Agriculture, the World Population, Global Climate Change and Natural Resources in the Context of Increased Food Insecurity: A Romanian Academic Approach

Part II – Agricultural Research, Global Climate Change, Natural Resources and Food Security

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Abstract: The second part of the article (see Part I, no 1, pages 35-45) is a critical analysis of the impact of the damage done upon the soil, upon the biodiversity, forests, upon the soil - plant - climate - animal - man - market system and of the sustainable development upon inducing food insecurity to the world population. The introductory part addresses shortly the vital elements needed in combating food insecurity such as the importance of effective management of climatic events, the guiding principles for future sustainable development of human society in order to ensure saving the planet and the importance of biodiversity and aquatic and terrestrial resources. The issue under review highlights the many factors on which future agricultural production depends and that relate to valuing, preserving and protecting the soil, the concepts of biodiversity and agro-biodiversity, the contribution and the multi functionality of forest to life support and food security, causes - effects relations between forests and environment factors, the beneficial ecosystem’s services provided by forests, the impact of nutrients versus xenobiotic chemicals in food, the interactions between science, knowledge and innovation in the network of influence factors upon the crisis in the food system, but also the impact of global sustainable development on preventing food insecurity (with 3 major integrated research themes targeting eight current priorities). In the conclusions’ part are inserted two charts regarding the quality of the food and nutrition reflecting the deepening gap between the populations of the developed and rich countries (normal food security) and the undeveloped and poor (abnormal conditions of food insecurity which is increasing gradually) in the context of the action of the above factors. In this unfavourable context it must be increased the government’s liability and the human solidarity at national, regional, continental and global level.

Keywords: Earth, Human population, Food, Climate change, Food security.

1. INTRODUCTION

Global climate change affects Earth’s natural resources and represent an attack on the food security of the population. In this sense, the first imperative alarm signal to all planet’s governments was launched at the UN Conference regarding the future of humanity and of the environment [1]; the conference warned that it is required deep thinking on both the importance of the environment for the future development of human society and on the present and its devastating consequences caused by overexploitation of natural resources in the pursuit of profits at any cost.

Overexploitation of natural resources. It is a destructive phenomenon, which inevitably led to conflicts between the accelerated growing of industrial civilization’s development and the accentuated degradation of renewable natural resources [2].

The importance of effective management of climatic phenomena in combating food insecurity. Climatic data of recent decades show a gradual warming of the atmosphere and increased frequency of extreme events; it has been noticed the rapid alternation between severe heat waves / accentuated drought and increased rainfall generating quick flash floods and flooding - facts which become more and more obvious [3].

The techniques of remote sensing and geographic information systems (GIS) represent objective geospatial analysis methods that allow the collection of useful information for monitoring and evaluation of extreme weather events (slow and fast floods, storms, blizzards, ...); the elements obtained from the satellite data, later integrated in GIS, allow assessment of the impact of these local extreme weather events on environment and population; these elements are useful tools for local and government policy makers who are involved in the crisis management and reconstruction [3].

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Guiding principles for the future sustainable development of human society. Sustainability is an ecological concept with economic impact, which is specific to a viable society who shapes its economic and social system so that natural resources and life support systems become sustainable. The Brundtland report - Our Common Future, developed in 1987 for the World Commission on Environment and Development includes the guiding principles and solutions to meet the requirements of the present without compromising the ability of future generations to meet their own conceptions and goals for a sustainable development of human society through the owned respect and appreciation which can be paid to the environment [4].

Making a symbiosis between economic and ecological requirements. The solution is a realization of a symbiosis between economic and environmental studies, embodied in a green economy that respects the environment in such a manner that it integrates the ecosystem of the planet, not destroy it [5].

Waiving brutal and uncontrolled human activities. Other authors draw attention to the dangers mankind is facing under the brutal and uncontrolled human activities with devastating effects for the environment [6].

Serious concerns related to saving the planet. The literature provides those interested valuable works, which address this complex issue.

Lester Brown’s works. These are valuable works devoted to studying the present environmental issues (the series of works called Plan B, from 1 to 4) developed by the illustrious contemporary scientist Lester R. Brown and dedicated to rescuing a planet under pressure and to a civilization in trouble; the last volume of the series (Plan B4. O) refers to "the general mobilization to save civilization" [7].

The works of Anders Wijkaman and Johan Rockstrom. Another reference work for saving the environment is "The Bankruptcy of Nature. Denying the limits of the planet" [8] that should be studied by the national legislative and executive factors with decision power because the modern science has sufficient data and is able to find new solutions to saving the environment and terrestrial civilization located in an impasse as the implementation of scientific knowledge depends on the government's political decision makers [4].

Biodiversity, water resources and food security. In the Earth’s biodiversity, the man is only a part of it; our planet is often called "the Blue Planet" due to his grandiose expanses of water in seas and oceans, it is also the genesis place of life of countless species from which have evolved the current organisms [4].

Biodiversity, land resources and food security. The denomination of the terrestrial space as "planet earth" refers both to the ground and the underground; the soil is the thin layer from the surface, which is a living organism with maximum complexity, endowed with remarkable characteristics and capable of unique biological processes, which also maintains the green carpet which generates global food, protection and creation for all living beings; in fact, soil is a gift of nature, whose absence would mean the disappearance of humanity [4].

Instead of conclusions. The care and respect for the whole planet is a guarantee of stability and a solid building of future, of strengthen the security and food safety, which are so necessary for the peace and prosperity of mankind [4].

2. THE IMPACT OF THE DAMAGE INFLECTED TO THE SOIL, BIODIVERSITY, FORESTS, TO THE SYSTEM SOIL - PLANT - CLIMATE - ANIMAL - MAN - MARKET AND THE SUSTAINABLE DEVELOPMENT ON FOOD INSECURITY: A CRITICAL ANALYSIS

The irresponsible destructive interventions on soil, biodiversity and forests, the serious disturbance of the circuit soil - plant - climate - animal - man - market and the lack of a viable strategy for a sustainable planet development will increase in the next years the world food crisis.

The impact of soil damaging on the food. In 2006, there were identified eight main threats to the soil of the European Union, which are encountered also in the most soils of other continents of the planet; these threats relate to the erosion, contamination, pollution, salinization and soil compaction, removal of soil from agricultural circuit, to the biodiversity loss, as well as landslides and floods affecting porosity and soil fertility [9].

New concepts based on preventing the action of aggressive factors. In this unfavourable context, it is necessary to promote a new concept based on preventing the action of the above listed aggressive factors along with the efficient management of predisposing factors and with the mitigation of the consequences of extreme weather events. The future of agricultural production depends on many factors [9]:
Improvement of overall conception of integrated river basin planning in close correlation with the works of land reclamation, hydraulic engineering, agro- and forestry measures; the prioritization of these planning measures should take into account their economic viability measured by the contribution to the rural development;

- Facilitation of communication between human groups involved in agricultural production in order to create projects supported by the landowners;
- Creating better conditions for the production and sale of food products;
- Promotion of sustainable production and consumption agricultural and food models;
- Identify measures to remove the causes of deficiencies in food production by valorisation of the annual reports on the state of vegetation;
- Establishment of concrete and precise regulations addressed to local communities concerning the completion of works to prevent and manage natural disasters;
- Development of national and regional centres for emergency interventions.

The importance of protecting and preserving soil in ensuring the food safety. Soil is the source of life for people, the environment essential resource to which it is our duty to pay respect, to protect, preserve and improve over time, as it is the legacy that we transmit to our descendants’ descendants. Along with the soil, the environment offers numerous essential resources to life, such as drinking water (without which organisms could not survive), atmospheric oxygen (vital in ensuring the respiration of living beings) and nitrogen (fundamental element in structural, functional and information biosynthesis of proteins that are the fundamental constituents for the existence of living organisms); with respect to all environmental resources, humanity has the mission of honour to protect it from destructive factors such as pollution and degradation, to increase human knowledge and to use it creatively to ensure the survival of terrestrial life and environmental sustainability [4].

The impact of a damaged biodiversity upon food insecurity. The fundamental theme for the World Environment Day 2015 was the Green Economy, due to the major increasingly visible changes in the environment which caused the erosion and degradation of biodiversity with disastrous long-term effects, affecting indirectly, but increasingly intense the world population’s food security.

Uncertain effectiveness of environment conservation. This efficiency is jeopardized by a number of uncontrollable global processes and phenomena such as acid rains, the greenhouse effect, the ozone depletion, water’s eutrophication, acidification and nitrification of soils and the desertification of arable land. In this context, in Romania, the Ministry of Environment has identified 13 priority areas to be addressed in order to adapt to climate change: industry, agriculture and fisheries, public health, infrastructure, construction and urban planning, transport, water resources and protection systems against floods, forests, energy, the biodiversity of the environment, the insurance system, the damage to the environment by human action and the education system [10].

Strategic documents for environmental protection. The concern for protecting the environment from the destructive action of climate change is actively present at EU level through two strategic documents developed for this purpose, but which also aimed at alleviating the permanently increasing phenomenon of food insecurity; the first strategy document focuses on medium and long term and it is entitled "The package climate change - power in the perspective of 2030"; the second document which is entitled "The new global agreement on climate change" should have been negotiated and finalized by the end of 2015 and applied from 2020; these documents concern the new international strategy to combat climate change and represent a future global agreement for the post-Kyoto era [10].

Aspects regarding the impact of pollution on the environment and food safety and security. Official statistics show that harmful influence of climate change at global level is expressed through the devastating effects of pollution: the annual death of more than 2 million people; annual reduction of life expectancy with 4.6 million years summed by premature deaths; intensification of cases of anaemia and delays in mental development of children due to lead pollution; increase incidence of cancers caused by pollution with ozone, chromium, cobalt, asbestos, aromatic compounds and other chemicals; amplification of allergy cases caused by pollution with mineral of volatile powders, detergents, insecticides and food additives; increased risk of deaths due to lung cancer by 8% every 10 µg/m³ fine particles of inhaled air. Hence the special attention that should be paid to air pollution; moreover the unwanted climate change is also trigger by the use of a higher
percentage of biomass in animals' feed, which increases the air pollution and it is going to present itself as a major problem in the future [10].

One distinguishes agricultural biodiversity as a circumscribed domain within the frame of biodiversity. The integrating character of the agricultural biodiversity in its relations with the agronomic and dietary sciences, can be underlined in the diagram from Figure 1 [11]; within this the agricultural biodiversity represents an important sequence of the biodiversity. The mention of some descriptive items of biodiversity clearly emphasize the existing links within the food chain soil-plant-animal-human organism [12].

**Forests, environmental protection and food insecurity.** There exists a tight interdependency between forests, climatic changes, sustainable development and the food safety of the population.

**The role and the importance of forests.** By means of their multifunctionality and their biodiversity, the forests contribute to the formation and protection of soils (by insuring the stability of slopes and verges), they take part in the regulation of the water cycle and in the control of air quality, balances the climate at an regional and local level (especially through evaporation-perspiration), as well as at a macro regional and world level (including carbon capture and storage) [13]. Furthermore, forests play an essential part in the preservation of endangered habitats as well as in assuring shelter and migration corridors for the rare and endangered wild fauna [14]. All these aspects are illustrated in Figure 2.

**The contribution of forests to the food safety of the population.** From a socio-economical point of view, forests assure the production of timber, energy biomass and other goods unrelated to wood, hereby contributing to the development of tourism and creating jobs, as well as assuring some income sources for a significant part of the population [15], especially in the developing countries [16,17]; furthermore, forests act as an economic safety belt in special situations such as natural calamities, social conflicts and wars [14].

**The dangers of environment changes to forests.** Environment changes as determined by various causes and processes (air pollution, soil erosion, land clearance and soil deterioration) lead to significant losses in the productivity of forests, affecting the economic sector [18].

![Figure 1: Integrative character of agricultural biodiversity with respect to the whole biodiversity (Adaption over [11], quoted by [12]).](image1)

![Figure 2: Multifunctionality and forest contribution to food security and life support [14].](image2)
and the appearance of social conflicts; all these aspects are being synthetically shown in the Figure 3 [14].

The danger of some biotic and abiotic phenomena. Furthermore, climate changes induce the worsening of biotic and abiotic dangers looming over forests; among these dangers there are the forest fires, drought, storm, air pollution (gas emissions due to road traffic), forest fragmentation following construction works of tourism infrastructure and the devastating action of some animals, diseases and harmful agents [19].

The importance of integrated administration in the sustainable administration of forests. Within the above mentioned context, at a global level, the integrated administration of the environment in general and the sustainable management of forests in particular, play an essential part in the following factors: the analysis of the impact of the environment climate changes on forests, the development of mitigation measures against the negative effects triggered by environment changes on the quality of the human life, the setting up of programs for forest adaptation to the action of environment changes in general and climate changes in particular [20].

The importance of the ecosystem services provided by forests. Forests provide numerous ecosystem services entailing human benefits through the growth in welfare and quality of life [21]. The environment and climate changes indicated throughout time, have partially been determined by the necessity of changing the usage of afforested terrains and also by the faulty management, with a significant decrease in the favourable effects on the services provided by these genuine power plants [22-24].

The importance of databases managing the ecosystem processes for food safety. At an European level, databases have been obtained addressing this concept, taking into account the sum of the essential ecosystem processes, within the context of carrying out the following services [25]: supply (food, materials, energy); regulatory services and cultural services (spiritual and symbolic interactions with the environment, physical and intellectual interactions with the environment,...); the regulatory services provided by forests, mainly expressed by the mitigation of the toxic effects of waste and noxious fumes, the prevention of erosion and extreme events, the regulation of the rates of flow, of the carbon content and the control of the air composition are considered ecosystem services of reduction of negative effects [26,27] due to climate changes, as shown in Figure 4.

The importance of the multifunctional character of the forest management and promotion. The strategy of the European Union for forestry, adopted in 2013, proves the forests are important not only for the rural development, but also for the protection of the environment by preserving biodiversity, promoting bioeconomy and the ability to fight climate changes; according to this strategy, the European forestry policies have to be assumed, in an integrated way, within the national forestry strategies.

The necessity of amending the Kyoto Protocol. The 21st Session of the Conference of Parties (COP 21) within the UN Framework on Climate Change (UNFCCC), held in Paris in December 2015 and aiming the stopping of the global warming, represents a challenge assumed by the entire planet. One foresees the reaching of an inter-governmental agreement regarding the limitation of the global warmth to 2°C, as well as the adoption of another agreement that provides for the replacement of the Kyoto Protocol, beyond the year 2020, as to the limitation in the emission of greenhouse gases by their globally quantitative reaction from 40% to 70% by the year 2050. Within this framework, i.e. the accomplishment of these goals directly concerning the future of our planet, the forests will still play the part of generators of green energy, able to mitigate the global changes that intensify the global warming process.

The contribution of forestry to the public food safety. Today’s strategies, forecasts and national and international programmes regarding the future development of forestry show significant growths in agro-alimentary products (berries, edible mushrooms) within the area of the forest domains, due to the following
reasons: spectacular increase in harvesting costs; the decrease in the workforce as represented by the number of pickers; unfavourable natural conditions due to global climate changes. Furthermore, food safety will permanently remain in a shadow of uncertainty if one does not decide to increase forest areas and to manage them efficiently and sustainably by means of setting up national systems consisting in protecting forest stretches even if the scientific and technological advances will be more and more significant [28].

**Interventions within the soil-plant-climate-animal-man-market system on food safety.** The major objective of this agro-alimentary system consists in ensuring and maintaining the state of health of the population. This objective can be achieved by setting up a medium and long term development strategy of all the branches within the agroalimentary system towards a sustainable development by completing and monitoring the entire flux consisting in: the attainment of the natural resources intended for agricultural and animal production → storage and minimum processing → industrial food processing → temporary storing (in silos / preservation) → distribution in the market system → meeting the food requirements of the population → ensuring the health of the population [30].

Certain foods contain in addition to the known nutrients, some foreign substances (chemical xenobiotics) which enter the human organism once the foods have been consumed. The interaction between food nutrients and xenobiotics is being shown in Figure 5 [29].

Today’s society is based on knowledge, and it imperatively includes the usage of scientific and technological progresses, aiming at the achievement and the application of innovative elements in all the domains of activity in general and in the food sector in particular; the main interactions and factors of influence that can affect the integrated food system are presented in Figure 6.

With this relatively recent purpose, one has also defined the main future challenges with respect to a potential food crisis: which solutions will be found within the integrated food system aiming at a harmonization of the common agricultural policies with the global climate changes, the present orientations in our lifestyle and the characteristics of the consumption society? To what extent will the future economic and social changes affect the interactions and the conflicts between social safety and the availability, the access to and the use of food? [31].

**The impact of the global sustainable development on the prevention of food insecurity.** At a meeting held in Paris in 2012, the expert team "Transition Team" proposed 3 topics for the integrated researches regarding the global sustainable development [32]:

- The Dynamic Planet for the study of the terrestrial System, with an integrated assessment of the natural and social components aiming at anticipating the global danger levels;
- Global development for a balanced and sustainable employment of food, water, health and energy resources and other ecosystem services;
Transformation towards a sustainable development involving the understanding and the assessment of global environment strategies at different scales and within different sectors.

An essential feature of the new programme "Future Earth" consists in the direct involvement of the stakeholder along the entire research process, starting with planning (codesign) up to its working out (coproduction) and the distribution of the obtained results [34].

The group of experts "Transition Team" has finalized at the end of 2014 its strategic agenda of research showcasing 8 priorities [32]:

- The availability of water, energy and food for all the inhabitants of the planet;
- The detachment of carbon emissions from the issue of economic growth;
- The salvage of natural resources, of continental and marine waters;
• The development of healthy, resilient and productive cities;
• The promotion of a sustainable future for the rural human settlements;
• The improvement of the human health by correlation with the present modifications of the global environment;
• Promotion and encouragement of sustainable production and consumption of material and spiritual goods;
• The improvement of governmental activities and of fast warming systems with respect to a prompt reaction to eventual future threats.

There exists a tight interdependency between sustainable development and ecosanogenesis [35]. Within the triadic way of thinking on the matter, the reality is material and presents itself in the form of information, energy and substance [36].

In turn, every form in which matter reveals itself has several forms of existence, each of them forming interrelations with the other materials [35]; there is the fundamental information whose existence is not conditioned by the presence of an energy or substance substrate; the structural information characterizing the features of the energy or substance substrate on which it is located; the genetic information located on a substrate of living matter to which it orders formation and sustainability; the neuronal information, a derivative of the animal genetic information, located in neurons and specialized cells, by means of which animals regulate the relationship with their life environment; the rational information derivative of the neuronal information, developing within some human neurons, capable of knowledge and self-knowledge. All forms of existence of information are ephemeral, with the exception of the fundamental information, which is everlasting; in this context, in order to be transmissible, ephemeral forms of information need to reproduce [37].

3. CONCLUSIONS

The expansion and the amplification of climate phenomena. These have been, are and will continue to be caused by an intolerable negligence of the negative effects which the technological progress and the intensive industrialization exert on the environment in general and on climate in particular; climate changes substantially modify the characteristics of the different countries and regions of the planet, by limiting the areas favorable for agriculture and impose radical changes in the exploitation systems, of the sorts of vegetal and animal genotypes, of the cultivation and breeding technologies of plants and animals as well as the systems that insure the ecosanogenesis as a hole [38]. The more intense and less controlled man-made pressures are, the more important the growth in the danger of environmental deterioration and of extension of major climate changes at a planetary level [39].

Furthermore, the first primordial natural resource, the groundwater reserve is becoming exhausted through consumption by plant life and evaporation, such that humidity in plants attains limits corresponding to the withering interval, and groundwater reaches the value of the higroscopicity coefficient on variable soil depths; in these unfavourable conditions, the groundwater level drops dramatically, severely affecting the ecosystems in different geographic areas of the world. In turn, soil life, the second essential natural resource, slows down or stagnates, hereby disturbing the biological cycles of vital elements (especially nitrogen and carbon), with major and harmful repercussions on the reduction of soil fertility and agricultural production [38].

The widening of the gap between the populations in developed countries and those in undeveloped and poor countries. It occurs in the context of the above mentioned factors, which induce the intensification of food insecurity of the world population; this intensification can also be revealed by means of the diagrams regarding food quality and diet/alimentation; in the normal conditions of the rich and developed countries, food quality and diet imply the natural symbiosis between the axes alimentation – health and alimentation – pleasure, in which all the qualities of an aliment are contained (nutritional and hygienic qualities in insuring health, sensorial and aesthetic qualities in offering pleasure) as shown in Figure 7; in the abnormal conditions in the undeveloped and poor countries, the nutritional quality becomes survival food and the hygienic quality is surrounded by uncertainty, such that the axis alimentation – health becomes the axis alimentation – survival while the sensorial quality is reduced to the insurance of minimum food resources and the aesthetic quality can metamorphose into a malnutrition phenomenon or even continuously worsening hunger, such that the axis alimentation – pleasure becomes alimentation – insecurity (Figure 8).

In this unfavourable context, unconventional green technologies and green energy represent a viable alternative in order to reduce the harmful effects of global
climate changes and to decisively contribute to the reduction of food insecurity.

Figure 7: Food quality and alimentation under normal conditions specific for developed and rich countries.

Figure 8: Quality of the food and nutrition in abnormal conditions specific for undeveloped and poor countries.

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