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Tackling Unequal Access to Emerging Technologies in the International Agricultural Sector

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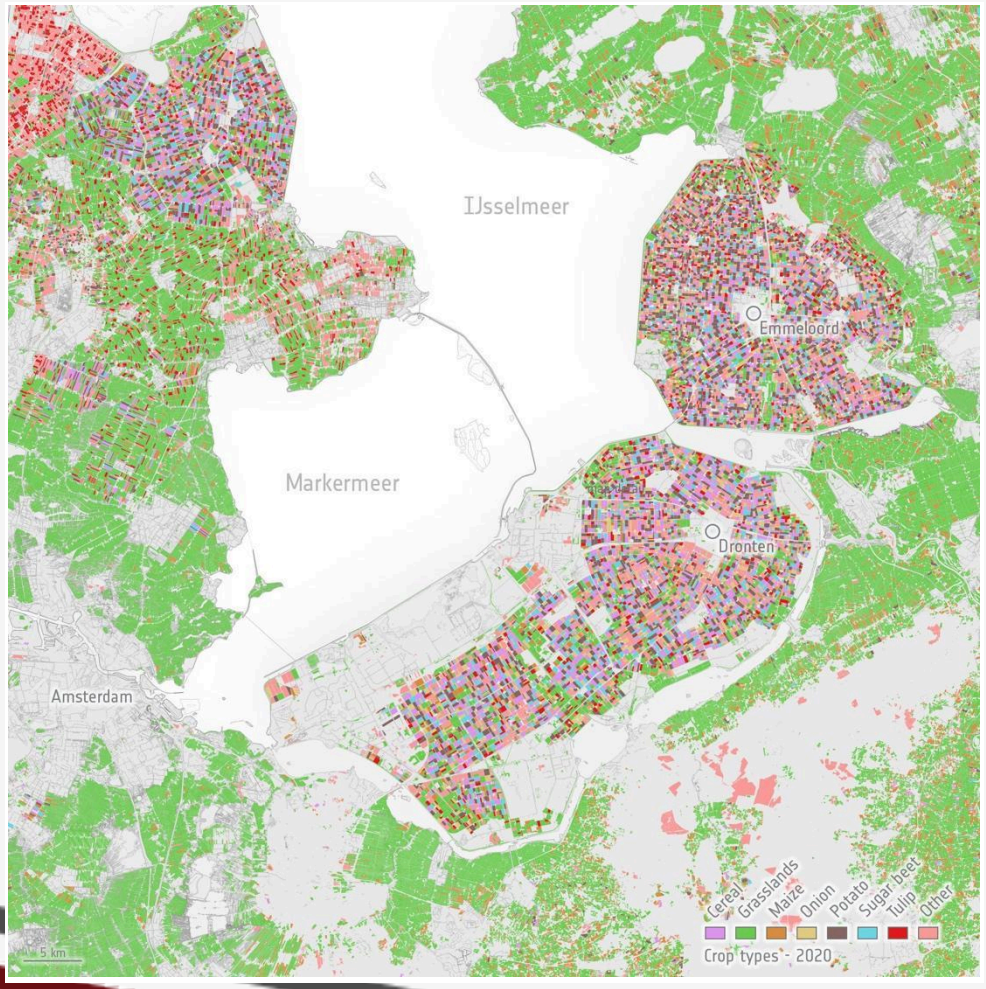

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Introduction

Food security, economic stability, and ecological sustainability are what the agricultural sector basically stands for worldwide. Such emerging technologies as precision agriculture, AI, IoT, and biotechnology are capable of changing farming to better yields and reduction of resource wastage (Habib 2024), making farming adaptable to climatic change. This could increase productivity by leaps and bounds, improving livelihoods considerably in areas relying on agriculture. However, unequal access to such technologies has created a growing chasm between resource-rich and resource-poor farmers, further polarizing social and economic inequalities in the international agricultural sector.

The root of the problem is caused by several interrelated factors. To begin with, high costs and limited access to financing bar smallholder farmers in developing countries from adopting advanced technologies. Added to this, infrastructural challenges like unreliable electricity, poor internet connectivity, and inadequate transportation networks further limit their ability to benefit from innovations. Knowledge and digital literacy gaps, especially in rural areas, leave farmers unprepared to use technologies effectively. Meanwhile, policies in most countries favour large-scale agribusiness over smallholders, depriving them of access to subsidies or resources to invest in new tools.

This unequal access does not come without a cost. First, it has created a vicious circle of poverty among smallholder farmers who cannot compete with more technologically advanced operations. Second, it is undermining global food security by failing to optimize agricultural productivity in regions with high potential but low access to innovations. Thirdly, inefficient agricultural practices are being enhanced, which involve environmental degradation in the form of soil degradation, over-exploitation of water, and even greenhouse gas emissions, where resources for sustainable agriculture are lacking.

This will be essential in fostering an inclusive and sustainable future of agriculture. The report basically discusses unequal access to emergent technologies in agriculture and then goes on to analyse its global implications.

Definition of key terms

Agricultural Sector

Refers to the part of the economy dedicated to farming, including crop production, livestock, forestry, and fisheries.

Agricultural Technologies

Tools, machines, and techniques used to improve agricultural efficiency and productivity, such as precision farming, IoT devices, and genetically modified crops.

Developing Countries

Nations with lower levels of industrialization, infrastructure, and income, often facing challenges like poverty and limited access to technology.

Food Agriculture

Encompasses all farming activities focused on producing food, such as crop cultivation and animal husbandry.

Food Security

Ensures that all people have consistent access to sufficient, safe, and nutritious food for an active and healthy life.

Smallholder Farmers

Farmers managing small plots of land, typically using family labour, and often facing limited access to resources and technology.

Unequal Access

Refers to disparities in availability or use of resources, technologies, or opportunities, often caused by socioeconomic, geographic, or systemic barriers.

General Overview

Different, New Agricultural Techniques

New emerging agricultural techniques have revolutionized farming by introducing advanced technologies to tackle global challenges on food security, environmental sustainability, and economic efficiency. Among them, precision agriculture has become popular due to its capability for optimization. Precision agriculture, using technologies like GPS mapping, soil sensors, and drones, has now empowered farmers to track crop and soil conditions in real time, thus allowing better use of water, fertilizers, and pesticides judiciously. This not only improves yields but also reduces environmental harm by minimizing resource wastage (Sharma).

Biotechnology has also emerged as a key player in modern farming. GMOs and gene-altering tools, such as CRISPR, are allowing crops to be engineered for resistance against pests, diseases, and extreme weather conditions while increasing their productivity and lessening the need for chemical pesticides. Of equal importance is vertical farming, the fully controlled conditions under which crops can be grown; it is fast becoming a practical reality and a solution for urban agriculture. Vertical farming, by employing hydroponic or aeroponic methods, preserves water and saves land, so it is a highly feasible alternative in highly populated areas (Das et all 2023).

IoT is revolutionizing farm management. Smart devices installed with sensors monitor weather conditions, soil health, and crop growth to provide critical information to farmers for making decisions. AI-powered predictive analytics further enhances this process by predicting market demands and risks. Autonomous machinery, like robotic harvesters and self-driving tractors, reduces the labour burden and ensures precision in field operations.

These are very much beyond the reach of most farmers, especially those in low-income countries. The high costs, together with the need for infrastructure and technical expertise, have created formidable barriers to adoption. While these techniques hold the promise of addressing global agricultural challenges, benefits are distributed in a highly unequal manner, hence leading to growing disparities within the sector.

The Level of Inequality

Emerging agricultural technologies have seen their adoption done highly unequally, truly reflecting deeply set inequalities within the global agricultural sector. The developed nations that possess capital and infrastructural advantages lead in this adoption to modernise their form of practices, whereas small-scale farmers in developing countries often have a lack of access, which extends the productivity gap (UNODP 2021).

For example, precision agriculture tools like drones and soil sensors, common in North America and Europe, remain extremely rare in Sub-Saharan Africa and South Asia. The FAO puts the number of farmland ownerships by small-scale farmers at 80 percent of the world's total but pegs their produce at less than 20 percent of the world's agricultural

output. Such wide disparity in production outcome is indicative of the inefficiencies occasioned by unequal access to modern technologies (FAO).

Inequality also goes further into the socioeconomic divide: rich farmers are more inclined to the adoption of advanced technologies since they can invest in high-cost machinery and training. Further, the various marginal groups that include women or indigenous farmers face additional problems while trying to satisfy their needs based on scarce access to credit, ownership of the land, and further systemic discrimination.

The inequality in access affects global food security as well. The regions with poor technological penetration often have low yields, further translating into food shortages and high vulnerability to climate change, while technologically advanced regions are dominant in agricultural exports, hence creating dependencies that reinforce inequality. This divide is not only a threat to the livelihoods of smallholder farmers but also a process in building a resilient and equitable global food system.

Causes of Inequality

The causes of the unequal access to emerging agricultural technologies are found in the economic, infrastructural, and institutional barriers. First is the unaffordable cost of modern equipment and tools. Technologies such as drones, AI-powered systems, and genetically modified seeds require huge upfront investments beyond the reach of smallholder farmers. The maintenance and operation of those technologies require specialized skills, too, further excluding the ones with limited technical education.

Other critical entry barriers include infrastructural deficiencies. Most rural areas, especially within developing countries, do not have the basic infrastructure necessary for adopting modern agricultural practices. The inability to constantly have electricity, poor internet connectivity, and bad transportation networks restrict farmers from using IoT devices, precision tools, and autonomous machinery effectively. These gaps are highly significant in cases of weak governance or conflict-affected areas, since infrastructure development is deprioritized (Fiocco et Ganesan 2024).

Institutional factors are also a critical determinant. Most of these policy frameworks support large-scale industrial agribusiness through subsidies, tax benefits, and opportunities to conduct research and development. Their opposite, the small-scale farmers, have very meager support and mostly have limited credit and insurance accessibility. Added to these, global trade policies and intellectual property laws worsen inequities. For example, patents on genetically modified seeds limit access to such seeds to rich farmers, while others have to rely on traditional and less productive varieties of seeds (Fiocco et Ganesan 2024).
Cultural and social reasons also exist. Discrimination against the less empowered groups, like women or indigenous farmers, is widely practiced in most developing countries, severely limiting their ability to access credit, land, and training services. Added to this might be sheer lack of information and education regarding new technologies among the most far-flung communities. These factors are cumulative in constructing a self-perpetuating noose of exclusion from agricultural innovation (Shibia et all 2024).

Major parties involved

Food and Agriculture Organization

A specialized organization within the United Nations, FAO is dedicated to promoting world food security with reduced inequalities regarding agriculture through developing sustainable farming; it also enables smallholder farmers to e-agriculture.

Multinational Agritech Companies

For example, John Deere, Bayer, and Syngenta develop and distribute advanced agricultural technologies, including genetically modified seeds, precision farming tools, and smart machinery. Their pricing and distribution strategies greatly influence access across regions.

National Governments

Examples like India, Kenya, and the United States. Governments can either promote or hinder access through the use of policies, subsidies, and programs. For example, Kenya's DigiFarm initiative and India's eNAM platform have been implemented to support smallholder farmers.

Non-governmental organizations

Examples like One Acre Fund and Oxfam: The NGOs fill the gaps in providing resources, training, and financial aid to smallholder farmers. For example, the One Acre Fund works to ensure that farmers in Africa have the proper tools and knowledge to raise their productivity levels.

World Bank Group Infrastructure projects

Outside financial support, like through the program known as Agriculture and Food Global Practice, tends towards rural development for access to improved technologies in developing countries.

Timeline of events

1996 November 13th

The World Food Summit adopts the Rome Declaration, acknowledging the need to invest in agricultural technologies to reduce hunger and ensure sustainable development.

2002 March 3rd

The Food and Agriculture Organization (FAO) launches the International Alliance Against Hunger, focusing on collaborative efforts to address global food security challenges.

2015 September 25th

The United Nations adopts the 2030 Agenda for Sustainable Development, including Goal 2: Zero Hunger, emphasizing technological advancements to eradicate hunger.

2016 April

The "e-Agriculture Strategy Guide" is published by the FAO and the International Telecommunication Union (ITU) to support countries in integrating digital technologies into agricultural policies and practices.

2021 March

The World Economic Forum (WEF) releases a report highlighting the importance of artificial intelligence for agricultural innovation.

2022

The Food and Agriculture Organization (FAO) publishes a report highlighting the "Digital Divide" in agriculture, emphasizing that unequal access to technology hampers food security efforts in developing nations.

Relevant UN treaties and events

A/RES/70/1; Transforming our world: the 2030 Agenda for Sustainable Development: Adopted by the General Assembly, this resolution established the Sustainable Development Goals (SDGs), including Goal 2 on ending hunger and promoting equitable access to technology in agriculture, 25 September 2015.

UN FAO Constitution: Establishes the Food and Agriculture Organization's role in improving agricultural practices and promoting technology access among member states, 16 October 1945.

FAO International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA): Promotes the sharing of genetic resources and associated technologies to support sustainable agriculture, 3 November 2001.

UN Convention on Biological Diversity (CBD): Encourages sustainable agricultural practices, including the use of biotechnology, as a means to preserve biodiversity, 5 June 1992.

Previous attempts to solve the issue

The Gates Foundation's Alliance for a Green Revolution in Africa (AGRA)

Smallholder farming support through investments in seed technology, market access, and policy advocacy to enhance agricultural productivity across Africa.

Digital Green Initiative

Leveraged video-based learning systems to educate farmers about best practices in agriculture. This initiative enabled knowledge sharing among farmers and improved adoption of modern technologies.

The Grameen Foundation

Mobile-based agricultural advisory services for smallholder farmers to provide weather forecasts, crop prices, and farming techniques, significantly reducing barriers to information access in rural areas.

Kenya's M-Pesa and Agri-wallet

Combined mobile banking with agricultural services to provide farmers with financial access for purchasing seeds and equipment, addressing both technological and financial barriers.

International Fund for Agricultural Development (IFAD) projects

Implements initiatives like the "Adaptation for Smallholder Agriculture Programme" to integrate climate-resilient technologies into farming practices in developing countries.

The African Union's Comprehensive Africa Agriculture Development Programme (CAADP)

Enhancing agricultural productivity and technology adoption through regional partnerships and increased investments in the agricultural sector.

Possible solutions

Fostering Public-Private Partnerships (PPPs)

Encourage collaboration between governments, private sector companies, and NGOs to develop affordable and regionally adapted technologies, ensuring equitable distribution and adoption.

Implementing Digital Literacy Programs

Introduce educational initiatives to equip farmers with the digital skills necessary to use emerging agricultural technologies effectively, ensuring accessibility and inclusivity.

Improving Infrastructure in Rural Areas

Invest in infrastructure, such as electricity, internet connectivity, and transportation, to facilitate the use and distribution of agricultural technologies in remote regions.

Providing Policy Incentives for Innovation

Encourage governments to adopt policies that promote research and development in agricultural technology, such as tax breaks or subsidies for companies working on sustainable solutions.

Establishing Data-Sharing Platforms

Develop global and regional data-sharing networks that allow farmers and stakeholders to access information on best practices, weather patterns, and market trends.

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