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

Part I - Agronomic Research, Demographic Explosion and Food Safety

Constantin Croitoru*

Department of Food Sciences at the Academy of Agricultural and Forestry Sciences, Bucharest, Romania

Abstract: This article is a warning signal that attempts to treat in two distinct parts the factors determining the food insecurity of the world population in an academic approach but without concrete results of scientific research. In this first part it is highlighted the fundamental role of agricultural research in ensuring food security in the context of a significant increase in world population. The article begins with introductory notions that briefly examine the main current global phenomena such as quasi exponential increase of world population, the shortfall of cereal crops, the new geopolitics of food, the rising food prices which are an attack on food security and the biding nature of securing daily access to food for everyone on the planet. Further there are defined and characterized the concepts of food security and nutrition security. The analysed issues address: the importance of conservative agriculture in order to prevent food insecurity, new ways to improve plants in order to adapt to the environment and to the scientific zootechnical research which has to be adapted to the new climate changes and the importance of water resources and green biotechnologies for food security. It is reviewed the Europe 2020 strategy on food security. The author presentes his conclusions through two original diagrams; the first diagram suggests that the attention of the world policy-makers, both continental and national ones, should be directed to the major problems of the planet that are organically related to the development inside the environment in the next period (regarding energy, water resources, biodiversity, climate, pollution and interactions between man and nature); the second diagram refers to the world ecological crisis regarding: the damage incurred to the agricultural production and drinking water resources, the reduction of fishery and aquatic resources, the emphasizing of deforestation, the increased discharge of toxic wastes and, not least, the accelerating climate change. All that creates the need to promote effective and courageous green energies and (bio)green technologies as a viable alternative to save mankind. It is stressed that the “green” technical-scientific progress, through its innovative and unconventional nature, is only a strictly necessary condition, but not sufficient in saving the planet; this fight needs the establishment of a professional, academic and scientific solidarity that requires also support in the form of the entire human solidarity; through their synergetic action, the two types of solidarity should gradually generate a national political solidarity, to further become a continental one and, in the near future, a world political solidarity to ensure real conditions for saving the planet.

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

1. INTRODUCTION

The complexity of the processes and phenomena to which mankind has assisted in the last 20-30 years involves a holistic approach to the acute issue of the alarming increase of food insecurity among the population in many regions of the planet. Along with the global climate change, one of the major factors influencing the increase of food insecurity, the rising number of world population plays also an important role.

The quasiexponential increase in world population. The latest estimate of the Food and Agriculture Organization of the United Nations (FAO) shows that by 2050 the global demand for food will increase with 60% [1]. World population is expected to reach 8 billion by 2030 and over 9 billion in 2050 [2].

The danger of population growth in developing countries. A large part of the world's population growth occurs in developing countries, which face the highest food insecurity; under these conditions, it is imperative to increase the agricultural production in order to ensure adequate and sustainable access to food for its entire population [2].

EU initiatives. The Joint Research Center of the European Commission launched in Brussels on 28 September 2012 an initiative for the scientific study of the needs and the possibilities to increase global availability and sustainable access to food for the entire population; this center provides consistent scientific support in strategic areas such as food security, protection of natural resources, climate change monitoring and improvement of forecasting systems for crops [2].

*Address correspondence to this author at the Department of Food Sciences at the Academy of Agricultural and Forestry Sciences, Bucharest, Romania; Tel: +40213136377; E-mail: c.croitoru@sodinal.com

© 2015 Revotech Press
The shortfall in grain crops. This will accelerate the transition from an abundance period and surplus to a period of chronic crisis. As food prices rise, global competition for control of land and water resources intensifies [3].

The new geopolitics of food. In this new world, access to food replaces access to oil resources, becoming a priority for governments. Food is the new oil and the earth is the new gold. So welcome to the new geopolitics of food! [3].

The increasing of food prices, a new attack to food security. For Americans who spend only 9% of personal income on food, the doubling of food prices is not a misfortune; instead, for those people who spend 50-70% of their income on food, rising food prices is a serious problem.

The accentuation of daily food consumption. Many poor families around the world have reduced their food intake at one meal / day due to rising prices; unfortunately, for many of these families, even eating one meal/day is no longer possible; in this unfavorable context millions of poor households try to plan certain days during a week with no food, i.e. days during which they do not eat anything [3].

Illustrations of daily lack of food. A recent study done by the international organization "Save the Children" shows that currently 24% families in India live for days completely devoided of food, while in Nigeria, the same indicator reaches 27% and in Peru 14%; in a world deprived of food, hunger often has the face of a child; millions of children are excessively hungry today and some of them are physically too weak to go to school; a very high percentage of these children were reported with disrupted physical and mental development [3].

Mandatory daily access to food for all Earth’s inhabitants. At the 15th World Congress of Soil Science (held in Mexico in 1994), Norman Borlang addressed Congress in his opening: "All those involved in food production, we have to keep in mind that world peace cannot be maintained under conditions of hunger and human misery. Consequently, given the access refusal of small farmers with few resources to factors of modern production such as varieties for improved crops, fertilizers and pesticides, the world will be condemned, not to poisoning, as some suppose, but to famine and social chaos" [4].

2. CONCEPTS, PRIORITIES AND AGRONOMIC STRATEGIES: A CRITICAL ANALYSIS

Among the main issues characterizing the current trends of globalization, alongside other economic, social and political concepts, there can be cited resource conservation, environmental protection, agricultural development and food security. There will be addressed the concepts of food and nutrition security and conservative agriculture, new ways to improve the plants to adapt to the environment, aspects regarding the scientific livestock research adapted to the new climate, water resources and food security, green biotechnologies, ecosanogenesis and food security, and finally, the 2020 Europe strategy on food security.

Definition and characterization of food and nutrition security concepts. The original concept of food security was defined in the Final Declaration of the World Summit of FAO regarding food, which states that "food security exists when all people at all times have physical and economic access to safe and nutritious food to meet energy and food needs and to lead a healthy and active life". Subsequently, completion of the definition of this concept proved to be very difficult, so currently it is estimated that there are over 200 definitions and approx. 450 indicators that relate to food security [5].

In the evolution of understanding the concepts related to food safety, there were issued distinct concepts related to food and nutrition aspects [6-10].

The concept of food security. It is based on four main dimensions, which are availability, accessibility, utilization and stability. If the first three dimensions are considered to have a circumstantial nature, the 4th dimension has an integrative character. Each dimension of the concept of food security can be assessed by various indicators (Figure 1).

The concept of nutrition security. In the sense of the proposed acceptation in the meeting of FAO in Rome in 2012, the concept of nutrition security was defined as "a situation in which all people at all times can consume sufficient food quality in terms of variety, diversity, nutrients content and health security, to meet energy needs and food preferences but also to lead a healthy and active life". Nutrition security is defined by three key factors [11]: access to adequate food (which means the use of proper food in all qualitative and quantitative aspects); care and food practices (which is dependent on the degree of training of the people...."
involved); sanitation and health (which relates primarily to ensuring the supply of drinking water and wastewater removal to maintain health).

**Integrated security concept of food and nutrition.** Specialists and experts prefer to use the "food and nutrition security" integrated concept, which highlights the importance of two complementary dimensions of food and nutrition issues. This integrated concept has become a standard, mentioned as early as 2009 in the documents of the WHO and FAO joint committees, such as "The Global Strategy for Food Security and Nutrition" or "The Global Partnership for Agriculture, Food and Nutrition security" used by CSA.

The complementary nature of the integrated concept emerges from its definition which states that "food and nutrition security exists when all people, at all times, have physical, social and economic access to aliments consumed in sufficient quantity and quality to meet their nutritional needs, when it is supported by an adequate environmental sanitation, health services and care to allow a healthy and active life".

**Interaction between food and nutrition security and food safety.** The links and connections between food and nutrition security and food safety were highlighted by the International Union of Food Science and Technology (IUFoST). The complexity of the interrelations between the two concepts is based on the multi-dimensional nature of food security, on the determinant characters of nutrition security and on the crucial character of pathogens to food safety, as outlined in the diagram from Figure 2 [12].

The importance of conservative agriculture in the prevention of food insecurity. Conservative agriculture is a complex concept, with CA as abbreviated name, which provides a set of principles destined to help guide the fundamentative efforts, the implementation and the development of sustainable and economically viable technologies for different culture systems [13].

**The principles of conservative agriculture.** Each of the CA principles pursue a clearly defined objective.

- **The principle for reduction of the intense works to the soil.** It is the first principle and its objective aims at applying the seeding system directly on the fallow soil or at applying the seeding system with controlled works, which normally affects the soil surface only in a reduced rate by 20-25%.

- **The principle of reasonable apprehension of a sufficiently high level of plant debris on the soil surface.** By its very name, the second principle aims at retaining sufficient quantities of plant debris on the soil surface to protect it from erosion under the action of wind, storm water, water evaporation
and surface water runoff; the major objective of this principle aimed at superior valorization of water and improvement of physical, chemical and biological soil properties, associated with long-term stable agricultural productions.

- **The principle of using appropriate crop rotation.** This third principle is based on efficient use of crop rotation, which is based on diversity and on economic viability, which would provide farmers with new options for risk reduction.

- **The principle of immediate levying of an increase in economic benefits and living standards as a result of the new technologies based on CA.** In the case of the fourth principle, the main objective aims at ensuring stability and economic viability of micro-farms and farms by reducing production costs and/or by higher and more stable crops. Farmers' awareness of the existence of an economic benefit before adopting CA is very important.

- **The principle of controlled traffic.** It is the fifth and final principle of CA. The main objective of this principle aims to eliminate soil compaction in the cultivated area, induced by the passing of aggregates' technology, in order to avoid the emergence of internal tensions that could transmit to plants and soil unnecessary stress in conditions of increasing performance on planted areas and in order to support agricultural production minimal inputs.

**The benefits of conservative agriculture.** Taking into account the experience of countries where farmers have adopted seeding on soils with some the conservative agriculture would represent an opportunity in the following situations [14]:

- Stopping soil degradation to preserve sustainable natural resources that exist in the soil, water and air;
- Increasing the efficiency of water exploitation in culture systems, both under natural rainfall and irrigation conditions;
- Increased productivity of crops by increasing efficiency of working time and inputs;
- Avoiding and/or reducing the destructive effects of climate change;
- Reducing production costs of farmers and improvement of their living standard.

**Conditions for implementation of conservative agriculture.** In order to research and extend into production some functional CA systems, it is proposed an innovative systemic and multidisciplinary approach involving the main human and professional links (the community relationships) and connections (complementarity relations) as well as the interdependencies established between many operators (especially farmers) who associate in order to fulfill the same goal [15].

**Exemplifying a system of conservative agriculture.** Figure 3 presents such an advanced technical and economic agricultural system (ATEAS) specialized in technologies based on CA, which represent a strategic association between research & development institutions, agricultural machinery makers, extension agencies, government agencies, inputs suppliers together with innovative farmers in order to capitalize research, development and innovation in agriculture; ATEAS has a particularly important role in promoting technical progress by rapid penetration of advanced knowledge and research results in all fields of agri-food, thus contributing to the development of functional CA systems [13].

**The beneficial effects of CA in preventing and combating the negative effects of drought.** Drought is a dangerous phenomenon that has become more frequent in the context of recent global climate change; this phenomenon with destructive impact on agriculture can be fought effectively by applying CA. CA systems associate minimum works of the soil with its covering with a layer of plant residues (30%) after planting; the waste layer varies with soil type, crop rotation and thickness of snow cover in winter [16].

![Figure 3: Advanced technical and economical agricultural system (ATEAS) specialized in technologies based on conservative agriculture (CA) [13].](image-url)
The expected effects after implementing specific AC measures on agricultural land, biodiversity and desertification trend are summarized in Table 1 [17].

Testing of new more efficient methods of plants' reaction to water shortage and high temperatures. It is highly necessary to speed up the implementation of research programs aimed at drought and heat resistance of plants in order to achieve real progress in this direction [18].

Improving crop emergence and crop installation in adverse environmental conditions. It is necessary to adopt some research programs to allow the production of wheat genotypes possessing a longer coleoptile (the first leaf, shaped as a sheath, that surrounds the embryo of plants from the Gramineae family). Through genetic recombination and metagenesis methods there were created wheat plants with shorter tiller and longer coleoptile [19], which are currently widely used in the program to create new varieties.

Improved resistance against diseases with increasing frequency under climate change or in the years with extreme weather events. This route is important because certain diseases frequently produce

Table 1: Recommended Measures to Reduce the Negative Effects of Climate Change on Soil, Biodiversity and Desertification. Adapted after [17]

| Land Use Conversion from Conventional to Conservative Agriculture System | The Effects of the Measures Recommended at the Level of: |
|---|---|---|
| | Soil | Biodiversity of Soil | Desertification |
| Minimal works | Increasing SOC from stage 0 (+) to the decrease fossil fuel use (+) | The increase of biodiversity in soil depending on the use of herbicides (+) | Reduction of erosion (+) Increased water retention capacity (+) |
| Retention of plant debris | Intensified increase of SOC (+ +) | A more increase of biodiversity (+ +) in soil | Improvement of soil fertility (+), Reduction of erosion (+), Increased water retention capacity (+) |
| Crops and permanent grasslands | Intensified increase of SOC (+ +), Increasing biomass from stage 0 (++) to, On concerted arable terrains: decreasing of biomass and SOC (+) to (-), accompanied by soil washing | Biodiversity increase as a function of plant species/ meadow from stage 0 (++) to, decrease of biodiversity On converted arable lands from (-) to (-) | Reduction of erosion (+ +), infiltration and increasing capacity of water retention (+) |
| Organic fertilizer (manure, compost, mulch, biosolids) | The significant increase of SOC from (+) to (+++) | Possible increase or decrease of soil biodiversity if organic fertilizers are contaminated with heavy metals from (-) to (+ +) | Improvement of soil fertility (+), Increase of water retention capacity (+) |
| Improved rotations (i.e. green manure, lawn, double culture) (without ploughing) | SOC increase (+) | The increase of biodiversity in soil above ground (+) | Improvement of soil fertility (+), Increase of water retention capacity (+) |
| Fertilization | Biomass increase from (+) to (++) | Possible secondary negative impact on endemic species from (-) to stage 0 | The increase of soil fertility and vegetation cover (+ + +), Possible acidification (ammonium salts) (-) |
| Irrigation | Biomass increase (+), GGE costs for Costuri EGS pentru preparation of irrigation water (-), Increased use of fertilizers (-), Increase of N2O emissions (-), Biomass Losses through salinization (-), Restricting the amount of land needed for crops and expansion of lands intended for renewable energy orafforestation from (+) to (+ +) | Impact independent of the use system of the replaces land, with possible loss of endemic species, Reducing biodiversity of cultivated species from (-) to stage 0 | Increased productivity with high risk of soil salinization from (-) to (+) |

SOC – Soil organic carbon; GGE – greenhouse gas emissions; Benefic trends – (+) or detrimental trends – (-).

The significance of the impact varies from stage 0 (stage without impact) to a positive (+) or negative (-) stage.
significant crop losses. In Romania, INCDA Fundulea created improvement lines for the resistance of wheat from *Thinopyrum* and *Triticale* species to a disease called BYDV (barley yellow dwarf virus).

**Improvement of anatomical and morphological features of plants that contribute to climate to mitigate the negative influence of climate change.** It is an indirect way of plant amelioration which aims to increase the reflectance of wheat's triller, reduce greenhouse gas emissions and increase of sequestration capacity of larger amounts of carbon dioxide by plants.

- **Increased reflectance of wheat's tiller.** It is based on the fact that a higher albedo (the fraction of incident light energy that is radiated diffusely by a body) of plants reduce their temperature, thus helping to mitigate the undesirable influence of climate change, fact demonstrated by the results of international research [20] and national [21,22].

- **Reducing greenhouse gas emissions.** It is possible by increasing the efficiency of nitrogen use and reducing nitrogen's legivation (accelerating the transformation into fine powder, readily soluble and assimilable) so that it can reduce the necessary amount of nitrogen fertilizer for the plants [18].

- **The seizure of larger quantities of carbon dioxide.** It aims to develop the biological features of the plant such as the maximizing of the photosynthesis (by increasing the efficiency of interception of light and solar energy conversion), a greater allocation of nutrition resources assimilated by the roots [23], improving efficiency of water use and nutrients and increasing tolerance to biotic and abiotic stresses [18].

**Instead of conclusions.** Besides the aspects above revealed, the adaption of wheat to the environment involves improving the mechanical strength of the stem against falling, increasing shaking resistance of grains when harvest is delayed, increasing resistance to excessive moisture, low temperatures (frost, hoarfrost), but also increased flexibility for planting dates (and versus the time of plants' emergent).

Zootechnical scientific research adapted to the new climate changes, valuable source of food safety. The relevant issues are addressed in the following section.

**The importance of interdisciplinary collaboration.** In the fight against climate changes, zootechnical scientific research must promote the interdisciplinary collaboration (agronomists, biologists, meteorologists, medics, economists, mathematicians) such that the following objectives become reality [24]:

- Reorientation of the objectives as to the improvement of animals, meaning the approach of the traits ensuring robustness and adaptability, next to the improvement of productive traits approached in all the previous researches;

- The development of molecular biology researches, aiming at obtaining genotypes displaying the aforementioned intended traits;

- The promotion of fodder crops, resilient to climate changes (Sudan grass, sweet sorghum, millet, ...);

- The development and implementation of new systems ensuring the thermal comfort of animals at a low consumption of energy, fueled by unconventional energy sources (green energy);

- Introduction of certain animal breeding and exploitation techniques that allow for saving on water resources.

**Possible solutions leading to a mitigation of the effects related to climate changes.** Among the potential solutions needed to counteract the negative effects of climate changes, mainly the thermal stress and the availability of fodder, one can list the following [24]:

- The collaboration between agronomic research units aiming at the production, assessment and supply of the newest hybrids or plant sorts, resilient to drought, must be permanent;

- The shortening of the reassessment intervals for energy demands and norms as well as for the nutritious elements that are essential towards an increase in the efficiency of the feeding process, by avoiding the waste of nutrients especially within the time intervals affected by the thermal stress;

- A more efficient determination and assessment of the chemical composition and nutritional value of plants obtained on fields exploited under thermal stress (high temperatures) and water deficit (lack of irrigation systems), by simultaneously updating the nutritional facts tables specific to animal fodder;

- The identification and the supply of new fodder sources originating in the industrial processing
of vegetables and fruits and some other sub-products originating in processing cereals and leguminous plants with different technological purposes, such that the nutritional ratio at animals bred on farms is optimized;

- The extension of areas dedicated to the growth of sweet sorghum which can be stored in silos (cultivated immediately after having harvested mixes of various vetches and early straw cereals), with the possibility of a late harvesting of the sorghum (towards the end of October);

- The improvement of animal breeding technologies by building sheds that replicate the micro-climate factors (especially air ventilation and protection against solar radiations).

**The limitation of fodder resources, threat to the food safety.** The limitation of these resources represents a serious threat to the socio-economical role of the agricultural sector, including the zootechnical one, even more in the context of the need to ensure food safety the world population. If the need for food products of animal origine increases, it is recommended to satisfy this necessity in geographical areas that practice agro-zootechnical systems based on the use of irrigation and the industrial systems of processing and exploitation of raw materials, emphasizing the animal production of pork and poultry and also the increase in the production of milk from bovines, within industrial production systems less affected by climate changes [24].

**Water resources and food safety.** The implication and the importance of water resources in the context of food security and safety has already been discussed in the previous paragraphs, but still needs a direct approach in a distinct chapter.

**Some statistical elements.** It may seem a paradox but only 0.46% of the world’s fresh water volume can be directly used and the rest of 99.54% is encountered in the form of vapour at atmosphere level (0.04%), in glaciers and polar caps (77.19%), lakes and marshland (0.35%), underground water and soil moisture (22.41%) as well as in terrestials water courses (0.01%).

**Some aspects regarding the vulnerability of water resources.** It has been forecast that around the years 2020-2025, the water crisis will hit the entire world, first affecting Africa and The Middle East, South and South-East Asia which would comprise the most populated countries, China and India. It is probable that the countries already possessing excedentary water resources, like Brazil, Russia, Canada, Australia shall reach agreements with the affected nations aiming at a more judicious sharing of these resources [25].

**The influence of water on food security and safety.** In the context of accelerated global climate changes, one recognizes the need to permanently reassess and update the hydrological potential which takes into account animal breeding and plant growing technologies, hydrotechnical works of regulation, collection and distribution of these resources towards users. The unfavourable evolution of hydrological regimes will be emphasized by the urbanization phenomenon, by a shortening of the flood cycli (noticed in the past at intervals of 100 years, will reoccur in the near future at a shorter interval of 20 to 50 years).

In this context, it is imperative to sustainably manage the water resources by promoting the concept of an approach as a whole of these resources, through permanent concern for its accumulation, by facilitating watercourses applying land improvement works, through awareness to the danger generated by the limited character of these resources and through an integrated and concentrated action on the whole analyzed river basin [26].

Only through such sustainable management will be possible a direct contribution of water resources to the population's food safety and security.

**Green biotechnology, ecosanogenesis and food security.** There is a tight interdependency between biotechnologies, ecosanogenesis and food security; through the attained scientific and technical achievements, biotechnologies promote the concept of ecosanogenesis and directly contribute to the ensurance of food safety for the population.

**Green biotechnologies.** A simple definition of biotechnologies recommends them as experimental systems that use living organisms to beneficial puroposes, for instance food production, the production of antibiotics, cellular cultures as well as the in vitro gene transfer between the different types of microorganisms. In turn, green biotechnologies are those which find application in food processing.

- **Interrelationship between the different types of biotechnologies.** The scientific reality has proved production has confirmed that there are numerous links between the different types of bio-
technologies. Within this context, the biotechnologies associated to food processing and nutrition, coupled to health and to maintaining the health of living organisms (plants, animals, people) harmoniously interweave with the biotechnologies targeting the diagnosis and treatment of the various disorders and diseases [27].

- **The relationship between the dynamic of the population growth and food resources.** Recent studies emphasize the unequivocal relationship between the dynamics of the world population growth and the ensurance of food products based on the contribution of green biotechnologies, in the context of the food crisis, looming together with the major climate changes. Based on the evolution of Earth’s population between (1950-2025) as presented on the site of Syngenta (http://www.syngenta.com), taking into account the exponential population growth up to the year 2025 and the increase in the stress induced by the lower food reserves, one notices that one hectare will have to feed 5 persons in 2025 as opposed to only 2 persons in 1950.

- **Short conclusion.** The above mentioned data highlight the limitations in the development potential of green biotechnologies, especially if one takes into account some of their negative aspects on the economy and the health of the population.

**Aspects in regard to the concept of food ecosanogenesis.** Statistics show that food security will severely be affected by a future world food and water crisis. Even if it may seem a paradox, both hunger and overfeeding are being signaled at a world level.

- **The intensification of the hunger phenomenon.** Throughout the last decades, this phenomenon has been affecting 14% of the world population (around 840 million victims), especially in Africa (33% of the total population) and Asia (16% of the total population). Nevertheless, hunger affects both developed countries (11 million victims) and developing countries (799 million victims). Present mainly on the African continent, food crises have their roots in the failure of the rural economies, but also in the intensification of the AIDS phenomenon, affecting the young labour force employed in agriculture [28].

- **The intensification of the overfeeding phenomenon and obesity.** According to the report *Images Économiques du Monde* 2004, the scourge of obesity increased in the last 10 years by 70% in US and by 50% in France. The health of the human organism depends on the health of the entire food chain that generates food products (plant health, animal health, health of the environment, ...); in other words, human food security and safety depends on the plant ecosanogenesis, the animal ecosanogenesis and the dynamics of the ratio alimentation to health [28].

**The strategy Europe 2020 regarding food security.** The current and future European objectives are based on the 3 priorities of the strategy Europe 2020: smart growth – promoting a more efficient economy supported by knowledge and innovation; durable growth – promoting a more competitive, ecological and efficient economy; a growth open to inclusion – promoting social and territorial cohesion. Within this framework, the world agricultural production receives a special importance, agriculture that can and must contribute to the ensurance of alimentation for the entire world population, by implementing decisive, efficient, durable and highly performant actions [4]:

- Capitalizing the agriculture by investments organisation, leadership, research, innovation and further technologization;
- The promotion of new irrigation systems and technologies in the context of water scarcity;
- Protection of natural resources and land areas;
- Restore and revitalize natural grazing areas;
- The introduction of mineral and organic fertilizers;
- Reviewing the agriculture through its adaptation to the new climate conditions;
- Revitalization and strengthening of activities in mountain areas;
- Association of small and medium agricultural households by extinction of co-op’s;
- Attainment of added value through a higher importance of zootechnology within agriculture;
- Superior capitalization of vegetal and animal food processing production by improving storage conditions and processing technologies and biotechnologies;
- Protection of the forest areas through afforestation and the implementation of agrosilvicultural protection curtains;
- Prevention and mitigation of the nefarious impact of some extreme climate phenomena and
of their consequences (drought, scorching, flood, landslides, ...);

- Promotion of technologies and green energy alongside an increase in the efficiency of agricultural machinery, of water usage coefficients and nutritious elements in food products;
- An increase in the respect shown towards farmers and their households, who represent a permanent source of food products;
- Financial support targeting a stabilization of the rural population and a durable and performant rural development;
- An increase in the significance of the scientific research, of the technological development and technical innovation with the purpose of having them capitalized by the producers of food products.

In the case of Romania, alongside the above mentioned measures, a more efficient capitalization of the funds set at disposal by the European Union between 2014-2020 is highly important as well as the finalization, at a national level, of the inscription in the land register of all agricultural and forest areas [4].

3. CONCLUSIONS

Conclusions within the academic environment. The changes noticed in our environment have emphasized an unlimited capacity of variation that endangers the future agricultural productions in areas of the world. The durable and efficient development of agriculture, such that it ensures the feeding of the continually growing world population, greatly depends on ensuring an optimal ecological equilibrium that can be obtained by protecting and preserving the soil, the water resources, the climate conditions and the biodiversity of the environment [4].

Within this unfavorable framework, a meaningful example is represented by the improvement of plants that could entrain a significant contribution to their adaptation to the more and more alarming current and future environmental conditions. Taking into account this harsh reality, plant improvement research programs have to approach with increased and continuous interest, the issue of plant adaptability to an ever changing environment [4].

Strategic proposals of the article's author. Starting from the order of importance of the vital requirements of living organisms (breathe, hydration and afterwards feeding), the attention of the world of continental and national policy-makers should be focused on one hand on the following major problems of the planet that are organically linked to the environmental development that is to come: energy, water resources, biodiversity, climate, pollution and interactions between man and nature (Figure 4).
REFERENCES

[1] Ciolo D. Mesaj al Comisarului European pentru Agricultură și Dezvoltare Rurală (Message of the European Commissioner for Agriculture and Rural Development). In: ’Agricultura, domeniul strategic pentru securitatea și siguranța alimentară (Agriculture, strategic support for food security and safety)” (Hera C. coord.), Editura Academiei Române, ISBN 978-973-27-2363-0. 2013; 21.

[2] Ristori D. Mesajul Directorului General al Centrului Comun de Cercetare al Comisiei Europene (Message of the General Director of the Joint Research Centre of the European Commission). In: ’Agricultura, domeniul strategic pentru securitatea și siguranța alimentară (Agriculture, strategic support for food security and safety)” (Hera C. coord.), Editura Academiei Române, ISBN 978-973-27-2363-0. 2013; 37-38.

[3] Brown LR. Mesaj transmis de Ziua Mondială a Alimentației (Message transmitted on World Food Day). In: ’Agricultura, domeniul strategic pentru securitatea și siguranța alimentară (Agriculture, strategic support for food security and safety)” (Hera C. coord.), Editura Academiei Române, ISBN 978-973-27-2363-0. 2013; 28-29.

[4] Hera C. Agricultura, domeniul strategic al securității alimentare (Agriculture, strategic support for food security). In: ’Agricultura, domeniul strategic pentru securitatea și siguranța alimentară (Agriculture, strategic support for food security and safety)” (Hera C. coord.), Editura Academiei Române, ISBN 978-973-27-2363-0. 2013; 41: 61-62.

[5] Bajagai YS. Basic concepts of food security: definition, dimensions and integrated phase classification, www.foodandenvironment.com. 2014.

[6] Gărban Z, Holban, Brazdă M, Clubotariu D, Vâcărescu G. Unele probleme de patologie moleculară în carcinogeneză chimică. I. Interacțiunea ADN cu compuși policiicli (Some problems of molecular pathology in chemical carcinogenesis. I. The interaction of DNA with polycyclic compounds). Studii i cercetări de biochimie. 1985; 28(1): 31-40.

[7] Riely F, Mock N, Cogill B, Bailey L, Kenefick E. Food security indicators and framework for use in the monitoring and evaluation of food aid programs. Food and Nutrition Technical Assistance Project, Academy of Educational Development, Washington DC. 1999.

[8] Moll M, Moll N. Securité alimentaire du consommateur. Editions Lavoisier, Collection Science et Technologie, Paris. 2003.

[9] Ecker O, Brasinger C. The food security system – a new conceptual framework. Discussion paper 01166, published by International Food Policy Research Institute, Washington DC. 2012.

[10] Croitoru C. Tratat de stilința alimentației și cunoașterea alimentelor. Vol. I – Bazele alimentației și sănătățea (Treaty of food science and knowledge of foods. Vol. I - Basics of nutrition and health). Editura Agir, București. 2015.

[11] Wüstfeld M. Food and nutrition security, United Nation System Standing Committee on Nutrition Meeting of the minds Nutrition Impact of food systems. 2013; 25-28.

[12] Hanning BI, O’Bryan CA, Crandall PG, Rieke SC. Food safety and food security. Nat Educ Knowl. 2012; 3(10): 9.

[13] Cociu AI. Strategia INCDA Fundulea pentru fundamentarea, realizarea și dezvoltarea de tehnologii durabile și economic viabile bazate pe agricultura conservativă (The strategy of NARDI Fundulea for founding, implementing and developing sustainable and economically viable technologies based on conservative agriculture). In: ’Agricultura, domeniul strategic pentru securitatea și siguranța alimentară (Agriculture, strategic support for food security and safety)” (Hera C. coord.), Editura Academiei Române, ISBN 978-973-27-2363-0. 2013; 350: 352-353.

[14] Sayre KD, Govaerts B. Conservation agriculture – providing the basis for the development of sustainable crop management technologies. 8th International Wheat Conference, St. Petersburg, Russia. 2010.

[15] Sayre KD. Consultancy report for the modernizing of agricultural knowledge and information system project. Theme 2 – Promoting conservation tillage and low input practices – to be undertaken by the National Agricultural Research an Development Institute (NARDI), located at Fundulea, Romania. 2008.

[16] Sin G, Popescu A. Măsuri de prevenire și reducere a efectelor fenomenului de scăderea generării de schimbările climatice (Measures to prevent and mitigate the effects of droughts caused by climate change). In: Schimbările climatice globale, grila pentru resursele naturale (Global climatic change, care for natural resources), Editura Academiei Române, ISBN 978-973-27-2526-9. 2015; 313: 335-336.

[17] Zuazo VHD, Rodriguez Pleguezuelo CR, Flanagan D, Garcia Tejero I, Muriel Fernandez JL. Sustainable land use and agricultural soil. In: Alternative farming systems, biotechnology, droughts stress and ecological fertilization. Uichfouse E, Springer Science & Business Media B.V. (Coord.), Dijon, France, 2011; 107-192. http://dx.doi.org/10.1007/978-94-007-0186-1_5

[18] Sălăiescu NN. Ameliorarea plantelor și adaptarea la mediu – Studiu de caz: ameliorarea grâului În România (Plant breeding and adaptation to the environment – Case study: improving wheat in Romania). In: Schimbările climatice globale, grila pentru resursele naturale (Global climatic change, care for natural resources), Editura Academiei Române, ISBN 978-973-27-2526-9. 2015; 89-91.

[19] Erban G. Identification of longer colorriole mutants in an Rht-b1b semidwarf wheat population. Rom Agric Res. 2012; 29: 17-21.

[20] Ridgwell A, Singarayer JS, Hetherington AM, Valdes PJ. Talking regional climate change by leaf albedo bio-geoengineering. Curr Biol. 2009; 19: 1-5. http://dx.doi.org/10.1016/j.cub.2008.12.025

[21] Erban G, Cofas DT, Cofas PA. Significant differences in crop albedo among Romanian winter wheat cultivars. Rom Agric Res. 2011; 28: 11-15.
[22] Erban G, Cotfas DT, Cotfas PA. Crop albedo measurements after anthesis reveal significant differences among Romanian wheat cultivars. Rom Agric Res. 2012; 29: 39-43.

[23] Kell DB. Breeding crop plants with deep roots: their role in sustainable carbon, nutrient and water sequestration. Ann Bot. 2011; 108(3): 407-418. http://dx.doi.org/10.1093/aob/mcr175

[24] Grosu H, Dragomir C, Voicu I. Adaptarea sectorului zootehnic romanesc la schimbările globale (Romanian livestock sector adaptation to the global changes). In: Schimbările climatice globale, grijă pentru resursele naturale (Global climatic change, care for natural resources), Editura Academiei Române, ISBN 978-973-27-2526-9. 2015: 144-147.

[25] Jelev I. Apa – element esențial pentru securitatea și siguranța alimentară (Water – an essential element for food security and safety). In: “Agricultura, domeniul strategic pentru securitatea și siguranța alimentară” (Agriculture, strategic support for food security and safety)” (Hera C. coord.), Editura Academiei Române, ISBN 978-973-27-2363-0. 2013; 291-292, 318.

[26] Staniciu P, Tecuci I, Jelev I. Concepte noi în gestionarea durabilă a resurselor de apă (New concepts in sustainable management of water resources). Dezbaterea ”Ce ne poate da natura i cât ne poate lua !”. Parlamentul României (The debate “What nature can give us and how much we can take.” The Romanian Parliament). 29 February 2012.

[27] Pamfil DC. Biotehnologiile și alimentația viitorului: potențial și limite (Byotechnologies and the future of alimentation: potential and limitations). In: “Agricultura, domeniul strategic pentru securitatea și siguranța alimentară (Agriculture, strategic support for food security and safety)” (Hera C. coord.), Editura Academiei Române, ISBN 978-973-27-2363-0; 2013; 240-241, 244.

[28] Gruia R, Bogdan AT. Ecosanogeneza agroalimentară (Agri-food’s ecosanogenesis). In: “Agricultura, domeniul strategic pentru securitatea și siguranța alimentară (Agriculture, strategic support for food security and safety)” (Hera C. coord.), Editura Academiei Române, ISBN 978-973-27-2363-0. 2013; 448-449.