

THE DIGITAL REVOLUTION IN AGRICULTURE

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Abstract: This article examines the problems of the agricultural sector and ways to solve these problems through the digitalization of the agro-industry. In order to more effectively solve these problems, first of all, it is necessary to improve the digital infrastructure.

Key words: Agriculture, agricultural sector, agro-industry, digitalization, digital transformations, digital innovations.

The agri-food sector faces numerous challenges. If in 2021 the world's population was 7.6 billion people, then by 2050, according to preliminary estimates, it will exceed 9.6 billion, which will lead to a significant increase in food demand. At the same time, the available natural resources, including fresh water and productive arable land, are dwindling.

Production is not the only factor of concern: the agricultural products produced today are enough to feed the entire world, yet 821 million people worldwide still suffer from hunger [2]. Other processes, such as rapid urbanization, also have a strong impact on food production and consumption patterns.

The agri-food sector is critical in terms of employment and livelihoods. There are more than 570 million smallholder farmers in the world [10], and the agri-food sector employs 28% of the world's workforce [7].

Achieving the UN-defined Sustainable Development Goal to end hunger by 2030 will require building more productive, efficient, resilient, inclusive, transparent and resilient food systems [3]. This means that existing agri-food systems must be transformed immediately.

Part of the solution to this problem can be provided by digital innovations and technologies. The so-called "fourth industrial revolution" (Industry 4.0) is accompanied by the rapid transformation of a number of sectors under the influence of "disruptive" digital innovations - blockchain, Internet of things, artificial intelligence and immersive reality. In the agri-food sector, the proliferation of mobile technology, remote sensing services and distributed data processing is already increasing smallholder farmers' access to information, inputs, markets, finance and training. Digital technologies are opening up new opportunities for integrating smallholder farmers into digital agri-food systems [14].

Rural communities are expected to be the driving force behind the next period of mobile growth. Today, 70% of people in the developing world who belong to the poorest 20 percent have access to a mobile phone [15]. In addition, more than 40% of the world's inhabitants have access to the Internet, and numerous initiatives are already underway to ensure that people in rural areas of developing countries have access to the World Wide Web [15].

In doing so, however, the digitalization of agriculture and the food value chain is accompanied by a number of challenges that cannot be neglected. Transformations must be undertaken with care to avoid creating a digital divide between countries and industries, and between those with different capacities to absorb new technologies.

In countries with economies in transition, as in rural areas, underdeveloped technical infrastructure, high cost of technology, low levels of computer literacy, digital skills and limited access to services pose the risk of lagging behind the digitalization process. [11]

On the other hand, developing countries may have the advantage of being able to leapfrog aging agri-food technologies and models by joining the digital agriculture revolution immediately. Such a scenario would

require policymakers, international organizations, business leaders and ordinary people to radically rethink the situation: going the beaten path will not solve problems.

In the past, agriculture has experienced several revolutions, each of which brought efficiency, productivity and profitability to levels previously unattainable. Market forecasts for the next decade agree that the “digital revolution in agriculture” will create a shift that will allow the agricultural sector to meet the future needs of the world's population.

Digitalization will change all the links in the agri-food chain. Resource management of any element of the system can be based on the principles of optimization, individual approach, rationality and predictability. The system will function in real time through data-driven hyper-connectivity. Value chains can be fully traceable and coordinated and optimal models for the management of agricultural land, crops and animals can be created. Digital agriculture will create systems that are highly productive, predictable and adaptable to change, including those brought about by a changing climate. This, in turn, can help improve food security, profitability and sustainability.

In the era of digitalization, information and communication technologies (ICTs), including mobile phones and computers, have revolutionized the way we access knowledge and information, fundamentally changing entrepreneurship and the use of services. However, significant digital divide exists both within and between countries.

Basic conditions for the implementation of digital transformations. There are a number of basic conditions necessary for the use of digital technologies and, accordingly, for the implementation of digital transformations in the agri-food sector: infrastructure and connectivity (mobile subscribers, network coverage, Internet access, electricity supply), financial inclusion, educational level (literacy, ICT education) and institutional support.

Access to digital technology can bring significant benefits to smallholders and other rural enterprises in terms of supplier relationships, access to information, employability of talented workers, forging strategic partnerships, access to support services - educational, financial, legal - and especially important to markets and consumers.

At the same time, however, the introduction of digital technologies in rural areas can be accompanied by certain problems. Globally, the rural population is shrinking and there are limited training and employment opportunities. Infrastructure, including basic IT infrastructure, is often lacking, especially in the most remote rural and indigenous communities. The cost of building IT infrastructure is a major obstacle in rural areas, which are often very poor, especially in developing countries or least developed countries (LDCs).

All over the world, the number of mobile phone subscribers has been growing in recent years. From 2013 to 2018, there were a billion more of them, and today the share of mobile subscribers is 67% of the global population [4;5]. Much of this growth has come from Africa and the Asia-Pacific region. Access to computers and the Internet has also increased in LDCs and developing countries. However, 3.8 billion people still lack access to telecommunications services, with a disproportionate proportion of them concentrated in rural and remote areas[4].

One problem is that rural network coverage is still limited. Although 4G has become the most widely used connectivity technology in the world today, and over 90% of subscribers have at least 3G connectivity, 3G coverage in LDCs covers only about a third of the rural population [5].

Smartphones have become the main means of Internet access for consumers. Reducing device prices and innovations such as prepaid plans are making mobile communications even more affordable, both financially and practically, which is also true for rural communities [6]. Globally, seven out of ten poorest households have mobile phones, and this proportion is even higher in LDCs (ITU, 2018). However, not all of their phones provide Internet access.

Although in recent years the number of smartphone owners and the number of users of mobile broadband technologies have grown at a faster rate in developing countries than in developed countries, the

share of mobile broadband subscribers is still twice as high in developed countries as in developing (Fig. 1). In LDCs, the main obstacle to smartphone ownership remains financial inaccessibility: a base rate that includes mobile broadband corresponds to more than 60% of gross national income per capita [8].

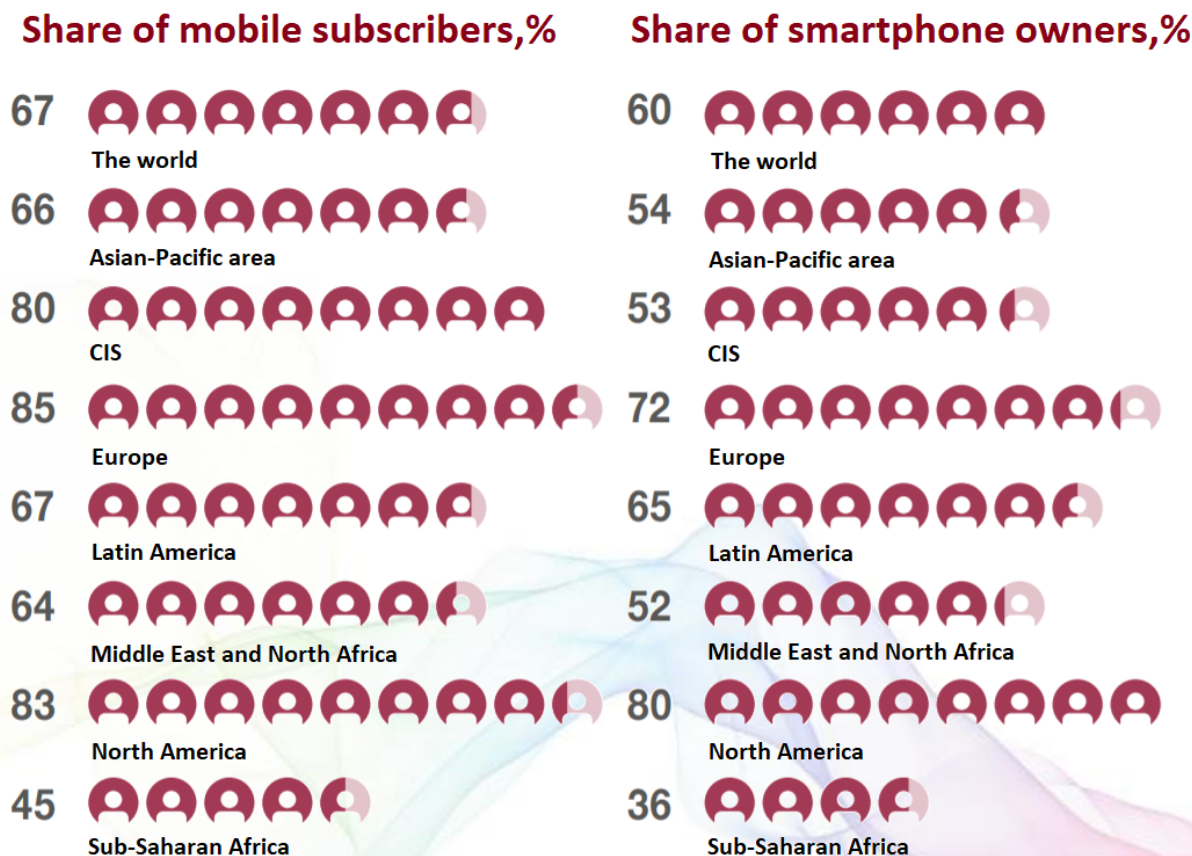


Fig. 1. Share of mobile subscribers and smartphone owners by region, 2018,% [5]

In the context of the Sustainable Development Goals, digital agriculture can deliver economic benefits through increased productivity, better spending and market opportunities, through increased communication and greater inclusiveness, social and cultural benefits, through optimized use of resources and adaptation to climate change. - environmental benefits.

The potential benefits of digitalization in the agri-food industry seem compelling, but realizing them will require major changes in agricultural production systems, the rural economy, community life and natural resource management. Based on the foregoing, obtaining potential benefits in full will require a holistic, systematic approach.

Education level, computer literacy and rural employment. The use of digital technology requires a basic level of literacy, numeracy, and certain technical knowledge and skills. In societies where digitalization is becoming an increasingly powerful driving force, people without these skills risk being marginalized.

In rural areas, lack of infrastructure and resources often limits the quality of education. As a result, the effectiveness of learning decreases, students attend school less often and drop out earlier. In addition, rural youth often have to work, and there is little time left for school.

As a consequence, educational attainment in rural areas is often lower than in urban areas, which is especially true for LDCs (Figure 2). Despite the fact that 60% of countries for which data are available have succeeded in eradicating youth illiteracy completely or almost completely, in rural areas of many LDCs, literacy

rates, especially among women, are still low. The population's inability to read and count greatly hinders the use of digital technologies.

In addition, to use computer technology, you must be computer literate. Compared to many developed countries, where students regularly use advanced digital technologies and skills in both education and daily life, LDCs lag behind in terms of ICT knowledge and digital skills. In many LDCs and developing countries, basic computer training is not included in primary and secondary school curricula, as governments and the private sector have no incentive to invest in digital skills when already digital skills can be recruited. skills of workers.

The lack of digital tools in schools, including tablets and laptops, was cited by teachers as the main obstacles to teaching computer science [1]. In addition, teachers lack the necessary skills. This primarily applies to rural areas. In urban areas, schools generally have access to the Internet and online educational resources. At the same time, rural and remote schools are often denied access to the Internet. This situation exists in developed countries as well, but the problem is most acute in developing countries and LDCs.

Over the next 15 years, 1.6 billion people in developing countries and LDCs will reach working age. Providing them with the opportunity to work while maintaining their existing employment will be very difficult, especially in the agri-food sector [16]. In rural areas, unemployment is disproportionately high, with women and youth being the main victims.

The agricultural sector in rural areas has been and remains the main source of livelihoods. The digitalization of the sector will significantly change the nature of work and the requirements for workers and their skills. The demand for computer literacy of workers in the agri-food sector will gain relevance, which will require the organization of appropriate education and training.

Digitizing agriculture and rural areas will still require a lot of work. In this case, a number of particularly important factors should be taken into account.

First, understanding the concept of digitalization of agriculture is largely hampered by the lack of systematic, official data on this topic. Most of the data - for example, on the level of computer literacy - is only available at the country level, without disaggregation by urban and rural areas. Network data mainly reflects coverage, but does not provide information on the quality and availability of services. There is a lack of information on government support and the regulatory framework for digitalization, which has so far been carried out indirectly, including on the availability of electronic government services and regulatory frameworks in terms of connectivity and data protection.

The second problem is the significant gap in the introduction of digital technologies in the agricultural sector of developed and developing countries, as well as in global companies and in local, community, family farms. The introduction of modern agricultural technologies is due to the availability of financial resources and the level of education. Smallholder farmers in rural areas are disproportionately disadvantaged in this regard, with limited access to infrastructure, networks and technologies.

Finally, economies of scale are taken into account when implementing digital agriculture. The larger the scale of the enterprise, the easier it is to implement such technologies. In this regard, large farms have an advantage over small ones. This situation generates inequality between large and small farms and, accordingly, inequality between developed and developing countries. Digital innovation and technologies that are paving the way for transformation are often not created for the scale of smallholder farming.

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