

## **Agro-Industrial Clusters of Russia in the Xxi Century: Looking Forward\***

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**Abstract:** *Interdisciplinary research based on the use of objective multidimensional data from various independent sources pointed out that the World System develops in the regime with aggravation, humanity has entered into the deepest evolutionary global systemic crisis, that is unprecedented in history, unprecedented increased risks of global catastrophes. Along with this has opened up new opportunities for human development. Most advisable implement the creation of a global system of clusters, including agriculture, using the properties of the external environment. Clusters allow us to locally solve global problems, and partly to stop the global systemic crisis and prevent a global catastrophe. A significant contribution to the development of clusters can Russia, possessing unique resources and capabilities. The development of clusters in Russia is becoming increasingly global in nature. It is advisable the formation of a system agranny Russian cluster, using new knowledge, a variety of natural mechanisms, innovative technologies that will improve the efficiency of agriculture in Russia and prevent a global catastrophe.*

**Keywords:** *Agriculture, agroforestry clusters; interdisciplinary studies; global systemic crisis; the modes with an aggravation; increase scientific capacity and the number of clusters is the megatrend of the XXI century global problems, risks, disasters; global climate change, positive feedback; chain/network reaction; self-organization; the hypothesis of the development of complex systems; global system for clusters; multimodal; clusters III-th generation; multidimensional synergistic mechanism; local solutions to global problems; the concept of sustainable development, green economy, preventing a global catastrophe.*

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**The purpose of the study** is to identify and exploit the capabilities of the various aspects of the global systemic crisis for the development of Russian cluster system as a holistic tool for the development of Russia's AIC and the relief of the global systemic crisis and global disasters, to develop a theoretical basis for the formation of agro-industrial clusters in Russia, including their models.

**The leading approaches to the study** of the problem are multidisciplinary and global approaches.

**For the first time** a descriptive model of the global systemic crisis is developed, which allows to identify unprecedented dangers in general, and - new opportunities, which can be partially cropped and positively used by the cluster system for their self-development. For the first time the hypothesis of the complex systems development was formulated, namely the clusters of global catastrophes in the blow-up regime, promoting the development of effective clusters and disaster prevention. **For the first time** multi model of the third generation cluster was developed, implementing ultrafast processes in the blow-up regime, aimed at local solutions to global problems, risk reduction and prevention of global catastrophes, import substitution, development of the Russian agriculture in high-tech environment-friendly manner.

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\* The article uses specific terminology resulting from the application of an interdisciplinary approach. A kind of introduction for this publication is article Huhurin A. S., Bundina I., Agnaeva I. Yu., Tolmachev N. P. "development of agro-industrial clusters in Russia: synergetic approach", previously published in the journal international journal of econometrics and financial management, 2014, 2(4), pp. 130-135. Electronic resource: <http://pubs.sciepub.com/ijefm/2/4/3/index.html>.

It is necessary to introduce a short essay to the main content of the article that reveals the essence of research and facilitates the perception of its results.

Complex systems, namely economic clusters - are a product of human development, its environment, living conditions, the global situation. Clusters cannot be separated from all these. Understanding the emergence and development of clusters conditions allows better define their purpose and future development.

Complex systems, (especially such as "Humanity - Biosphere", global catastrophes, agricultural clusters, etc.) are self-organized, self-regulated, dynamic, contradictory, versatile and multifunctional. Therefore, in order to fully understand them, and moreover effectively influence and develop them, the **interdisciplinary approach** to research and development of complex systems is necessary. They should be explored as self-organizing systems, networks, socio - economic, biological objects, etc. in conjunction with the environment. At this time, humanity is, and in 2060 is likely to be in serious evolutionary global systemic crisis, the outcome of which can be either a transition of mankind to a higher stage of development, or a global catastrophe fraught with its downfall. The results of a holistic analysis of the global systemic crisis provide a depressing effect (Table. 1). The mankind implements a suicidal "development". But there are positive trends, megatrends. And they should be used. Prominent Russian scientist, the founder of synergy, its original Moscow branch, Sergey Pavlovich Kurdyumov, who researched blow-up regimes, stated: "There is no need to wait with our heads low for a new global catastrophe, we need to try another way to simulate the development of the world" [1]. Multidisciplinary studies, the synergy are the key to the understanding of complex systems: to the development of clusters, the prevention of global catastrophes, etc. The elementary units of the cluster approach, synergetic, theory of complex networks, systems and other sciences research are the "networks". They are ubiquitous. Clusters are networks, natural ecosystems at any level are networks. The world is interconnected, and there are even no basic independent units and entities in it. Any unit is in the context of the relationship and interaction networks. It should be evaluated precisely in the context of interconnections. This idea is clearly expressed by Fritjof Capra: "The universe is seen as a network of interrelated events. None of the properties of a portion of the network is of a fundamental nature, all of them are caused by the properties of the other parts of the network ... "[2].

The world population, world GDP, global urbanization, literacy of the population of the world, information flows, China's GDP in the last 30 years, a variety of marine biota during the Phanerozoic eon (the last 542 million years), increase in concentration of carbon dioxide over the past 10,000 years, spontaneous recovery of patients, disasters and even paradoxically writing this article and a lot more develop, being modified, occur in a blow-up regime.

Accordingly, clusters, including agro-industrial ones should develop in a blow-up regime. Since the "clusters" are an integral part of the network "World – systems", they are also "networks". Clusters are concentrated locally and dispersed globally. Now the networks of international clusters are formed. It is necessary to create a global system of clusters, especially agro-forestry as a holistic tool to strengthen the positive impact and the development of humanity, prevention of global catastrophes, agriculture development in Russia and the CIS countries.

## 1. INTRODUCTION

In the World - System two opposite tendencies operate. The first tendency - breaking, destruction of relationships in the form of the global systemic crisis not recognized by everybody (Table 1) and the second - integration, unification and development in the form of globalization, in particular the number of cluster growth, their networks [3-5], global production systems and strategic alliances. Global evolution crisis of mankind, overtaking the whole world, gave birth on the one hand, to unprecedented challenges, risks, high probability of global catastrophe, putting humanity on the brink of survival, and on the other - unprecedented new opportunities.

The world economy is implicitly transferred to a new, higher level of system performance and efficiency. The main factors of economic development have become the science, innovation and production in their unity, in the format of clusters and their networks of global production systems and strategic alliances of TNCs. The essence of the past three forms is unified - to form a "network". The growth of R & D intensity and the number of clusters in the world is the megatrend of the XXI century [3-5]. Russia can not be outside of this trend in civilization development, otherwise it will fall behind forever.

According to the Russian Cluster Observatory more than 200 cluster initiatives in the agro-industrial complex are implemented in the country, 3 agro-forest clusters and 3 forest clusters are created [6], and nearly 50 cluster initiatives are implemented.

In focus of the global systemic crisis (Table 1), global problems complex "Population growth - food, water, energy shortages - ecology", high probability of global catastrophes the development of Russian agro-industrial cluster system is an indisputable strategic priority.

**2. THE GLOBAL SYSTEMIC CRISIS AND CLUSTERS**

Under **the cluster** (in a broad sense) we understand geographically concentrated network - a system of mutually complementary subjects of the market of various industries with unique competitive advantages of the location, the application of science, innovations, know-how.

**Agricultural Cluster** - is a geographically concentrated network - a system of mutually complementary market entities (agricultural organizations, private farms, peasant farms, processing enterprises, research institutes and educational institutions, banks, governments, and other), focused on the production, processing and sale of foodstuff, creating innovative products that address the socio-economic development of rural areas, environmental protection, local solutions to global problems, etc. and with unique competitive advantages of location, use of science, innovation, know-how, the strategy to be "unique".

Key features of the cluster are geographic concentration, self-organization, network organization, systematic, interdisciplinary nature, unique character, research intensity, innovation.

The most distinctive features of clusters, in our opinion, are their self-organization and unique features. World experience shows that the most effective clusters are self-organized (for example, Silicon Valley and California wine cluster in the US) for a long time (10-40 years). Attempts to reproduce effective clusters in other countries and even in other regions of the same country mostly did not bring success. Because effective clusters always had unique conditions and always had a unique competitive advantage. Given the emerging geo-economic situation, Russia needs to create an effective clusters within a short space of time (1 year - 5 years depending on the type of clusters), with unique competitive advantages. Owing the latter allows clusters and their home countries own unique niches in the global and domestic markets, and to be merely out of the competition. Synergistic approach should be used for appropriate use of self-organizing clusters for their development [3, 5].

**Table1.** *Manifestation of the global systemic crisis (GSC)*

	Short description of the symptoms, etc. GSC
1	2
<ul style="list-style-type: none"> <li>The humanity is evolving in the blow-up regime</li> </ul>	<ul style="list-style-type: none"> <li>Population growth rate is proportional not to the number of people but to the square of the number of people <math>dN/dt = aN^2</math>. This is an autocatalytic process, the blow-up regime. The consistent pattern of the population growth itself with a quadratic nonlinearity provides the possibility of instability, demographic crisis, global catastrophes et al. [1,8-15,17,20,21]. The principal consequences of the mathematical model: the time of exacerbation falls on 2025.; global acceleration of the world development; instability increases; ultra-fast development near the moment of peaking makes the possibility of adapting, human adaptation and social systems in general to the constantly changing conditions extremely difficult, evolutionary crisis is peculiar to the whole world.</li> <li>In the blow-up regime there is growth of the world population, global GDP, urbanization, information, etc.; phase transitions of these characteristics, or global singularity* with maximum peaking in 2025-2030</li> </ul>
<ul style="list-style-type: none"> <li>Global energy jump - an abrupt change in energy system at all levels of our planet, starting since 1998. The changes in the</li> </ul>	<ul style="list-style-type: none"> <li>In 1998, there was a sudden change in the shape of the Earth - it has shrunk at the poles and widened at the Equator (according to NASA data) (18 )</li> <li>From 1983 to 2003 the drift velocity of the North Magnetic Pole has increased by 500%. (18)</li> <li>From 1920 to 2015 a significant increase in natural disasters by 10 times (18) is observed in the world</li> <li>Over the past 5.5 years, there were almost 2 times more earthquakes than</li> </ul>

blow-up regime	<p>within 35 years before (from 2009 to April 2015 there were nearly 1,570 earthquakes, from 1973 to 2008 - 858 earthquakes). The eruption of the Yellowstone supervolcano has high probability [19].</p> <ul style="list-style-type: none"> <li>• Full completion of the "global energy leap" is expected by 2026. [18,19]</li> </ul>
<ul style="list-style-type: none"> <li>• Period of exacerbation</li> </ul>	<ul style="list-style-type: none"> <li>• 2025-2030 – period of the maximum exacerbation of the strongest human civilization crisis. The total duration of the transition phase (aggravation time) is nearly 90 years (until the completion ~ 2060) [8-11, 20]</li> </ul>
<ul style="list-style-type: none"> <li>• Critical speed of development</li> </ul>	<ul style="list-style-type: none"> <li>• Historical time "accelerated" by more than 10.3 times. The history becomes more and more concentrated. 1 million years in the Paleolithic is the equivalent of 40 years, i.e., in fact a generation, in modern time. The subsequent period of human development is 2.72 times shorter than the previous one. [20]</li> </ul>
<ul style="list-style-type: none"> <li>• Unprecedented volatility growth</li> </ul>	<ul style="list-style-type: none"> <li>• Global singularity in 2025-2030, instability increases as we approach the period of exacerbation in 2025-2030, the technological singularity is around 2030 -2045. [8-11, 20]</li> <li>• Increase in efficiency of small fluctuations (effects) as it approaches the maximum exacerbation period, the growth of probability of the less probable and improbable events. [1]</li> </ul>
<ul style="list-style-type: none"> <li>• Critical concentration increase</li> </ul>	<ul style="list-style-type: none"> <li>• Human evolution is accompanied by increased concentrations of matter, energy and information, particularly in economy, science, etc. This leads to the consolidation and merger of companies, the growth of R &amp; D intensity, the formation of clusters, including agribusiness. The world witnesses the growth of R &amp; D intensity and the number of clusters. [21]</li> </ul>
<ul style="list-style-type: none"> <li>• Demographic aspect</li> </ul>	<ul style="list-style-type: none"> <li>• By 2030 the world population will be nearly 8.3 billion people. A trend of an aging population will appear, especially in developed countries, and aging countries will face the problem of maintaining well-being. Migration increases. [22]</li> </ul>
<ul style="list-style-type: none"> <li>• Economic aspect</li> </ul>	<ul style="list-style-type: none"> <li>• The growth of the global economy in 2014 was 2.6%, in 2015 - 2.4% (according to the World Bank) and in 2016 - 2.4% (the World Bank estimate). Economic growth in China in 2014 was 7.3%, in 2015 - 6.9% (the World Bank data), in 2016 - 6.7% (the World Bank estimate). China is almost on par with the US economic power. By 2030 nearly 2/3 of global GDP will be concentrated in the newly industrialized countries, and Europe's share will sharply fall. China is actively increasing its gold reserves. Real gold reserves in China, according to various estimates are 10-30 thousand tons. The official US gold reserves are 8134 tons (as of 01.01.2014). US national debt according to various estimates ranges from \$ 18 trillion to \$ 186 trillion and more than 90% of US debt is not controlled. [23]</li> <li>• The main causes of the global economic crisis are: financial problems, "innovation pause" [24], strategic miscalculations, the development of mankind in the blow-up regime.</li> <li>• "Deutsche Bank" - one of the global systemically important banks, built a pyramid of derivatives worth more than 70 trillion euros. The consequences of a collapse are greater than "Lehmann Brothers" fall.</li> <li>• "The deadly potential of the combination of new financial methods of trade may contribute to the beginning of the destructive chain reaction. Today the global financial market is more dangerous for stability, rather than nuclear weapons" [25].</li> </ul>
<ul style="list-style-type: none"> <li>• The deficit of food, water, energy, ecology</li> </ul>	<ul style="list-style-type: none"> <li>• With the world's population growth the need for food, water and energy will increase, respectively, by 35; 40 and 50%. Rising food prices is a megatrend of the XXI century. More than 1.4 billion people in the world do not have access to clean and safe water. By 2020 water scarcity will act as one of the main obstacles to the development of mankind. Over 40% of the world's population (nearly 2.5 billion people) live in areas facing moderate or severe water shortages. By 2025 this number will increase to 5.5 billion, and will be 2/3 of the Earth's population. In 2030 the gap between water supply and water demand will be 40%. China, India and the United States are experiencing an acute need for fresh water. [26]</li> </ul>
<ul style="list-style-type: none"> <li>• Environmental aspect</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental risks are most significant for the development of humanity, characterized by the presence of 2 mutually reinforcing trends:</li> <li>• - Objective: global climate changes occur according to the same laws as the processes in the Earth's crust, and even the deeper layers of our planet. Around 1998 the global energy jump began (exponential and hyperbolic growth) of a number of characteristics (the number of strong earthquakes and volcanic eruptions, tsunamis, the magnetic poles drift velocity, J2 coefficient changes, etc.). [18]</li> <li>• - Subjective: destructive human activities, including:</li> </ul>

	<ul style="list-style-type: none"> <li>• Excessive consumption of resources (According to WWF, the humanity is using 30% more resources than the Earth is able to reproduce. Because of this each year "ecological debt" of the humanity to the nature is estimated at \$ 4-5 trillion), including: deforestation; [27]</li> <li>• Waste pollution (According to the UN each year 1.4 million people in China, nearly 700 thousand people in India, nearly 200 thousand people in Europe die from air and water pollution, including waste, in general, nearly 3 million people die on our planet annually; great Pacific garbage Patch, etc.);</li> <li>• Stealth application: of geophysical weapons: the US, China, Russia, possess geophysical weapon that can permanently unbalance the Earth's ecosystem;</li> <li>• Man-made disasters: the growing number and scale of impacts;</li> <li>• The space is littered (more than 30 thousand objects in space).</li> <li>• The coincidence of Objective and Subjective trends led to increased negative changes, to increase in the likelihood of a global catastrophe, which suddenly occurs.</li> </ul>
<ul style="list-style-type: none"> <li>• Some facts</li> </ul>	<ul style="list-style-type: none"> <li>• 40% of all food in the world is contaminated with various toxic compounds accumulated in the process of cultivation, storage, etc.</li> <li>• • In 2014 the mortality of Russian population from digestive diseases has increased by 2.3 times compared to 1990, and the incidence - over the same period: with neoplasms by 2.1 times; eating disorders and metabolism by more than three times; malformations (chromosomal abnormalities – by 3 times) *. [28]</li> <li>• • 97% of scientists - climatologists of the US believe that man-made greenhouse gas emissions are largely responsible for what is happening to global warming.</li> <li>• • In 2013 the concentration of CO<sub>2</sub> in the atmosphere was 142%, of methane 253% and of nitrous oxide 121% (since the pre-industrial era - 1750). [29]</li> <li>• According to FAO estimates, emissions from agriculture, forestry and fisheries sectors has doubled over the past 50 years.</li> <li>• The amount of methane emitted from the Arctic permafrost has doubled compared to the projections of 2010. [30]</li> <li>• Irreversible flooding of the Netherlands. Satellites Sentinel 1-1A and Sentinel 1-1V fixed irreversible reduction in the surface of the Netherlands of land relative to sea level, showing the country's flooding. Especially in regions where the production of gas was held. [31]</li> <li>• China falls underground. In 2012 in the city of Yiyang, Hunan Province, 693 holes in the ground were formed within two months. The failures have been recorded at the bottom of bodies of water - the whole rivers were drained underground. Serious subsidence was recorded in 50 municipalities of 12 Chinese Provinces [32]</li> <li>• The failures of the soil in the United States are on the scale of a national disaster, often, these processes are artificial in nature [33]</li> <li>• The failures of the soil also occur in Russia, for example, the largest - is the Bezniki failure.</li> <li>• On October 29, 2015 the US Geological Survey has made a sensational statement: Only within 2 weeks 435 earthquakes were recorded in the vicinity of San Francisco [34]</li> <li>• Great Pacific Garbage Patch is located between Alaska and Hawaii. The area of the patch reaches about half of the area of the United States, in the waters of the patch there is over 120 mln tons of various waste [35].</li> <li>• In China more than 70% of urban water sources were exposed to different levels of contamination, as well as more than 80% of groundwater in the country [36].</li> <li>• Annually, approximately 25 * 10<sup>9</sup>t of waste is created in the world. Every day the world produces 3.5 million tons of solid waste [37]. In Russia, according to various estimates from 90 to 110 billion tons of waste [38] is accumulated.</li> <li>• Landslide (20.12.2015 ) from artificial mountains - illegal landfill in Shenzhen, China, was according to canonical scenario, self-organized criticality by P. Buck. [15] (Over the years the landfill has reached a height of 20-storey building, continued to grow and the slopes became steeper, all the complaints of the local population have been ignored, the sudden landslide destroyed 33 buildings, killed approximately 73-91 people, the soil covered the area of 380 thousand m<sup>2</sup>). Similarly, there may be a global disaster: everybody knows that it is highly likely, everyone is talking about it, but do not do anything, the disaster comes suddenly. [39]</li> </ul>

<ul style="list-style-type: none"> <li>The geopolitical aspect</li> </ul>	<ul style="list-style-type: none"> <li>The unipolar world turns into a multipolar system with the main centers of the "force": the US, the EU, China, Russia. Redistribution of power has led to a substantial aggravation of the geopolitical situation. The geopolitical conflict in Syria has been caused in part by the presence of huge oil and gas reserves there. It has increased the likelihood of conflicts, including due to lack of water.</li> </ul>
<ul style="list-style-type: none"> <li>Global risks</li> </ul>	<ul style="list-style-type: none"> <li>There are more than 50 global risks. The main ones are: geopolitical risks (indirect inter-state conflicts, international terrorism, and other); global warming, increase in the number of extreme weather events, the growing number of natural and man-made disasters; covert use of geophysical weapons, which according to some experts, causes global warming; complex problem "Population growth - lack of food, water, energy - environment"; exhaustion of resources; environmental pollution, increase in the volume of waste; unprecedented growth in systemic risk. [40]</li> </ul>
<ul style="list-style-type: none"> <li>Probability of global disaster</li> </ul>	<ul style="list-style-type: none"> <li>On May 12, 2016 a statement of scientists, representing the University of Oxford, was published in the media that within next 5 years the Earth expects a global catastrophe [41]</li> <li>The total probability of catastrophe that could lead to the extinction of humanity in the XXI century, is estimated between 10 and 50%. [42]</li> <li>The likelihood of a nuclear war - 18%. [43]</li> <li>According to NASA forecast over the next 3 years the city of California can be destroyed by aftershocks and tsunami. The probability of this event is estimated by the agency experts at 99% [44].</li> <li>Legendary scientist Stephen Hawking predicts that in 10 years, even earlier, the main threat for the humanity will be man-made disasters [45]</li> <li>The collapse of human civilization ~ 2050 [14,46]</li> </ul>
<ul style="list-style-type: none"> <li>Mankind lacking the unifying idea</li> </ul>	<ul style="list-style-type: none"> <li>The conflict of global and local interests could lead to a global catastrophe, when a chain reaction of catastrophic events can not be stopped.</li> <li>Humanity hardly perceives the "voice" of the mind. In the end only the manifestation of power is what matters. The concept of sustainable development, the "green economy" are not the ideas of uniting the humanity. They are not effective enough.</li> <li>Concept of instant global strike, controlled chaos is the mental basis of a possible global catastrophe.</li> </ul>
<ul style="list-style-type: none"> <li>Megatrends of the XXI century</li> </ul>	<ul style="list-style-type: none"> <li>Megatrends of the XXI century • Globalisation; increase in research intensity and number of clusters and their networks; miniaturization technologies; Robotic Revolution; the growing importance of basic research and agricultural research and development; rising food prices; the use of recycling technologies; hybrid, closing techniques, etc.; the tendency to increase recycling; the development of cross-border, inter-state clusters, reducing the share of hydrocarbons in the energy balance of the countries, the use of renewable energy sources, technological singularity by 2030 *</li> </ul>

Clusters can be studied as a phenomenon (certain phenomenon in the unity of all parties), as the geographical concentration of the market actors, as the network, as self-organizing integration shape, as the development of clusters will be agreed with the trends of the environment, as a global phenomenon, and other. Therefore, in this study interdisciplinary approach is used (from the points of view of the cluster, synergistic, network, system and global approaches) as well as to the study of clusters and their development environment - global situation, characterized as a global systemic crisis. In the World - System everything is interconnected. In terms of synergy or the theory of self-organizing **effective clusters will be appropriately and quickly organizing themselves, if the clusters development is consistent with the needs and trends of the environment.**

The data in Table 1 allows to make a number of fundamental conclusions not only about the development of human civilization, its habitat, but also about economic clusters.

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\* We believe that technological singularity will occur not only as a result of the creation of artificial superintelligence, but, above all, by increasing the multidisciplinary R & D, synergies of their results.

### 3. GLOBAL SYSTEMIC CRISIS FORMS THE ENVIRONMENT, IN WHICH CLUSTERS ARISE AND DEVELOP.

Surprisingly the humanity and planet Earth develop in the blow-up regime. Since 1998 several characteristics of planetary processes changed in exponential and hyperbolic way. The peak of the crisis or time of maximum GSC aggravation falls on 2025-2030, historical time has accelerated by more than 10 times, the efficiency of small effects increased, the concentration of the growth has reached its limit, as a consequence economic clusters emerged. By 2030 the world population will reach 8.3 billion people. World economic growth is very modest, even against the background of the reduced rate of growth in China. One of the main reasons for the economic crisis is "innovation pause". Experts, figuratively speaking, state that currently the financial markets are more dangerous than the nuclear weapons for the stability in the world [25].

Systemic global problem became extremely aggravated: "The growth of the population - food, water, energy shortages - ecology". In general, the environmental aspect has gained an extraordinary sharpness, like a "perfect storm"; when an objective trend (solar activity, changing the parameters of the Earth, ocean) and human activities have acted in the same direction of the global warming that threatens a catastrophe. Geopolitics is also characterized by the tectonic shifts in the direction of the formation of a multipolar world, generating war. Overall, there are 50 global risks. The main among them are geopolitical and risks associated with a single set of global problems: "The growth of the population - food, water, energy shortages - ecology", the depletion of resources, the unprecedented growth of waste volumes and systemic risk. The probability of global catastrophe can be defined as high, as in the case of the immutability of human relationship to nature as fatal.

Given the systemic nature of the crisis, high systemic risk can not uniquely identify its root causes and the network of causes, a comprehensive list of drivers, positive feedbacks, that can give rise to chain reactions. We can select a piece of positive feedbacks, resembling a "perfect storm." Single action of 5 key drivers (increased solar activity, an abrupt change in Earth's energy, population growth, the economic and spiritual crisis) have created the probability of global catastrophe real close to 1. Their collaboration gave rise to a chain reaction, which is almost impossible to stop.

According to Table 1, it is possible to put forward the paradoxical at first glance, fundamental hypothesis that the real complex systems (CS), in particular global catastrophes, the clusters are developing in blow-up regime - hyperbolically.

Under a blow-up regime we understand ultra-fast process development, systems, when the characteristic parameters (population, energy, concentration of capital, and other) increase indefinitely in a finite period of time called the exacerbation time [8].

The essence of the hypothesis is that the understanding and use of CS in the development of a blow-up regime allows to more effectively prevent a global catastrophe, to form effective clusters (up to 1 year - 5 years depending on the type of clusters), to ensure the growth of their efficiency many times.

The facts bearing evidence of the development of complex systems in a blow-up regime. In a blow-up regime occurs (occurred) growth (development) of the world population, global urbanization, global GDP, literacy of the world, the population of China from 700 BC until 1851 AD, the flow of information, China's GDP within last 30 years; diversity of marine biota during the Phanerozoic eon (the last 542 million years), the increase of carbon dioxide concentration, the spontaneous recovery of patients and others.

The foundations of the theory. Conventionally, there are four stages of the CS development: slow, fast and explosive growth, stabilization. CS has peculiar self-organization, openness, network organization. CS can spontaneously organize themselves and come to the stage of explosive growth. CS as open systems include the sources and sinks of matter, energy, information, their depot. For example, the Earth's forests and soils are a depot for the storage of carbon, have enormous potential absorption and storage of annual anthropogenic CO<sub>2</sub> emissions (up to 75% of greenhouse gas emissions). [47] CS have a network organization. For networks, the lack of a single control center is indicative. In the network there are many centers of activity and the approximate equality of status, comprising the system of actors. The decisive role in the development of the CS belongs to the period of slow growth, which is nearly 99% of the system development time. This time, the CS are developed very slowly and steadily.

CS, consisting of thousands, millions, billions of components and even larger number of interconnections, have strong "inertia", can not change their state quickly, and even instantaneously. At the stage of slow growth, self-changes occur unevenly, with respect to any impact of the huge CS they are extremely small or even insignificant, and their effects do not initially have a significant impact on the CS, from the observer's point of view. Impacts on the CS are in for a long time, small effects accumulate. During self-organization cumulative effects occur: positive feedback, their complexes on the network of CS actors, with various trends appearing etc.

If the cumulative effect exceeds the threshold value, coincides with the trends of the dynamics of the CS, reaches a critical mass, positive feedback "start", using sources, sinks and others, CS instantly moves quickly to the stage of explosive growth. Consequently, as a result of CS self-organizing at the slow growth stage positive feedback can occur, depot, generating chain, network responses, i.e. there are some potential changes (positive feedbacks, sources, drains, custody matter, energy, information, etc.). With a strong non-linearity of sources, chain/network ultrafast processes may go limited and manageable.

Consistently in the "Art of War" by Sun Tzu a refined concept of a "potential situation" is introduced [48], which partly refers to the accumulation, cumulation of small effects, including resonant, capable, according to the Chinese traditional strategy, to instantly be updated when "potential of the situation" ripens or has reached a critical mass.

In other words, "potential situation" immediately is implemented in the form of a specific, desired expedient process.

Thus, ultrafast processes in a blow-up regime are due to the nature of CS. This is the law of development - complex systems, including global catastrophes, agricultural clusters, which should be used for their appropriate self-organizing clusters within the short term preventing a global catastrophe. From this hypothesis it was logically concluded that:

- Complex systems develop in the blow-up regime as a consequence of its nature;
- The defining stage of the CS is the stage of slow growth. The slow self-organization of positive feedback on the CS network causes the appearance of the chain / network reactions, ultrafast processes;
- To prevent global catastrophes, such as global warming, it is necessary to remove, neutralize and weaken their positive feedback generators, creating a negative feedback;
- Agro-Industrial Clusters such as CS can be formed and developed in a blow-up regime. Clusters' efficiency can be increased by many times. To do this, we must develop the technology for their design, creation and operation of the cluster model according to new technological principles;
- Agro-Industrial Clusters as a consequence of their location, scale and spatial dispersal, biotechnical nature and the network organization, can be a holistic tool for solving complex global problems "Population growth - food, water, energy shortages - ecology" to prevent global disasters, the development of agro-industrial complex of Russia, CIS, the global economy;
- The potential of the situation in terms of synergy can be represented as a system of forward and backward links, sources and sinks, the depot of matter, energy, information, etc.

The Data presented in Table 1 indicates that the probability of global catastrophe by 2050 is high, if the humanity does not change the essence - the consumer attitude to the environment, natural resources and waste.

The idea of preventing a global catastrophe - can become a rallying point for mankind. Since the immutability of human mentality and active destruction of nature occurrence of global disasters is highly probable!!!

Overall, the Table 1 shows that the global temperature is rising, concentration of greenhouse gases increases – these are irrefutable evidence of the ineffectiveness of the Concept of sustainable development and "green economy" [49,50]. Not an alternative to these global initiatives, rejecting them, is expedient, but a holistic tool to exploit the potential of these concepts on the basis of a single, unifying humanity ideas - Prevention of a global catastrophe – is necessary.

The idea of preventing a global catastrophe is based on the hypothesis of the development of complex



systems in a blow-up regime. It consists in the fact that it is necessary for the complex of positive feedbacks of global catastrophe to neutralize the system to counter negative feedbacks of the opposite direction.

Holistic tool for preventing global catastrophes triggering system of negative feedback is the use of the megatrend of the XXI century - science-intensive growth and the number of clusters that can maintain, develop more megatrends in clusters format: fundamental and applied research, especially agricultural research and development, which can be directed to the development of technologies for deep processing of raw materials; recycling, closing and opening, hybrid technologies, robotics, and other. The development of science, technology and business clusters and networking format will allow interrupting the "innovation pause", to speed up the dynamics of the world economy out of the global economic crisis, due to the positive feedback system, to ensure its harmonious development and thereby weaken the global systemic crisis and prevent a global catastrophe.

#### 4. AGRO-INDUSTRIAL CLUSTERS: A LOCAL SOLUTION OF GLOBAL ISSUES

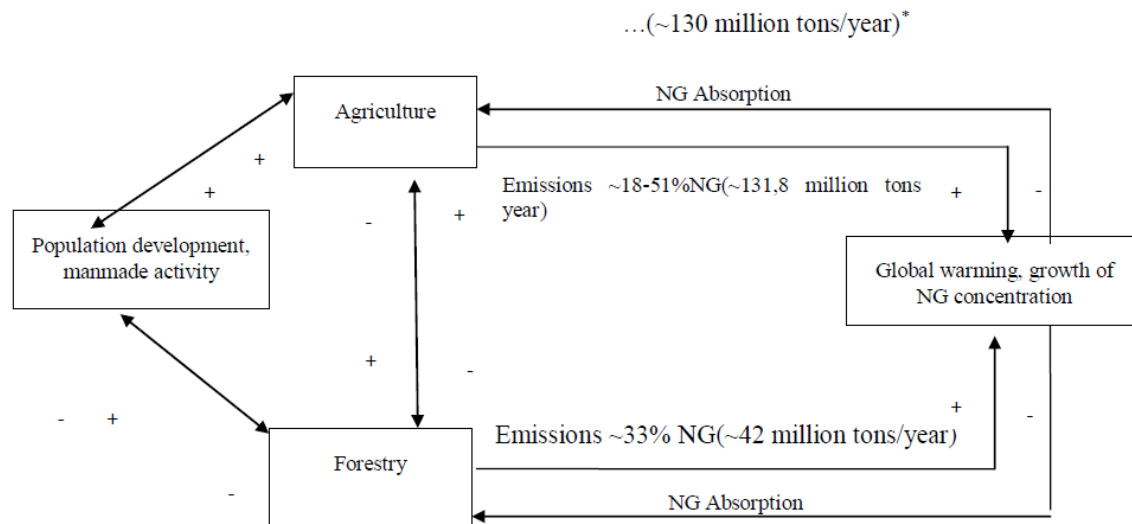
With a view to the development of agriculture in Russia, raising the level and quality of its population living standards, solving complex global problems "Population growth - food, water, energy shortages - ecology", as well as weaken and prevent adverse climate changes, global catastrophes, it is proposed to create a global cluster system, an important component, which is a system of agro-industrial, agro-forestry clusters in Russia and CIS.

The acute need for the formation of agro- industrial, agroforestry clusters is due to a number of key reasons:

- Development of World - System takes place in a blow-up regime (Table 1), as a result there is a global systemic crisis, the probability of unlikely events, such as global disasters; for example, global climate change is clearly observed;
- Increase in the number of clusters and knowledge-based economies - megatrends of the XXI century [3-5]. Clusters are part of the World - System. Therefore, it is advisable to carry out their development in a blow-up regime. The system of agro-industrial and agro-forestry clusters will occupy large areas that will ensure their effective impact not only on the local but also on the global climate;
- Particularly acute economic and environmental aspects of the global systemic crisis. They are interrelated and interdependent. One of the main reasons for the economic crisis is "innovation pause" [24], which can be overcome in the global economy through the development of science and innovation in a format of clusters, their systems. The development of science and innovation in the form of clusters leads to a more effective deep processing technologies ("0 - waste"), recycling, hybrid, opening and closing technologies, etc., that will practically implement the principles of circular economy and use blow-up regimes for solving the global problem of resource exhaustion, the weakening of global warming, provide a new quality of economic growth in the world economy;
- One of the main sources and sinks of greenhouse gases, that cause global warming, are agriculture and forestry. According to different estimates of greenhouse gas (GHG) emissions, the world's agriculture and forestry are respectively at 18-51% and 33% (Fig. 1). The most significant sources of GHG are energy (~ 35%), industry (~ 21%), transport (~ 14%) [51,52]. At the same time, soil and forests have enormous potential for absorption of annual anthropogenic CO<sub>2</sub> emissions, up to 75% of their volume [47]. As a result of the development of science in clusters and the development of hybrid technology format (stimulating natural mechanisms) GHG emissions can be significantly reduced and the absorption capacity of agriculture and forestry increased;
- Russia has considerable development potential for agroforestry in the form of clusters, possessing 45 million hectares of abandoned arable land and the largest forest area in the world (8,090.9 thousand Km<sup>2</sup> or 49.4% of the country's land). These resources can be used for the expedient development of the cluster system, which will provide a number of interrelated outcomes - to solve the food problems of Russia and significantly contribute to the elimination of food shortages in the world, as well as to ease global warming and even prevent the onset of a global catastrophe. At the same time, by 2030 the forests of Russia may turn from CO<sub>2</sub> absorbers into its source, un-

less steps are taken to regulate forest management. Especially the shelterbelts, created in 40-50-ies of XX century are derelict and no longer perform their functions;

- Determinants, factors, causes, dynamics of global climate change, and especially the terms of their research are so diverse, ambiguous, contradictory, that acquaintance with them literally plunges into dissonance. 97% of climate scientists in the US believe that global warming is a result of increased concentrations of greenhouse gases [55]. Another group of scientists believes that the warming and cooling is a natural cyclic process in the world, and therefore we should not pay so much attention [56] to global warming. The next, large group of scientists (more than 300 scientists from 85 countries) argues that climate change is caused by the global energy jump. [18] Russian researchers V.Gorshkov and A. Makarieva, who discovered the phenomenon of "forest biotic pump", believe that the main cause of climate change is disafforestation as the result of the Earth desertification, weakening the "forest biotic pump" [57].



**Figure1.** Main «manageable» factors of global warming and their interconnections [51,52,53,54] (Source: original development)

According to our opinion, this list of causes and factors is not exhaustive. Scientists often obtain and publish conflicting research results. However, we see a sign of truth, not lies, in this. Clearly Hegel is right: "The contradiction is the criterion of truth, no contradiction is the criterion of error". From our point of view, the existence of contradictions is natural, so the Earth's climate system is a super complex system consisting of a plurality of multi-functional components, direct, positive and negative connections, "Switch functions" and other. The system and its components function in blow-up regime and may be in different phases of this mode. Moreover, this system has not been investigated to the end, for example, the aspect of the global symbiosis. It is highly likely that may have the effect of other factors outside of the field of research, for example, the use of covert geophysical weapons, which leads to the release of enormous amounts of energy. Figuring out the main determinant factors, causes, etc. is essential to determine effective and optimal architectonic of agroforestry clusters, their systems. Agro-forestry, agro-industrial clusters **are multifunctional so they are able to eliminate and neutralize multiple causes of global warming;**

Finding out the major determinant system, etc. of the global climate change, we proceed from the principle of holism, that is, believe that climate change is caused by the action of not a single determinant, etc., but the system integrity of these determinants, drivers and others. This is the result of interaction of all drivers. Therefore, the main determinant of climate change we observe **in the development of the global climate system in a blow-up regime.** Surprisingly, the researchers predict the peak of global warming in 2030, in the period of maximum GCW exacerbation [58]. Any natural ecosystem at any level is a network [59]. Agroforestry cluster is a "network" as well, a locally concentrated and globally dispersed "network". Agroforestry clusters can cover large areas, which will have huge forests, particularly in the form of belts, Kyoto forests. The latter will greatly enhance the action of natural mechanisms (global symbiosis "biotic pump forestry" \* et al.). In agroforestry systems networks of clusters positive and negative connections can be deliberately created, their combinations, forming a multi-dimensional synergetic mechanism, implementing ultrafast processes in a blow-up

regime. From this perspective, the coverage of natural ecosystems and the effectiveness of impact of the agro-forestry cluster networks systems on them is most appropriate not only for the creation of a favorable local climate, but the global one. Because cluster system can use very powerful natural mechanisms such as "forest biotic pumps" and the global symbiosis [57].

Thus, the creation of a global cluster system, first of all, the Russian agroforestry system cluster, is an urgent need for a radical solution to the complex problems of global "population growth - food, water, energy shortages - ecology", the weakening of global warming and preventing global catastrophes. The main cause of the global systemic crisis is the outcome of the interaction of all the determinants, factors, etc., being expressed in the development of World - System in a blow-up regime. In order to "control" such a system it is advisable to properly create an adequate, holistic mechanism in the form of a global cluster system.

Using an interdisciplinary approach, competences of various sciences allows develop and validate the architecture of agroforestry clusters, their systems. (The definition of the "architectonic" concept involves achieving an organic combination of the elements of clusters, their systems).

Analysis of the main factors of global warming and interactions (Fig. 1) revealed a pattern. Throughout the history of humanity (hyperbolic) population growth was observed, agricultural development has led to a reduction in forest cover, deforestation, desertification, increase of greenhouse gas emissions, increase of their concentration and ultimate increase in the average annual temperature. Deforestation, especially deforestation in tropical areas, has led to an increase in greenhouse gas emissions, the weakening of "forest biotic pump", enhancing the drought.

Based on this it is relevant and possible, with the creation of agro-forestry clusters, the development of science and innovation in their format, to carry out a different pattern, more efficient and environment friendly: "increase / decrease in the population → agriculture → increase in forest area → increase in the absorption of GHG → decrease in the GHG concentration → decrease in global temperature". The use of different sciences' competences make the latter pattern quite real. Reduced population growth can be achieved by taking care of respecting the rights of women, ensuring their access to education, showing "soap operas" on television (examples are Bangladesh, Brazil). Moreover, global warming itself leads to fertility decrease [60]. Agriculture needs to be developed on the basis of innovation, using new technologies, increasing productivity and reducing GHG emissions, increasing the absorption capacity of the soil. We need to develop agro-forestry, in fact symbiotic of the forest and agriculture. This will lead to the growth of productivity in agriculture. The development of agro-forestry cluster will increase the absorption capacity of forests that will reduce GHG concentrations and global temperature, and most importantly, enhance the action of "forest biotic pump".

Thus, clusters agroforestry system appropriately, accurately, "softly" covers and operates three inter-related factors (Fig. 1). In other words, the effective model of agroforestry clusters, their system can be developed only on the basis of a multidisciplinary approach. Agroforestry system clusters should have components of agriculture and forestry in their symbiotic relationship, as well as socio-educational, media component, especially for developing countries, where population growth is particularly high. This is very tentatively the architectonic of agroforestry clusters.

From our point of view, the aims and objectives, development strategy of Russian agro-forestry clusters should be local and global.

Because agroforestry clusters in their economic and biotech entities can have not only a local impact (such as the creation of a favorable climate on the field for the cultivation of wheat), but also a huge influence on the generation of greenhouse gases, combating drought; desertification, prevention of global catastrophes, etc. and ultimately the formation of the global climate.

The objectives of the creation and development of systems of agro-industrial clusters in Russia, CIS countries, can be [3-5, 61-63]:

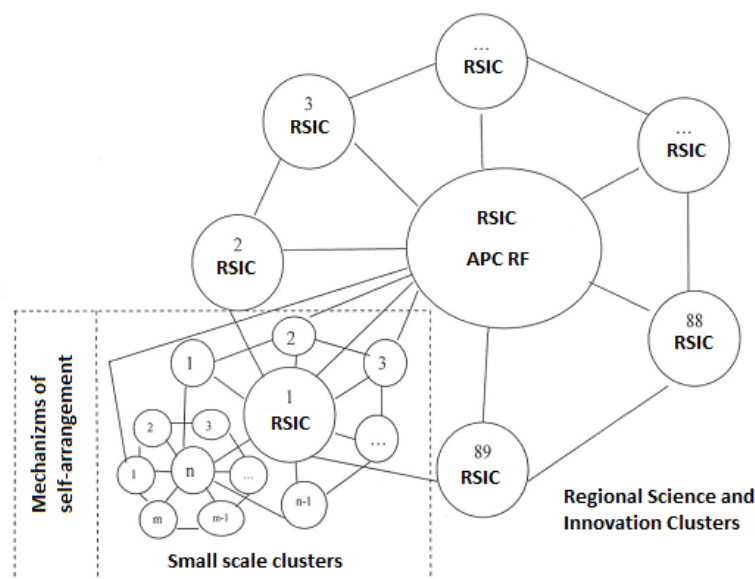
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\*"Biotic Forest pump" - the high leaf area index of natural forests, which supports high evaporation flows, exceeding evaporation flows over the ocean. Thus there are updrafts of rising air above the forests that leads to sucking moist air from the ocean, which then returns to the ocean in the upper atmosphere after filling precipitation over land. [57]

- Development of agriculture at a qualitatively new scientific and innovative basis using the results of interdisciplinary researches with maximum use of the positive forces of nature, its natural mechanisms (the idea of blow-up regimes, their mechanisms of global symbiosis, "forest biotic pumps", etc.);
- Improving the efficiency and competitiveness of the agro-industrial complex of Russia, the level and quality of its population life;
- Provision of import substitution, food security of Russia, CIS and the world;
- The solution of the complex global problems of humanity: "The growth of the population - food, water shortages - ecology";
- The weakening of global warming and the prevention of global catastrophes; The development of a radical new directions of integrated science, technologies (hybrid, deep processing of raw materials, open, close, etc.), contributing to an interruption of the "innovation pause" and the humanity leaving unprecedented global systemic crisis, the development of the Russian economy, countries with GHG blow-up regimes.

The idea of local - global impact of agroforestry System of clusters is that the World-System, in particular its climate subsystem, is in a metastable state, volatility of which as it approaches the point of global singularity - 2025- 2030 or a maximum time of exacerbation, further increases. In connection with this "small resonant effects" generated by the system of clusters may have a significant stabilizing effect not only on the economy of Russia, the CIS countries, but also on the world as a whole, not just the local climate of the country, but the Earth's climate system. Impact of Systems of agroforestry clusters in Russia, CIS is like "world acupuncture" [1]. The basis of multidimensional synergistic mechanisms of the agroforestry clusters must include straight, positive and negative feedbacks, their combinations, to decide how to dual task the transition of the systems of clusters "into a blow-up regime and turning at the same time into the "closed-loop economy". This dual task can be solved with the use of partial models of the system based on the use of mechanisms of positive and negative feedback.

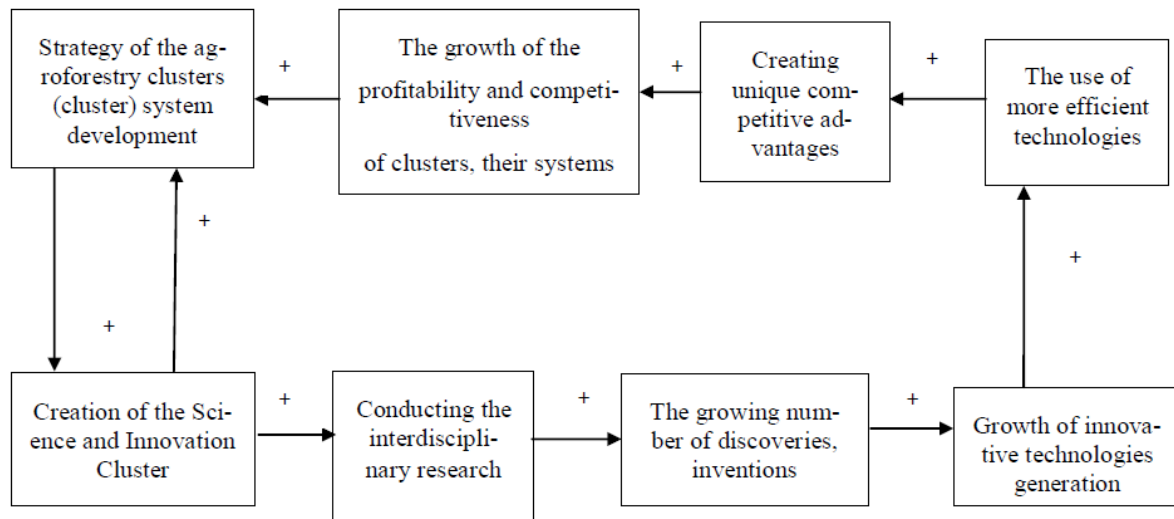
From our point of view, agroforestry system is expedient to creating clusters in the form of a network (Fig. 2) based on the fractal principle with the "core" of the system in the form of innovative scientific and educational clusters.



**Figure2.** The model of the system of Russian Agro-industrial clusters, based on the unique competitive advantages of location and Innovation Symbol: RSIK - Regional Science and Innovation Cluster (Source: author's design)

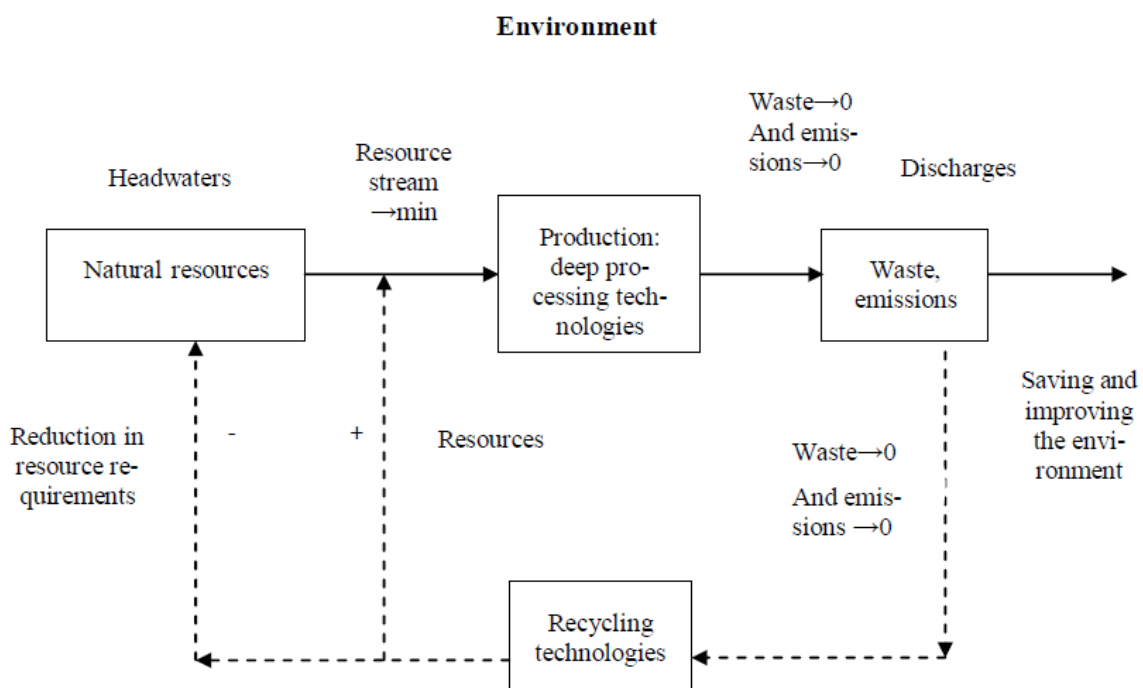
The most important task of scientific and educational innovation cluster is to conduct interdisciplinary research in the development of target-specific hybrid, etc. technologies that would contribute to the

establishment and development of mutually beneficial relations between the cluster parts. Moreover, research and innovation cluster generates scientific and innovative economic processes in a blow-up regime (Fig. 3).



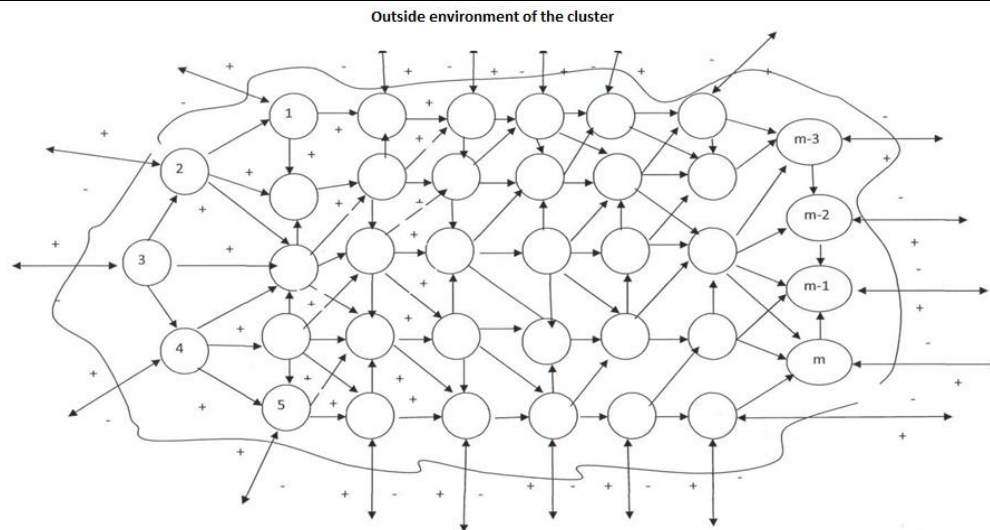
**Figure3.** The block - diagram of a nonlinear positive feedback in the agroforestry system of clusters / cluster (Source: author's design)

The development of deep processing technologies of raw materials and recycling by science in the form of clusters allows clusters to create and use a flow chart shown in Figure 4, which "starts" the positive and negative connections, carrying out the principles of circular economy and the blow-up regimes.



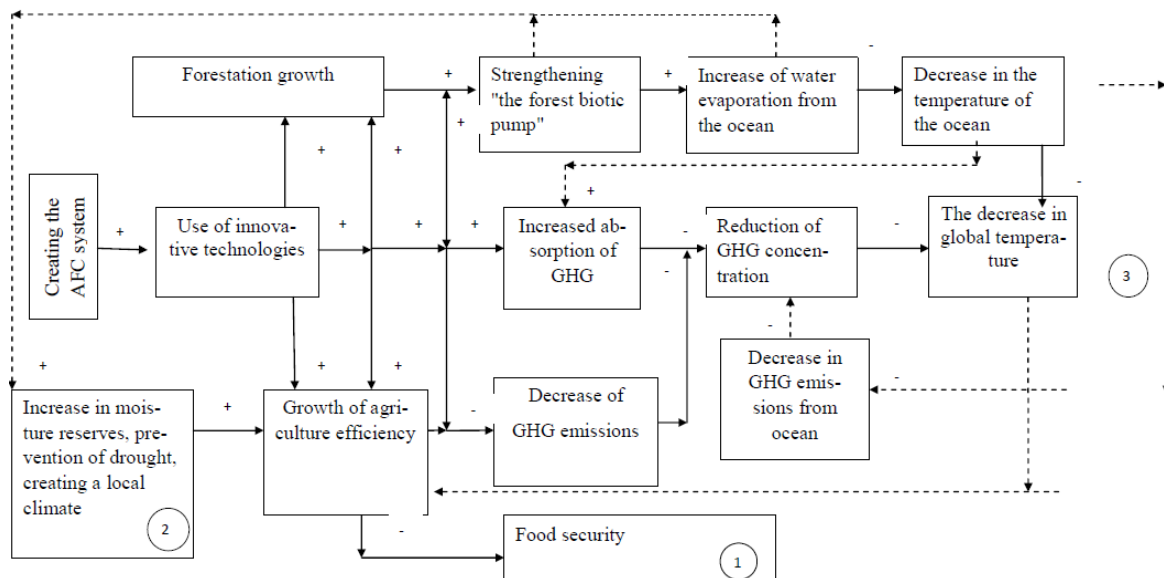
**Figure4.** Process flow diagram of the solution of global problems of resources exhaustion, conservation of the environment and the third generation of cluster-based applicationstechnologies of deep processing and recycling(Source: author's design)

The set of positive feedbacks between cluster participants (clusters system) on their networks forms a multi-dimensional synergetic mechanism to ensure the functioning of agroforestry, agro-industrial cluster in the blow-up regime (Fig. 5).



**Figure 5.** A fragment of a network clusters (cluster) system model which implements ultra-fast processes in a blow-up regime in the form of a "chain reaction network" (Source: author's design)

Overall multimodel of the cluster system lets us build a mechanism of agroforestry clusters (Fig. 6), which will help to solve a triune task: 1) increase the efficiency of agriculture in Russia (in the world), i.e. ensure national and global food security; 2) eliminate the water deficit (largely); 3) reduce the global temperature, prevent global catastrophe.



**Figure 6.** Agroforestry clusters system mechanism model (global, CIS, Russia, regional), oriented to solve complex global problems "Population growth - food, water, energy shortages - ecology" Symbol: AFC \* - agroforestry cluster (Source: author's design)

Thus, the creation of global agro-forestry systems, agro-industrial clusters, in particular their subsystem in Russia will let us solve locally a number of global

challenges; if not fully, then partially everything depends on the size of the project of creating a global clusters system (national or global).

In general, the undertaken studies suggest the following conclusions:

- Complex systems, in particular the World-System, the world's population, clusters, including agribusiness are developing in a blow-up regime. Using this pattern will accelerate the formation of clusters and will contribute to the prevention of global catastrophes.
- Elementary units of a global system of clusters are the clusters of third generation, the hallmark of which is the use of multiple positive feedback loops that give rise to the formation and development of efficient agro-industrial clusters (within 1 year - 5 years) in the blow-up re-

gime. Multimodel of the agroforestry cluster of the third generation in its nature and form is not exhaustive (Fig. 2-6). In each case, the individual models and multimodels as a whole will have a unique embodiment, a priori, providing a unique competitive advantage to the created agro-industrial cluster.

- At the time of the maximum exacerbation of the global systemic crisis (2025-2030) the likelihood of a global catastrophe increases, which no one would escape. The probability of global catastrophe is unprecedented, and in order for the mankind to survive it must unite to prevent this catastrophe, erecting a cluster policy to the rank of global politics. One of holistic instruments to prevent a global catastrophe, quit the global systemic crisis, may be the formation of a global cluster system, agro-forestry in the first place, especially in Russia.

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