2024). Biotechnology applications such as genetic engineering or selective breeding can improve crop resilience and resistance to environmental stress and disease, while technologies such as geographic information systems (GIS) provide farmers with deeper insights for more effective land management. The application of these innovations paves the way for achieving agricultural production that is more sustainable, efficient, and suited to the specific needs of various local food crop ecosystems (Ali, 2021).

However, the adoption of modern agricultural technologies also raises several important questions related to affordability, adaptation by small-scale farmers, their effects on farmers' socio-economic aspects, as well as long-term impacts on the environment and sustainability of production (Aly & Borik, 2023). Therefore, it is important to critically examine the influence of modern agricultural technologies in the context of local food crop production, understand their potential and challenges, and explore ways to optimise their benefits for increasing local food crop productivity (Baba & Adamu, 2021).

Through this research, it is hoped that a deeper understanding of how modern agricultural technologies can contribute to increasing the productivity of local food crops can be gained, as well as an overview of the best approaches to integrating these technologies into local farming systems in various regions. This research is important to

inform the development of agricultural policies, community empowerment programmes, and research and development initiatives aimed at strengthening the local agricultural sector and improving food security.

Research Methods

The study conducted in this research is the literature research method. Literature research method is a technique used to collect, analyse, and interpret data from written sources. In literature research, researchers will trace and collect materials related to the topic under study from various sources such as books, scientific journals, articles, reports, and other documents. (Barlian, 2018); (Fadli, 2021).

Results and Discussion

Definition of Modern Agricultural Technology

Modern agricultural technology refers to the utilisation of the latest tools, practices, and innovations in the agricultural sector to improve crop productivity, work efficiency, and environmental sustainability. This includes the use of advanced machinery such as tractors with GPS systems, drones for crop mapping and monitoring, automated irrigation systems, and tools for precision farming that allow farmers to apply nutrients and resources precisely according to crop needs (Baba & Adamu, 2021). In addition, modern agricultural technology also includes the use of biotechnology, such as genetic engineering and selective breeding to develop crop varieties that are more resistant to pests and diseases and have higher productivity. The utilisation of big data and artificial intelligence for analysis and decision-making is another important component of modern agriculture, enabling the real-time adjustment of farming practices based on weather patterns, soil conditions and other factors (Bambio et al., 2022).

The scope of modern agricultural technology covers various aspects from land management, planting, maintenance, harvesting, to post-harvesting. It includes technologies that focus on conserving resources such as water and soil, improving soil fertility through smart nutrient management, and managing pests and plant diseases using more environmentally friendly methods such as biological control and pesticide integration management (Beetstra et al., 2021). In addition, agricultural technology includes tracking and reporting systems that ensure a safe and transparent food supply chain and help with the ossification and certification of agricultural products (Bekenova et al., 2021). Overall, the scope of modern agricultural technology is to help farmers produce more and better food with more efficient and sustainable methods, so as to meet the demands of a growing world population while reducing negative impacts on the environment (Berha, 2022).

One example of modern agricultural technology is precision farming systems, which combine GPS and geographic information systems (GIS) to manage farmland

more effectively (Bhattacharya & Pandey, 2020). This technology allows farmers to map in detail variations in the field, such as soil moisture, fertility levels, and pest presence, which in turn allows them to apply fertiliser, water, and pesticides only where they are needed and in the right amounts (Bhuyan & Kotoky, 2022). Its applications are significant in reducing material wastage, improving crop quality, and minimising environmental impact. These precision technologies also involve the use of automated tools such as GPS-controlled tractors, which can operate with very high accuracy, and agricultural drones, which are used to monitor crop health and apply targeted treatments (D.S & G, 2022).

Other examples are hydroponics and aquaponics technologies, which are forms of soil-less farming that enable large-scale cultivation of crops without the need for large tracts of farmland. Hydroponics involves growing plants in special nutrient solutions, eliminating the need for soil as a growing medium, thus allowing climate and other external factors to be tightly controlled (Demydenko, 2023). Aquaponics combines hydroponics with aquaculture, creating a mutually beneficial system where nutrient-rich water from fish farming is used to irrigate and nourish plants, while cleaning the water for fish. Applications of both systems are prominent in the development of urban agriculture and sustainable land use, offering solutions for areas with limited natural resources such as water and fertile soil (Dolganyuk et al., 2023).

Productivity of Local Food Crops

Productivity in the context of agriculture refers to a measure of production efficiency in producing agricultural products, calculated as the ratio of outputs (products produced) to inputs (resources used such as labour, land, and capital). Productivity is a key indicator in assessing the performance of the agricultural sector, reflecting how well and effectively natural and human resources are used to produce food, fibre and other products (Gaballa & Ghaly, 2020). The goal of increasing agricultural productivity is to meet the needs of a growing society without having to expand into new land or significantly increase the inputs used. This is particularly important in the context of globalisation and climate change, where pressure on natural resources is growing, and the need to produce more with less is a top priority (Ibrahim & Namish, 2023).

Factors affecting agricultural productivity are diverse, including natural conditions, technologies used, farm management practices, and socio-economic conditions. Natural conditions such as climate, soil quality and water availability play a critical role in determining how much and what can be grown in a given place (IBRAHIM et al., 2022). The agricultural approaches chosen, such as the use of pest and disease resistant crop varieties and efficient irrigation techniques, also have a significant impact on agricultural output. Technically, the adoption of innovations such as precision agriculture technology, biotechnology and mechanisation increases production

efficiency and capacity (Kozlova et al., 2020). Furthermore, socio-economic factors such as access to markets, agricultural policy support systems, and investments in research and development contribute to farmers' ability to optimise production and manage resources effectively. Overall, an integrated approach that takes into account all these factors is needed to maximise agricultural productivity while ensuring environmental sustainability (Kukal & Irmak, 2020).

Statistics related to the productivity of local food crops in different regions can vary widely depending on factors such as climatic conditions, technology availability, farming practices used, and local government policies. For example, in some Southeast Asian regions, such as Indonesia and the Philippines, local food crops such as rice, maize and sweet potato show significant variations in productivity (Kumar, 2020). In Indonesia, efforts to increase rice productivity have been ongoing through the use of new high-yielding rice varieties, the implementation of better irrigation systems, and more efficient use of fertilisers and pesticides. This has resulted in increased productivity in some areas, with provinces in Java being a prime example, where rice productivity can reach more than 5 tonnes per hectare (Lambek, 2020).

Meanwhile, innovative farming techniques such as System of Rice Intensification (SRI) have been introduced to strengthen food crop productivity in several countries, including Madagascar, where the system was first developed. SRI, with its different crop, water and soil management approaches, has helped to significantly increase average rice yields in many places with productivity increasing two to three times over conventional techniques (Lazko, 2022). In other regions, such as in parts of Sub-Saharan Africa, local food crop productivity still faces major challenges due to limited access to technology, extreme climatic conditions and socio-economic issues. This highlights the importance of appropriate and innovative interventions to improve agricultural productivity at the local level, to ensure food security and sustainable livelihoods for a growing global population (Len, 2024).

In conclusion, the productivity of local food crops in different regions is strongly influenced by a combination of factors such as climatic conditions, technologies used, farm management practices and government policies. The provision of high-yielding varieties, improved irrigation systems, and the application of farming methods such as SRI can significantly increase crop production yields. However, challenges remain, especially in areas with limited access to advanced technologies and unfavourable socio-economic conditions. Therefore, a concerted effort is needed between the government, research institutions and farming communities to implement innovative and sustainable solutions that can increase the productivity of local food crops while ensuring environmental sustainability and community livelihoods.

Influence of Modern Agricultural Technology

Modern agricultural technologies have brought a number of positive impacts to the productivity of local food crops, helping farmers optimise resource use and increase yields. For example, the use of precision agriculture technologies such as integrated sensing systems that include GPS, sensors and mapping drones, allows farmers to monitor land and crop conditions more accurately and efficiently (Li et al., 2023). These technologies help in mapping spatial variations in a plot of land, so that interventions such as planting, fertilisation and irrigation can be made more precisely. As a result, farmers can use fertiliser and water more efficiently, reduce wastage, and improve the quality and quantity of crops (M & J, 2022).

In addition, the adoption of biotechnological methods in the development of local food crop varieties that are more resistant to diseases, pests and extreme climatic conditions has also transformed productivity. Pest-resistant varieties reduce losses caused by pest and disease attacks, while abiotic-tolerant varieties such as drought ensure that crops continue to grow even under the stress of unfavourable climatic conditions (Meja & Kebede, 2022). These technologies not only provide benefits in terms of yield volume, but also contribute to the stability of crop production, which is crucial in maintaining food security and agricultural sustainability. Through the application of modern agricultural technologies, farmers can be more adaptive and resilient to current and future climate change (Mihailescu & Soares, 2020).

Furthermore, modern agricultural technology has improved farmers' ability to implement sustainable farming practices. For example, drip irrigation and smart irrigation systems have significantly reduced the amount of water wasted, while increasing irrigation efficiency (MISHRA & Misra, 2020). As such, these technologies offer water-saving solutions, especially in regions that are under water resource stress. Better soil management, such as the use of technologically advanced machinery that can perform selective ploughing, also helps in maintaining soil structure and improving soil health, which in turn boosts crop growth and productivity outcomes.

Ultimately, technological innovations in agriculture help to reduce the cropping period, enabling the cultivation of more cropping cycles in a year, which translates to increased crop production and income for farmers. The adoption of modern agricultural tools and machinery has simplified processes such as planting, maintenance and harvesting, leading to time efficiency and reduced workload (Mitrofanov et al., 2023). In addition, increased access to information through digital platforms has strengthened farmers' capacity for decision-making based on data analytics; making it easier for them to understand market trends, find the best prices, compete with larger operations, and ultimately develop methods and techniques that increase income while maintaining production and environmental sustainability (Mobarak et al., 2021).

While modern agricultural technologies offer a wide range of benefits, their implementation often faces a number of barriers. One of the main challenges is the high

initial cost, which can be a significant barrier for small and medium-sized farmers. The purchase of advanced equipment, hardware and software for precision farming, as well as biotechnology, can require large initial investments that are not affordable for all farmers (Morita, 2021). In addition, farmers also need access to training and technical support to be able to use these new technologies effectively, which can also add to the cost burden. To address these issues, governments and financial institutions can play an important role in providing affordable subsidies, credits, or financing schemes for farmers. Non-profit organisations and private companies can also contribute through partnership and training programmes to facilitate technology adoption (Na & Yuxiang, 2020).

Besides financial constraints, other barriers include lack of technical knowledge and resistance to change. Many farmers may not be familiar with modern agricultural technologies or are unsure about the benefits of their implementation. These constraints can be exacerbated by the lack of infrastructure such as internet connections in rural areas, which limits access to information about new technologies (Naimur, 2020). To overcome this, extensive training and education programmes are needed, designed to increase farmers' awareness and technical skills on modern agricultural technologies (Nan, 2020). Public and private initiatives can assist in providing technical training and ongoing support, while promoting the long-term benefits of agricultural technologies, not only in terms of increased productivity and income, but also in terms of environmental sustainability and adaptation to climate change.

Conclusion

The results of this study show that the implementation of modern agricultural technologies has had a significant impact on increasing agricultural productivity and efficiency. The use of tools such as drip irrigation systems, soil moisture sensors, and drones for crop monitoring, have contributed substantially to optimising the use of natural resources such as water and soil. In addition, innovations in biotechnology such as genetically modified crops provide higher yields and resistance to pests and diseases, reducing the need for harmful chemical pesticides.

Furthermore, findings show that the adoption of information and communication technologies in the agricultural sector has strengthened farmers' decision-making processes. Digital platforms and mobile apps that provide real-time weather data, farming tips, market prices, and other information, have been shown to improve farmers' informativeness. This enables farmers to apply best practices according to local and market conditions, thereby increasing their income and the sustainability of their farming businesses.

However, the study also highlighted challenges in the adoption of agricultural technologies. Key constraints include high investment costs, lack of technical

knowledge and skills among farmers, and inadequate infrastructure in some rural areas. To achieve wider and effective adoption, interventions from the government and private institutions are needed to provide financial support, technical training, and necessary infrastructure upgrades. Thus, the integration of technology in agriculture can be accelerated, resulting in greater benefits for the sector.

The findings of this study have significant implications for efforts to increase the productivity of local food crops, underscoring the importance of integrating modern agricultural technologies to maximise the potential of local agriculture. Through the application of technologies such as advanced irrigation systems, biotechnology techniques to develop crop varieties that are more resistant to pests and diseases, and the use of data-driven crop monitoring and management tools, it is possible to significantly increase the production yield of local food crops. This not only improves food security locally but also provides economic opportunities for rural communities, reduces vulnerability to climate change, and supports environmental sustainability. Investment in agricultural technologies and the capacity of local farmers to adopt these innovations are therefore key to effectively advancing the productivity of local food crops.

References

Abdsattarovich, K. B. (2023). Influence of Environmental Conditions on Yield of Agricultural Crops. *Nutrition and Food Processing*, *6*(7), 1–3. https://doi.org/10.31579/2637-8914/150

Abdullahi, N., Igwe, E. C., & Dandago, M. A. (2021). Heavy metal uptake and stress in food crops: A Review. *Agricultural Science and Technology*, *13*(4), 323–332. https://doi.org/10.15547/ast.2021.04.053

Abman, R., & Carney, C. (2020). Land rights, agricultural productivity, and deforestation. *Food Policy*, *94*(Query date: 2024-06-18 17:31:34), 101841–101841. https://doi.org/10.1016/j.foodpol.2020.101841

Abramova, N. (2023). Influence of Maternal Ancestral Productivity on Offspring's Milk Yield. *Agricultural and Lifestock Technology / АгроЗооТехника*, *1*. https://doi.org/10.15838/alt.2023.6.1.5

Addis, Y., & Sani, S. (2021). Impact of Adoption of Improved Agricultural Production Technologies on Cereal Crops Productivity and Farmers' Welfare in Central Ethiopia. *Indian Journal of Science and Technology*, *14*(44), 3280–3287. https://doi.org/10.17485/ijst/v14i44.1306

Akalu, G., & Mekonnen, M. (2021). Improving faba bean production and productivity through the integrated management of Orobanche Crenatae at Kutaber, Amhara Region, Ethiopia. *International Journal of Agricultural Science and Food Technology*, *Query date: 2024-06-18 17:31:34*, 114–117. https://doi.org/10.17352/2455-815x.000097

Akbar, A., Khairunnisa, K., Meutiasari, C. S., Sari, M. T., & Mahyuny, S. R. (2024). The Influence of Biosaka as an Elisitor to Increase Productivity of Food Crops Pakcoy

(Brassica rapa L.) as Eco-Friendly Agricultural Innovation. *Jurnal Biologi Tropis*, *24*(1), 821–826. https://doi.org/10.29303/jbt.v24i1.6180

Ali, A. A.-E.-G. (2021). Seed Technology and Improvement Productivity of Field Crops. *Mitigating Environmental Stresses for Agricultural Sustainability in Egypt*, *Query date: 2024-06-18 17:31:34*, 409–436. https://doi.org/10.1007/978-3-030-64323-2_15

Aly, A. A., & Borik, Z. M. (2023). Food crops, growth and productivity as an important focus for sustainable agriculture. *Plant Small RNA in Food Crops*, *Query date: 2024-06-18 17:31:34*, 3–23. https://doi.org/10.1016/b978-0-323-91722-3.00002-6

Baba, S. A., & Adamu, I. A. (2021). Implications of Climate Change on Agricultural Productivity: A Review. *Journal of Food Technology & Nutrition Sciences*, *Query date: 2024-06-18 17:31:34*, 1–5. https://doi.org/10.47363/jftns/2021(3)130

Bambio, Y., Deb, A., & Kazianga, H. (2022). Exposure to agricultural technologies and adoption: The West Africa agricultural productivity program in Ghana, Senegal and Mali. *Food Policy*, *113*(Query date: 2024-06-18 17:31:34), 102288–102288. https://doi.org/10.1016/j.foodpol.2022.102288

Barlian, E. (2018). *METODOLOGI PENELITIAN KUALITATIF & KUANTITATIF*. *Query date: 2024-05-25 20:59:55*. https://doi.org/10.31227/osf.io/aucjd

Beetstra, M., Wilson, R., & Toman, E. (2021). The influence of the seasons: How the agricultural calendar impacts farmer perceptions of cover crops. *Renewable Agriculture and Food Systems*, *37*(3), 187–197. https://doi.org/10.1017/s1742170521000521

Bekenova, Sh., Bazarkul, Zh., & Seifullin, S. (2021). SEED QUALITY INDICATORS AND FIELD PRODUCTIVITY OF WINTER WHEAT CROPS IN T. RYSKULOV DISTRICT ZHAMBYL REGION. *Topical Issues of Agricultural Development*, *Query date: 2024-06-18 17:31:34*. https://doi.org/10.19110/93206-022-2

Berha, A. N. (2022). Does exposure to weather variability deter the use of productivity-enhancing agricultural technology? Evidence from Ethiopia. *World Food Policy*, *8*(1), 85–117. https://doi.org/10.1002/wfp2.12037

Bhattacharya, T., & Pandey, S. K. (2020). Suitability of Fly Ash Amendment in Soil for Productivity of Agricultural Crops. *Ecological and Practical Applications for Sustainable Agriculture*, *Query date: 2024-06-18 17:31:34*, 251–260. https://doi.org/10.1007/978-981-15-3372-3_12

Bhuyan, D., & Kotoky, A. (2022). Instability in Production and Productivity of Horticultural Crops in Assam. *Indian Journal Of Agricultural Research*, *Query date: 2024-06-18 17:31:34*. https://doi.org/10.18805/ijare.a-5927

Demydenko, O. V. (2023). Productivity of agricultural crops under climate change in the Central Forest Steppe of Ukraine. *Agriculture and Plant Sciences: Theory and Practice*, *1*, 75–91. https://doi.org/10.54651/agri.2023.01.09

Dolganyuk, V., Sukhikh, S., Ulrikh, E., Babich, O., & Kashirskikh, E. (2023). Selection of microalgae cultivation parameters for maximum productivity. *INTERNATIONAL SCIENTIFIC AND PRACTICAL CONFERENCE "CURRENT ISSUES OF BIOLOGY, BREEDING, TECHNOLOGY AND PROCESSING OF AGRICULTURAL CROPS" (CIBTA2022) (To the 110th Anniversary of V.S. Pustovoit All-Russian Research Institute of Oil Crops)*, *Query date: 2024-06-18 17:31:34*. https://doi.org/10.1063/5.0143039

D.S, D., & G, K. (2022). *Enhanced Blockchain based Agricultural Traceability System for Food Crops Products*. *Query date: 2024-06-18 17:31:34*. https://doi.org/10.21203/rs.3.rs-998152/v1

Fadli, M. R. (2021). Memahami desain metode penelitian kualitatif. *HUMANIKA*, *21*(1), 33–54. https://doi.org/10.21831/hum.v21i1.38075

Gaballa, D., & Ghaly, H. (2020). Efficiency use resources of the most important salt tolerant crops productivity in Sahl ELTinah. *Scientific Journal of Agricultural Sciences*, *Query date: 2024-06-18 17:31:34*. https://doi.org/10.21608/sjas.2020.30224.1024

Ibrahim, A., & Namish, A. (2023). The Allelopathic Potential Effect of Winter Crops on Biochemical Constituents and Productivity of Cotton. *Journal of Sustainable Agricultural Sciences*, *49*(3). https://doi.org/10.21608/jsas.2023.195208.1399

IBRAHIM, H. I., IBRAHIM, H. Y., ADEOLA, S. S., & OJOKO, E. A. (2022). POST-HARVEST LOSS AND FOOD SECURITY: A CASE STUDY OF MAJOR FOOD CROPS IN KATSINA STATE, NIGERIA. *FUDMA Journal of Agriculture and Agricultural Technology*, *8*(1), 393–403. https://doi.org/10.33003/jaat.2022.0801.106

Kozlova, Z., Matais, L., & Glushkova, O. (2020). INFLUENCE OF FODDER CROP ROTATIONS ON CROP CONFERENCE AND PRODUCTIVITY OF AGRICULTURAL CROPS IN BAIKAL REGION. *Vestnik of Kazan State Agrarian University*, *15*(2), 20–24. https://doi.org/10.12737/2073-0462-2020-20-24

Kukal, M. S., & Irmak, S. (2020). Characterization of water use and productivity dynamics across four C3 and C4 row crops under optimal growth conditions. *Agricultural Water Management*, *227*(Query date: 2024-06-18 17:31:34), 105840–105840. https://doi.org/10.1016/j.agwat.2019.105840

Kumar, S. (2020). *The State of Indian Agriculture: Agricultural Productivity, Food Security and Climate Change*. *Query date: 2024-06-18 17:31:34*. https://doi.org/10.4135/9789353885953

Lambek, N. (2020). The UN Committee on World Food Security's break from the agricultural productivity trap. *Transnational Food Security*, *Query date: 2024-06-18 17:31:34*, 241–255. https://doi.org/10.4324/9781003029632-16

Lazko, V. E. (2022). THE EFFECT OF LEAF FERTILIZING WITH AGROCHELATE FERTILIZER ON THE PRODUCTIVITY OF SUMMER MELON CROPS. *Ecological and Genetic Bases of Breeding and Cultivation of Agricultural Crops*, *Query date: 2024-06-18 17:31:34*. https://doi.org/10.33775/conf-2022-147-156

Len, O. I. (2024). THE PRODUCTIVITY OF SPRING BARLEY DEPENDS ON THE CULTIVATION TECHNOLOGY. *NEW CONCEPTS, THEORETICAL AND PRACTICAL PROBLEMS IN THE FIELD OF AGRICULTURAL SCIENCES AND FOOD*, *Query date: 2024-06-18 17:31:34*. https://doi.org/10.30525/978-9934-26-420-7-3

Li, M., Wang, Y., Guo, H., Ding, F., & Yan, H. (2023). Evaluation of variable rate irrigation management in forage crops: Saving water and increasing water productivity. *Agricultural Water Management*, *275*(Query date: 2024-06-18 17:31:34), 108020–108020. https://doi.org/10.1016/j.agwat.2022.108020

M, M. S., & J, A. M. (2022). Recommendations for Agricultural Crops Based on Productivity and Season. *International Journal of Advanced Research in Science,*

Communication and Technology, *Query date: 2024-06-18 17:31:34*, 590–595. https://doi.org/10.48175/ijarsct-5418

Meja, M., & Kebede, A. K. (2022). *Impact of Agricultural Inputs Use on Productivity of Major Crops in Southern Ethiopia*. *Query date: 2024-06-18 17:31:34*. https://doi.org/10.21203/rs.3.rs-2062064/v1

Mihailescu, E., & Soares, M. B. (2020). The Influence of Climate on Agricultural Decisions for Three European Crops: A Systematic Review. *Frontiers in Sustainable Food Systems*, *4*(Query date: 2024-06-18 17:31:34). https://doi.org/10.3389/fsufs.2020.00064

MISHRA, K., & Misra, L. (2020). *Revisiting the Determinants Of Agricultural Productivity Of Food Grains In India: An Econometric Approach*. *Query date: 2024-06-18 17:31:34*. https://doi.org/10.31124/advance.12355838.v1

Mitrofanov, Yu. I., Gulyaev, M. V., & Pervushina, N. K. (2023). Influence of agromelioration and drainage methods on the field crops productivity. *Вестник Российской Сельскохозяйственной Науки*, *3*, 63–69. https://doi.org/10.31857/2500-2082/2023/3/63-69

Mobarak, H., Mahfuza, B., Moshiur, R., Abul, H., & Richard, B. (2021). Resource conservation technology for sustainable productivity of intensive rice-based cropping pattern in Bangladesh. *International Journal of Agricultural Science and Food Technology*, *Query date: 2024-06-18 17:31:34*, 53–60. https://doi.org/10.17352/2455-815x.000088

Morita. (2021). Water productivity improvements for agricultural growth and food security: Where and why? *Water Productivity and Food Security - Global Trends and Regional Patterns*, *Query date: 2024-06-18 17:31:34*, 1–9. https://doi.org/10.1016/b978-0-323-91277-8.00008-3

Na, Y., & Yuxiang, H. (2020). Thoughts on Talent Training of Data Science and Big Data Technology in Local Agricultural Colleges—Take Tianjin Agricultural University as an example. *Proceedings of the International Conference on Modern Educational Technology and Innovation and Entrepreneurship (ICMETIE 2020)*, *Query date: 2024-06-18 17:31:34*. https://doi.org/10.2991/assehr.k.200306.158

Naimur, R. Md. (2020). Crops pattern change and agricultural diversification: A case study of Domar Upazila, Nilphamari. *International Journal of Agricultural Science and Food Technology*, *6*(1), 22–29. https://doi.org/10.17352/2455-815x.000050

Nan, J. (2020). Redefinition of 'Agricultural Green Productivity' and 'Green Total Factor Productivity' under the Constraints of Carbon Emissions—A Review of Chinese Agricultural Green Productivity Studies. *Journal of Macau University of Science and Technology*, *14*(1), 24–24. https://doi.org/10.58664/mustjournal.2020.01.024