

Digital technologies as the factor of development of agro-industrial clusters in the countries of Africa

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Abstract—In this article the author carries out scientific consideration of a question of use of digital technologies as factor of development of agro-industrial clusters in the countries of Africa. The main problems that can be focused scientific research in the further study and research of digital technologies in agro-industrial clusters in the countries of Africa are revealed. The author drew recommendations and conclusions concerning understanding of features and nuances of the existing factors of development of agro-industrial clusters, at the same time, the author structured problems of further implementation of digital technologies in the countries of Africa in the considered sphere.

Keywords—Africa, agro-industrial cluster, digital technologies, agriculture.

Digital technologies open the road for the whole revolution in an agro-industrial cluster, it is designed to make agriculture more smart, more effective and more reliable. Increase in efficiency of decision-making process will stimulate the economic growth of the country in an agro-industrial cluster, thanks to increase in ability of a cluster to compete due to increase in efficiency and reduction of losses.

In the matter there is an enormous potential, in particular for farmers with small economy. Such farmers living in rural areas about the most important farmers in developing countries, such as Africa are those who will be able to get the greatest profit and efficiency on similar technological implementations. In most cases they have most a disadvantage concerning access to agricultural resources of an agro-industrial cluster, finance and the credits, storage and professional consultations, and as a result are the farthest effective management of the agriculture [1, p. 25].

An opportunity to get professional advice – most easily and effectively giving in digitization a component in the system of increase in development of agro-industrial clusters. We take in an example company BAYER. In it the application under the name "WEEDSCOUT" allowing to distinguish weeds according to photos was developed.

Belonging with all importance, it is necessary to understand that digital agriculture should be in an upper part of the strategic agenda of the countries of Africa. Having headed in this direction, Africa can create competitive advantage in comparison with European farmers and all agro-industrial complex of Europe. Africa should seize the moment and take the lead in forming of the next generation of agriculture[3, p. 2].

It is necessary to take the following measures to promote digital agriculture within the general agricultural policy: make digital agriculture a positive step in the continuing process of reforms and use means for support of farmers who already took steps for digitalization and also encourage those which did not make it yet; providing target financial support considerably would increase transition probability of the farmer to farming practices on the basis of digital data.

A large number of researches prove that agro-industrial clusters of Africa as social and economic systems with specific properties and characteristics, are capable to integrate small and medium business into a chain of creation of added value and to create conditions for its effective activity [2, p. 17].

As showed in one of the researches conducted earlier, agro-industrial clusters did not gain due development in Africa and did not change a situation in the agro-industrial sector. Still, despite achievements of agriculture in recent years, the gap between production of agricultural products and its processing quality of life of people in rural areas and the cities, labor productivity and problems of development of the agro-industrial sector is observed. Despite a considerable share in agro-industrial production of the small and medium enterprises, many of them are limited in use of new innovation and high technologies as are excluded from developments and improvement of business.

It is possible to change a situation by implementation of the concept of management of development of agro-industrial clusters via mechanisms of improvement of interaction of participants of clusters means of information technologies. Processing of digital data of economic activity of participants of an agro-industrial cluster and use of results of their analysis for increase in efficiency of processes of production, storage, sales, deliveries of goods and services on each repartition in a chain of creation of added value becomes a key factor of development of clusters. The basis for implementation of the concept "Digital cluster" is accepted within the Development strategy of information society in Africa [6].

At the same time, the intensification of modern agriculture on the continent is becoming increasingly widespread. As the Nigerian author of the Harvard Business Review notes, African farmers are striving as widely as possible to use various highly efficient and cost-effective technologies that can significantly increase profitability by increasing yields and product quality [8, p. 56].

The integrated information management system a cluster - "a digital cluster" - becomes the tool of the organization of

interaction synchronizing activity of participants of the cluster educations acting on the basis of the direct contractual relations (contracts) that will actually transform activity of separate small-scale enterprises to a self-organizing economic system. At the same time conditions of transparency of management are met, the balanced development of the primary activities entering the agro-industrial sector information vacuum as for vendors and consumers of agro-industrial products on all its repartitions, and for investors is liquidated. In comparison with the fragmented business organization, at the vendors integrated into cluster designs the investment attractiveness increases that contributes to the development of business, territories and the agro-industrial sector of Africa in general [4, p. 4].

It is about implementation of complexes of the analysis of productivity and application of fertilizers, a status of soils and finished goods, expansion of use of meteorological data, use of systems of navigation, irrigation upgrade, automatization of cattle breeding farms and also many other. Different startups in Nigeria, Kenya, Ghana, Ethiopia and some other countries aimed at an intensification of agriculture and development of modern "exact agriculture" are oriented to cooperation with landowners.

One of the main problems in this sphere traditionally consists in too high prices of the different hi-tech equipment which owners of small African farms are not able to afford. Other negative aspect – almost total absence of commercial crediting of agricultural producers.

According to the Food and Agriculture Organization of the United Nations, more than 60 percent of all able-bodied population are engaged in Africa in agriculture now, not less than 30 percent of GDP of the countries of the continent have the share of the industry. Besides we will remind that many African countries wait for the help in fight against degradation of land resources [9, p. 15-16].

Domestic landowners also aim not to lag behind world process on digitalization of productions as understand clearly what to work "in the old manner", means to lose in the world competition. Modern agrarian production should be "smart". And it means not only orientation to demand and preferences of consumers, but also decrease in expenses and growth of efficiency on the basis of use of digital technologies (satellite pictures, algorithms of diversified processing of the earth, hi-tech sensors, drones, mobile applications and GPS systems and so forth).

Modern infrastructure will contribute to the development of "smart" agar production. So, the domestic companies are ready to develop infrastructure. The AYR-TELECOM company develops a data transmission network on the LoRaWAN standard. And for 2 years it is going to connect to it not only 30 cities, but also rural areas as the enterprises of agriculture are outside city line. The feature of LoRaWAN is that she is capable to provide communication at distance of 20 km in the clean floor. Development of network in rural areas is favorable. According to PWC, creation of "smart" farms allows to increase milk yield by 30-40%, and introduction of control of transport reduces costs of fuel consumption of 20% [1].

It is necessary to give an example of implementation of clever technologies in the Moscow region. So, on meat-processing plant "Okraina" the system of operational management of production is introduced. The system is

directed to increase in labor productivity, cost saving and improvement of quality of products. The project consists of three main units [2, p. 45]:

- the first allows to trace, analyze and draw conclusions about labor productivity of each worker. Activity of workers is monitored by means of the smartwatch;
- the second allows to monitor activity of the worker on the basis of video surveillance, to carry out the analysis of process of production and efficiency of labor costs of each worker;
- the third visualizes production by means of sensors. They monitor movement of a container, raw materials and materials and also an operating mode of the equipment, temperature condition at production and so forth. This unit allows you to control the quality of products, track the time of production of defective products and determine the causes of defects (technical, technological, "human" factor etc.).

The introduced system in the first month of application would allow to lower the wages fund by 30%, general production expenses (fuel and lubricants, the electric power, food and so forth) — for 10% [6].

In addition, the Bagre agro-industrial cluster (AC Bagre) in Burkina Faso is one of the most successful agro-industrial clusters in Africa. so it is important to consider the introduction of digital technologies in the agribusiness cluster Bagre. On June 21, 2011, the World Bank approved the project on the creation of agro-industrial cluster Bagre [10].

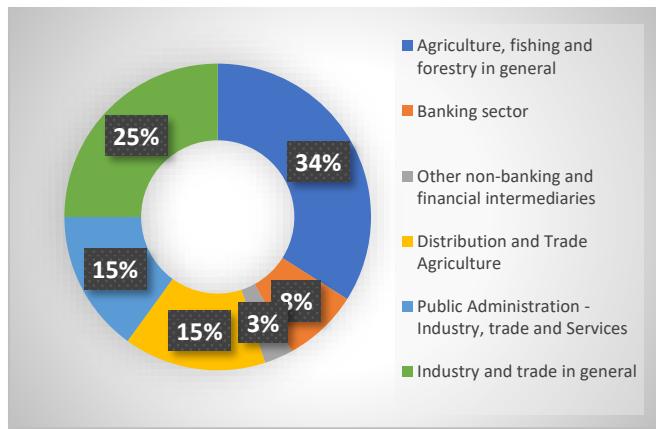
Agro-industrial cluster Bagre was created at the initiative of the Government of Burkina Faso, by Decree No. 2013-555 / PRES / PM / MEF of July 5, 2013, by the former President Blaise Compaore "On the approval of the governing document for the development of clusters in the Republic of Burkina Faso". Today, Bagre is the only agro-industrial cluster in West Africa and is located in the Bagre region, which is located about 250 km from Ouagadougou, the capital of Burkina Faso. In 2012, the cluster opened the launch of the New Alliance for Food Security and Nutrition (NASAN), which was an important stage in the economic reforms in Burkina Faso. Its main goal is to contribute to increased economic activity in the Bagre region by increasing private investment, job creation, and the production and processing of agricultural products. The total cost of AC Bagre's sales is \$ 133.70 million, of which the World Bank financed 86%, i.e. \$ 115 million [11].

Agro-industrial complex Bagre includes three components:

1. Improving institutional capacity and investment climate in the project area for more efficient management of the region;
2. Development of key infrastructure facilities (construction and equipment of irrigation canals to irrigate of up to 15,000 hectares of agricultural land; work and services in the field of animal husbandry, preservation and processing of fish; restoration and construction of roads, and arable land);
3. Developing the necessary services to support small farmers and small and medium-sized enterprises (financial and private sector projects, technical assistance).

Agro-industrial cluster Bagre provides development of 30 thousand hectares of land, of which 15 thousand hectares should be used for construction and equipment of irrigation canals, and 6 thousand hectares should be provided for the activities of small producers [12].

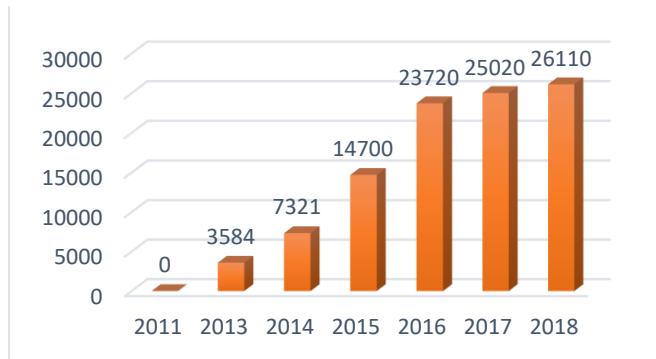
AC Bagre includes 6 main sectors [13]. (Fig. 1). Of these, the largest shares are in the agriculture, fisheries and forestry sectors; and industry and commerce.



a. Source: compiled by the author on materials from the Official website of the Universal Bank <http://projects.banquemondiale.org/P119662/burkina-faso-bagre-growth-pole-project?lang=fr&tab=overview>

Fig. 1. AC Bagre main sectors

Since the formation of the cluster, a large number of jobs have been created. Currently, there are 26110 jobs 79% of the total number of planned jobs by 2020, i.e. 33000.[14]. (Fig. 2)



b. Source: compiled by the author based on materials from the Official Website of the Universal Bank <http://projects.banquemondiale.org/P119662/burkina-faso-bagre-growth-pole-project?lang=fr&tab=results>

Fig. 2. Dynamics of created jobs in AC Bagre from 2011 to 2018.

The specific tax regime of AC Bagre provides customs and tax benefits to private investors (individual entrepreneurs, unions, associations, etc.) that have an investment agreement with AC Bagre, as well as to contractors and cluster management structures during the investment phase and the operation phase.

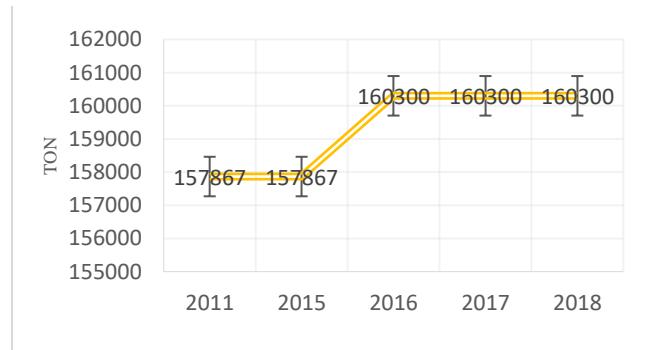
These benefits include, in particular, a full exemption from VAT and income tax, customs duties and other fees charged for the importation of goods and services intended for sale in the local market, as well as property tax, business tax and training tax on income for receivables. At the stage of operation, the level of accumulated duties and taxes paid by investors is 7.5% for all imported goods and services. Also,

investors receive a full exemption from all taxes and duties on exports, as well as a full exemption from income tax during the first 7 years of the business, and after these 7 years the tax rate will be 15% over the entire life of the business. Due to this specific tax regime in AC Bagre in 2017, there are about 167 companies, among which 89 are private providers.

The creation of a hydroelectric dam Bagre had a beneficial effect on the environment and on the development of this area, as the dam provides serious support for the sustainable development of communities in its coverage area (irrigated agriculture, fishing, cattle breeding, trade, tourism), and also supports the development of the entire Bagre region. The existence of the dam caused significant changes in relation to the living conditions of the population, the protection of agricultural activities (rice cultivation, seasonal agricultural crops), cattle breeding; and the development of other activities, such as fishing, fish processing and other income-generating activities.

In addition to the hydroelectric dam, for the effective use and development of the cluster "Bagre" were built: Business Center, Center for Ecotourism, Institute for Training and Training Personnel IFODER, Radio FM Bagre (FM Bagre).

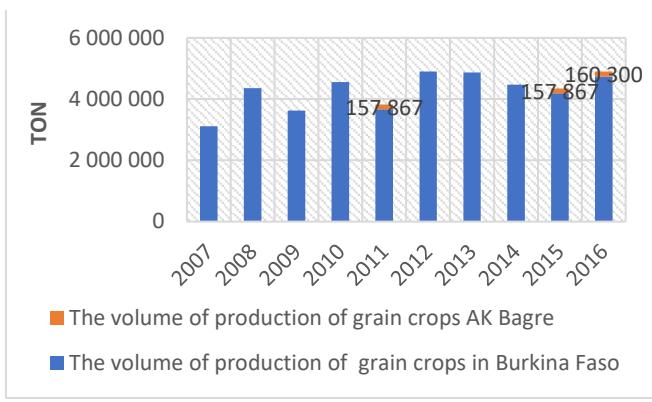
The main agricultural crops grown by AC Bagre are cereals (rice, corn, sorghum, millet, beans, etc.). The volume of production of grain crops in AC Bagre in 2011 amounted to 157867 tons, it increased by 2433 tons by 2018. (Fig. 3). Currently, the volume of cereal crops production is 73% of the total planned cereal crops AC Bagre production by 2020, i.e. 220,000 tons[10]. Part of the production of AC is used by the national market, and the other part is exported to Niger, Togo, Benin and Ghana.



c. Source: compiled by the author based on materials from the Official Website of the Universal Bank <http://projects.banquemondiale.org/P119662/burkina-faso-bagre-growth-pole-project?lang=fr&tab=results>

Fig. 3. Dynamics of production of grain crops AC Bagre

The following figure shows the dynamics of cereal production in Burkina Faso and the share of AC Bagre's grain production in the total cereal production in Burkina Faso. (Fig. 4)



d. Source: compiled by the author based on of the UN and FAO data
www.fao.org/faostat/fr/#country/233 et
<http://perspective.usherbrooke.ca/bilan/servlet/BMTendanceStatPays?langue=fr&codePays=BFA&codeStat=RSA.FAO.CerealsTotal&codeStat2=x>

Fig. 4. The share of the production of cereals AC Bagre in the total production of grain in Burkina Faso

In Burkina Faso, the volume of cereal production for the entire study period varies. The lowest production volume was 3.1 million tons in 2007 due to the global crisis, and since 2012 there has been a sharp increase in the volume of cereal production in the Republic to 4.9 million tons, due to good climatic conditions, the implementation of a number of various agricultural programs and the formation of agro-industrial cluster "Bagre". In 2014, the volume of grain production amounted to about 5 million tons, thus, the increase of 4 % of the volume of their production for the period 2011-2014.

The share of cereal crops AC Bagre production is not large and amounts to 3% of the total cereal production in Burkina Faso in 2016. In 2017, the production of grain crops of AC Bagre increased from 4% to 8%. At this point in time, the first phase of AC Bagre allowed to increase rice yield by 30%, train about 10 thousand people. in areas such as agricultural production, livestock and fisheries - according to Mr. Jacob Ouedraogo, Minister of Agriculture of the Republic of Burkina Faso[15]

AC Bagre is the most successful agricultural development project in Burkina Faso and on the African continent, as it will meet the needs of the country's population for agricultural products - according to the Prime Minister of Burkina Faso, Mr. Paul Kaba Teba. Despite this, AC Bagre has a number of difficulties in the process of its development, among which there are such as:

- Intensive use of chemical fertilizers and pesticides;
- lack of modern equipment;
- lack of digital technology;
- the climate disturbances
- excessively active and wasteful use of land by foreign investors at the expense of the most vulnerable segments of the population;
- lack of support for small producers in the development of irrigation infrastructure;
- lack of advice to the local population and their representatives, organizations, peasant, women's organizations and non-governmental organizations, as well as local government bodies.

The introduction of digital technology in AC Bagre, for example, Smartphones, sensors (N-Sensor ALS), drones (UAV Pteryx) and the smart greenhouse, allows us to solve the problems of using pesticides, chemicals and earth, deciphering their exact amount for better land use and increase their productivity. In addition, they can reduce the costs for the purchase of pesticides, chemicals and protect the land. The smart greenhouse promise an excellent yields better than in the open field, because of its advantages on climate control. Its must be able to reduce the surrounding climate disturbances, so that plants can develop in accordance with the conditions set[16]

In conclusion, we can say that in Africa to eradicate hunger and poverty in rural areas in the next decade, the African Development Bank is taking its strategy of "Feeding Africa" (Nourrir l'Afrique), to revolutionize agriculture in Africa. This will be achieved through transformation based on the large-scale development of agriculture as a high-value-added business, stimulated by the private sector and supported by the state, which uses innovative financing and modern technologies.

The world has now entered an era of using digital technology for agricultural development. Developed countries are rapidly developing innovative technologies dominated by digital platforms, artificial intelligence and robotics. The African economy in general and agribusiness clusters in particular need to be integrated into this process in order to increase production efficiency and preserve the environment. Due to these technologies, African farmers will be able to increase the efficiency of their activities and get closer to the production performance of farmers in developed countries. And in order for local examples of digital technology to become ubiquitous, it is necessary to make the agricultural industry attractive for young people.

The development of agricultural production in Africa and in the world is a priority and strategic task now. But the use of digital technologies in the main branch of the African economy, that is, agriculture, will it not increase the level of unemployment in this region?

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