Green strategies for the sustainable growth of food security

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Abstract. Modern society today is reconsidering its development strategy in the light of changing environmental conditions. The global climatic changes observed over the last 30-40 years require not just a careful attitude toward nature and resources, but a comprehensive review of the technologies of production and processing of raw materials and resources. The consumer strategy that has dominated society for the past 2-3 centuries must be completely transformed into a new philosophy of sustainable development of economic systems and growth of food supply for the growing world population. Deteriorating production conditions and resource depletion will not allow a growing humanity to develop at the same speed without a sustainable food base. Therefore, the task of increasing food security becomes a priority in the strategy for the development of the national economy.

1 Introduction

For several centuries, the world economic system has evolved on the principle of increasing productivity and efficiency to provide mankind with food, without taking into account the fact that nature cannot indefinitely give up its resources, recycling the waste and emissions it receives in return [1]. The changes taking place in the environment have taken on a planetary scale. The accumulated threats are forcing a radical change, not just of single economic systems, but the formation of entire international commissions to develop future strategic solutions to address the situation.

A coordinated approach among countries will make it possible to reduce the anthropogenic burden on nature, stop the development of negative socio-economic processes,

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reduce the gap between countries, and eliminate barriers in communication on ecology and environmental conservation. In addition, each country must clearly understand its share of responsibility for its contribution to pollution. The main trend of inter-country cooperation should include the desire to converge approaches to the control and verification of emissions and absorption of greenhouse gases [2, 3, 4]. Only by developing universal evaluation criteria, it is possible to present a comprehensive overall picture and to work together to reduce the carbon footprint, to actively promote the development and expansion of the absorption capacity of natural ecosystems, to stimulate the use of green financing instruments to support climate projects and the transfer of the best available technologies.

Today, international climate services estimate the carbon footprint of each state over a number of years. Figure 1 shows some of the EAEU countries and their carbon footprint. The 1990 and 2021 figures are compared for clarity. As we can see from Figure 1, the maximum footprint is left by Russia, which in 2021 reduced it to 2119 million tons, compared to 1990's - 2,885 million tons. The other countries represented also reduced their carbon footprint, with the exception of Uzbekistan - an increase of 17.7% in 2021. The overall estimate of the reduction of the carbon footprint for the period 1990-2021 for the represented countries ranges from 62% (Armenia) to 11% (Cuba).

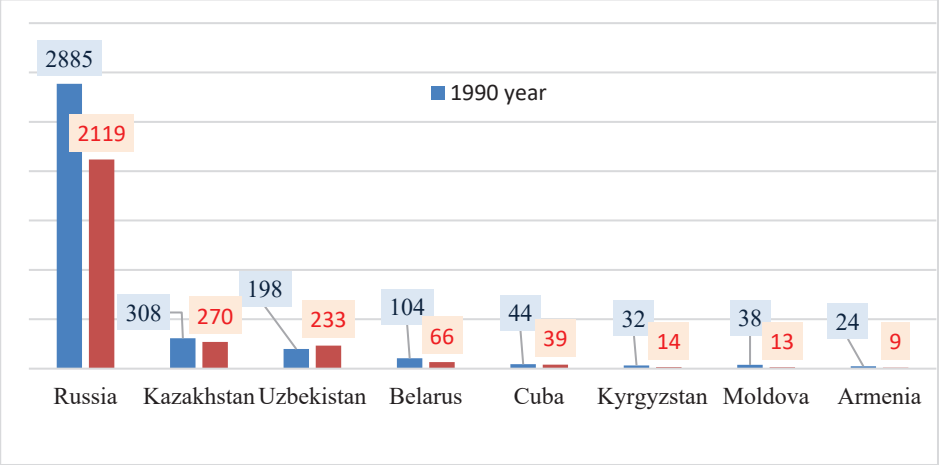

Fig. 1. Greenhouse gas emissions in the EAEU countries, million tons.

The general trend is obvious - to work collectively to reduce emissions and gases in the atmosphere, to form a common bank of low-carbon technologies and projects. The high rate of degradation of natural ecosystems will not allow to develop and expand the food base by former extensive technologies, which brings the "green" theme today to another strategic level [5, 6].

2 Results and discussion

Since Russia adopted the Declaration on the Implementation of Green Economy Principles in 2013, work on the development of "green" resource-saving technologies in all sectors of the economy has been underway for 10 years. As part of the implementation of the climate agreement the Strategy of socio-economic development of Russia with low greenhouse gas emissions until 2050 (hereinafter the Strategy) was adopted, which sets a general vector of socio-economic development of the state in a low-carbon agenda. The plan is to achieve carbon neutrality by 2060 (Figure 2).

Figure 2 shows that the trends in the overall reduction of gas emissions do not reflect significant shifts, but by 2050 the goal is to reach 630 million tons of CO_2 due to the growth of gas absorption. In fact, the level of net emissions should decrease over the period 2019-2050 by 60%, while the absorption volume should increase by 55%. Total greenhouse gas emissions into the environment will be reduced slightly (by 13.6%), because population growth and scientific and technological progress require more production of civilization goods. Therefore, the developers of the Strategy emphasize the strengthening of technologies to reduce and absorb gases [7].

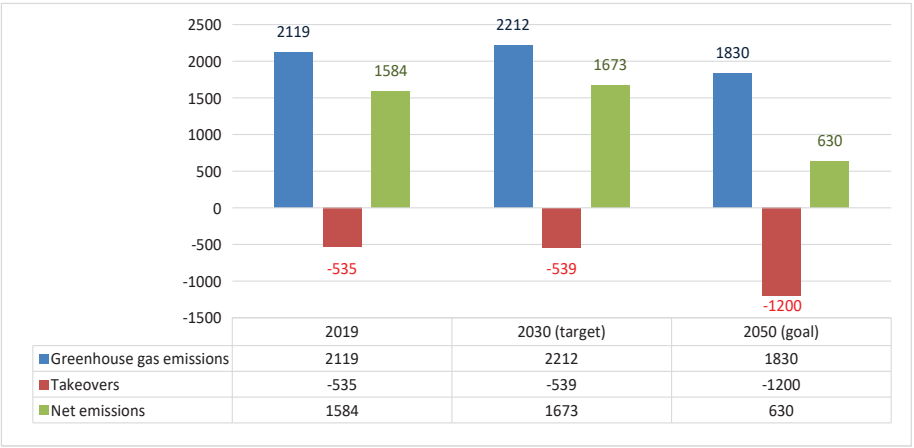

Fig. 2. The level of emissions by 2050 under the implementation of the Strategy, million tons of CO2 equivalent.

The collective response of countries to climate challenges is the expansion of "green" movements in all areas of economic development. It may be noted that fundamentally new production strategies are being formed, which will be harmoniously integrated into the ecosystems of the territories [8, 9]. According to official documents, it is the agricultural sector that should become a pilot area for the implementation of "green" production strategies. According to the UN estimates, agriculture ranks 5th by the volume of environmental pollution, but at the same time it is not as toxic as industry or chemical industry. While comparing harmful emissions produced by different sectors, according to FSSS, it is clear that sectors of agriculture are not the main polluters of the environment: land use and forestry absorb greenhouse gases, while only livestock farming produces emissions; at the same time, agriculture emits 93% less gas than the energy sector and 51% less than industry and processing sectors.

Let's take a closer look at what technologies and branches of agriculture produce emissions into the atmosphere (Figure 3). Figure 3 shows that the main problem is the technology of soil cultivation to 61.26 million tons of CO_2, which use aggressive chemical fertilizers for intensive productivity growth. Most of these fertilizers remain in the soil and then go into the groundwater. The second problem associated with the industries of the agro-industrial complex - fermentation of farm animals to 39.09 million tons of CO_2. In animal husbandry the problem of environmental pollution is more acute than in plant growing and forestry, as this industry does not absorb emissions, but only aims to produce food raw materials. Population growth and related nutritional needs impose an additional burden on the agricultural sector, which, with limited land resources, must produce an increasing amount of food raw materials from year to year [10, 11, 12].

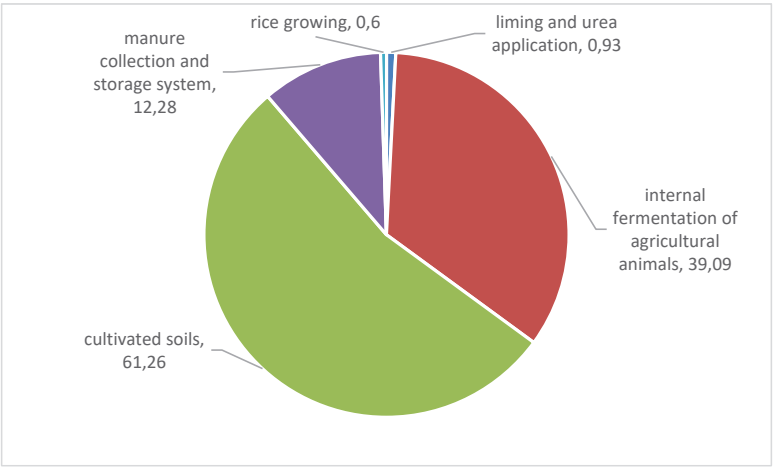

Fig. 3. Level of greenhouse gas emissions in the agricultural sector in 2020, million tons of CO_2 equivalent.

Intensive and unsystematic use of chemical fertilizers to increase productivity, the use of antibiotics in livestock and growth hormones give only a short-term spike in productivity, while the land and animals are actually destroyed. This strategy has no long-term prospects in the future, as it undermines the basis of the agro-industrial complex - depleting the land fund and reducing the viability and reproductive function and reproductive capacity of farm animals and birds [13]. Experiments on synthesizing artificial food raw materials are sporadic and do not find broad public support. Therefore, in order to preserve the food base for future periods it is necessary to review the strategies of agricultural production in favor of resource-saving "green" technologies of intensive production.

The problem of agricultural production is the depletion of soil, erosion, water pollution and as a result of this process - the reduction of suitable agricultural land. An alarming fact is the expansion of semi-deserts and deserts in southern Russia with anthropogenic origin. A number of agricultural regions of southern Russia are already subject to desertification processes, which also become a social problem - a source of income for the local population disappears and there is a forced migration to large cities and other regions. The best-known desert of anthropogenic origin is the "Black Earths" in the Republic of Kalmykia, which appeared in the late 1980s-1990s as a result of uncontrolled growth and breeding of farm animals and increased pressure on natural pastures. Despite the efforts of the world economic communities under the auspices of the UN, this problem has not yet been solved [13]. Therefore, we can see that it is possible to deplete the soil actually in 1-2 years, and it takes several dozens of years to restore it.

The land fund is also a sink for carbon dioxide, but its absorption capacity may decrease as it is exploited. Russia, with its vast areas of land fund, can become a major generator of the carbon-neutral movement [14]. But this requires investment in carbon agriculture or more precisely regenerative agriculture: planting plants and seedlings on abandoned and degraded lands, on unsuitable areas for agriculture, reducing the use of mineral fertilizers in crop production, increasing the use of forest agrosystems (forest pastures, alley plantings, forest farms, windproof plantings).

Regenerative farming is a new direction in crop production, not just related to resource conservation, but also aimed at regenerative soil-protective measures in the process of agricultural production. Plant production process cannot be stopped for several years as land resources are limited and it is extremely unprofitable to take the land out of turnover, so it is

necessary to combine production and regenerative processes in one agricultural cycle [15]. This solution is offered by regenerative farming technology, which is based on a number of fundamentally important rules (Figure 4).

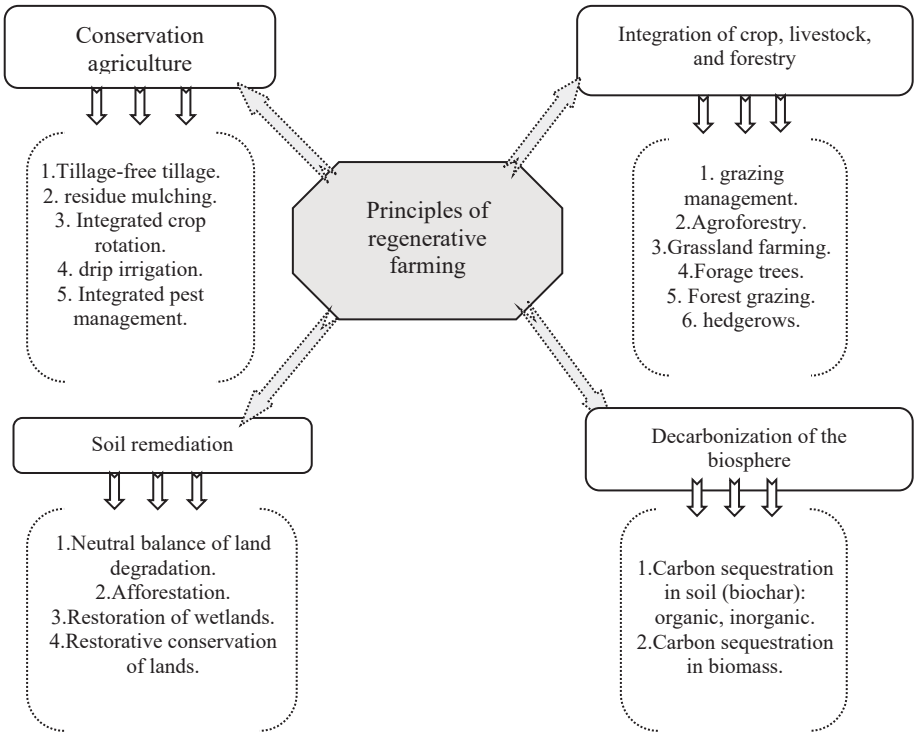

Fig. 4. Basic principles and technologies of regenerative farming.

Figure 4 proves that regenerative resource-saving technologies are becoming increasingly widespread in the agro-industrial sector. Concern of the world community about the reduction of suitable areas for agricultural production in parallel with the growing needs of the world population in the future may serve as a powerful trigger for the growth of military conflicts and social disaster in Asia, Africa, Latin America, where the problem of hunger or hidden "hunger" is extremely acute [16, 17, 18].

In addition, sufficiency of quality food raw materials is the key to the growth of a healthy young working-age generation [19]. Therefore, technologies, which will not only intensively produce food raw materials, but also restore the soil cover and ecosystems will allow to overcome a number of global withdrawals: reducing the cost of food production, increasing economic access to quality products for all social categories of citizens, slowing the degradation of agricultural land, preserving the absorption capacity of natural ecosystems CO_2, reducing anthropogenic pressure on the environment, reducing the growth of natural cataclysm [20, 21].

3 Conclusion

The transition of many countries to "green" technology today is fragmented, as it affects individual industries and sectors of the economy. To expand this trend, a comprehensive strategy of interstate coordinated cooperation is needed, which will reduce the accumulation

of harmful emissions in the atmosphere, slow down climate shifts and increase the productivity of industries of the agro-industrial complex without harming the environment.

The combination of regenerative farming technologies is a new approach in agriculture, which seems promising under strict state regulatory regulation of the entire industry. The Russian Federation, as the country with the most extensive land and forests, is capable of leading this movement and implementing the principles of "green" and regenerative agriculture on its territory.

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