AGRI-ENVIRONMENT: PERSPECTIVES ON SUSTAINABLE DEVELOPMENT

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FOREWORD

Agriculture is today at the crossroad. The human population on Earth is growing fastly, especially in developing countries, and will probably reach 9 billion people in 2050. Economic development globally increases people's income. As a consequence, the demand for food is sharply increasing. In addition, the demand for renewable energy, including biofuels, is also going up.

At the same time, natural resources are becoming scarce and climatic changes influence more and more the conditions of vegetal and animal production.

During the last decades, agricultural production methods have used large quantities of inputs like pesticides and chemical fertilizers. Enough food was produced for the world population, but some environmental problems appeared.

In the near future, a new equilibrium will have to be found between agriculture, environment and land management. New concepts are eleborated: “ecologically intensive agriculture”, “organic farming”, “water management”, “agri-environmental measures”, “urban agriculture” etc.

This book is a collection of papers dealing with these topics which will define the features of our future.

October 2012

Prof. Ph.D Philippe BURNY

A NEW PATH FOR A 360 DEGREES SOLUTION FOR SOLVING THE FOOD CRISIS FROM THE TECHNOLOGICAL-AGRIBUSINESS PERSPECTIVE

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Abstract. The ideas of agribusiness and of added value that is created through the chain of production – processing – distribution are synonyms. Starting from the last decade it began to get a higher and higher value for the economy but also for the social development of social classes, because they indirectly influence the healthcare system, the population's nutrition, the food security, the involved science in agriculture and government development. The transformation process was a slow one because of the complexity of the innovation-implementation process. Some players from the agricultural industry shifted from the position of producers with small profits, to bidders of investment solutions for high profits. To feed the entire population on Earth, production must double until 2050, confronting political problems, the global water reservoir that is decreasing, the prices volatility and the need for a growth strategy to obtain sustainable economic growth. This fact can look ephemeral in today's situation, but with the support of the sector that is based on accelerated innovation, the IT&C sector doesn't represent hard to reach peaks, through new information systems for operations, new attracted technologies to the agricultural industry and the increased levels of collaboration to improve partnerships and to create vertical and horizontal chains in the agricultural flow, this way making the industry more attractive for investors with an appetite for long term yields and that are based on real elements of the economy.

Key words: agribusiness, environmental standards, IT&C, solar energy, yield

1. Introduction

Following the idea of obtaining long term efficiency and with sustainability on new cycles is based on the intersection between healthcare, governance and economics, but not limited to them. The functional crossings are obtained through the desire to create food and vegetables that are healthy, nutritive and within environmental standards, population's culture from the area where it is produced, science as a factor for maintaining quality and increasing productivity, government intervention and economic development.

The idea of agribusiness was imposed at governmental level in the year 1998 by the Bill Clinton Administration (U.S.A.) and had as main purpose obtaining a healthy productivity that is scalable on the long run at emergent level (the production area being emergent with markets in developed countries). Companies from food industry discovered that they could be even more profitable if they would transform in bidders of solutions in a global distribution/supply chain. Observing the processes as partnerships from the client's perspective and also from bidder's perspective led to create win – win situations for all the factors that are involved in the supply/distribution chain. The result led to a higher and higher added value for the companies that approached these principles.

If there is no success in maintaining the clients' satisfaction, those from the industry would not have a long life cycle in that business (Enriquez, Goldberg, 2000). At the beginning the system was seen as an industry of commodities, but it evolved into an engine for social development and for a healthy economy. The players from the food industry evolved to be responsible not only in front of their business partners, their shareholders and their clients, but also in front of the society.

The values created for the long term are those that are based on permanent development of the production chain and for creating a stronger and stronger flow. This global flow is based on:

- **Need for more food.** Because of the growing population and of a bigger available income, because of the catching up process in the emergent and pre-emergent countries, a doubled productivity is needed until the year 2050.

- **Bio-fuels.** Bio-fuels, especially those obtained from ethanol created from sugar cane, represent an economic advantage created also with the purpose to reduce the energy productivity. Although all offered incentives to create a less polluting system were so big that they blocked the development of production obtain a higher volume of food and this way the global price for food grew, leading to the deployment of the food crisis.
- **Food globalization**. The try-outs to create territorial autonomy on food production were brought by the private sector, with the purpose to grow their operational profit, but the climatic and soil situations don't allow the development of production in countries that have the demand for food products with an exponential trend, here globalization being the promoter of competition and efficiency growth (in an USDA study it was observed the fact that in the 1950 – 1999 time frame, production globalization and its industrialization led to the decrease of nutritive qualities of agricultural products with 6% in proteins and 38% in riboflavin).
- **The importance of the sustainability of environmental processes**. The idea of sustainability becomes an important value for evaluating economic development and the idea of agribusiness.
- **Prices volatility**. The economy is based on meeting demand with offer, being the factors that move the price, but the whole system is based on the cycles of demand and offer, that is why an important factor is represented by anticipating consumer's demands for future production, the values for expected demand by the bidder.

The food industry was founded and is founded by companies that managed to grow their business 10 times in the last 10 years by focusing on their distribution chain. The Bunge Company, a Dutch company is a producer and distribution food company, growing from 3 distribution ports to 34 distribution ports all over the globe. If until now global agricultural conglomerates had as core development model creating and marketing brands, now they repositioned (shifted) their model on developing the company as an entire chain of distribution.

Going further on the agribusiness model of the agricultural conglomerate Bunge, they relied on the supply chain. The efficiency of the supply chain is based on the following types of efficiency:

- **Production efficiency.** This type of efficiency is obtained by using a distribution/supply chain based on technological development and production specialization;
- **Commercial efficiency.** The advantage is created by obtaining a system that excludes from the process the continuous intervention of operations management (practically is created a managerial perpetuum mobile, based on operational know-how);
- **Logistic efficiency.** the development of infrastructure represents the solution to reach this type of efficiency (a technical perpetuum mobile),

Bunge extended on emergent markets, this way creating new partnerships and collaborating for improving the products and services with end user clients (be it an business to business or business to client relation).

Considering China's size, this country represents an unique set of problems because it can represent a process of self-sufficiency. China's situation is as it follows:

- **From the consumers' perspective.** China consumed in the year 2011 much more food than it can produce inside Chinese territory, especially on harvesting food that is rich in proteins, like eggs, meat and soya.
- **From the offer's perspective.** China designs the development of production in the desire to achieve agricultural independence, wanting on the short run to reach 95% of self-sufficiency. To promote this objective, China promotes reforms in agriculture and in developing the production chain.
- **From the commercial exchange perspective.** Because of the commercial relations, China must develop a more open relation, although it is one of the worst exporters, because of what is produced in China doesn't cover the internal demand.

COFCO is one of the biggest agricultural conglomerates in the world and largest in China, and it is following the same trajectory as the global leading conglomerate Bunge, but by

transforming itself from a trading company to an integrator of distribution/supply in the vertical chain, based especially on vertical and horizontal collaboration.

From the desire to create equilibrium between production for the internal market and production for the external market, some countries or commercial unions marched on the idea of protectionism versus free trade. The recent food crisis led some countries on the protectionism road from the desire to support internal consumption, this way being an anti-globalization element. The negotiations and the public-private partnership drove to the approach of free trade in the agricultural industry from the desire to impose in the government's vision the agriculture as a collective resource for feeding the population, this way dampening the idea of borders (these are activated from the desire not to exaggerate on domestic priorities).

2. The links created between agribusiness, solar energy sector and the IT&C integration

After presenting the idea of agribusiness we need to hit the road on one of the created niches that brings a new rupture in the marginal productivity efficiency. The agribusiness process is based on the supply chain system, which is based on assuring the fast flow of the closed circuit of seeding – growing – harvesting – processing – delivery to the retailer – customer experience – feedback to the entire chain. To create a more efficient system we need a continuous innovational process. The fastest way to obtain an innovational process is through the implication of the IT&C sector in decreasing the costs of the most used utility along the agribusiness chain – the cost of electric energy. In the following pages we will link the idea of green energy with the idea of agribusiness development from the energy creation through green solar technologies and of global scale awareness by using as information channel the internet.

The rise of interdisciplinary innovation is driven by sub-layer technologies from the Internet. Like Gordon Moore's law that tells the fact that a power processing unit halves at every 18 months, which makes us to stress out the fact that the cost of business trend that is built on Moore's law has only one limit: tends to zero. This model was implemented in obtaining solar

energy for it to become more competitive in front of the energy obtained from fossil fuels.

Moore's law was valid until 2008, when it modified: from the 18 months halving period of the cost for processing unit it modified to 12 months. In the renewable energy businesses, on the solar energy niche there is a yield of 75%, that was created through physic efficiency of the silicon that is used in solar panels and by rethinking the absorption system of solar energy, through which a yield of 92%. This yield of 92% is the maximum possible to reach after the full efficiency of all physic components (silicon reached its maximum efficiency, the construction and development method of the technical and management systems reached their maximum efficiency point). But how can we reach the 100% yield? Through the introduction of an integrated management system of efficiency. Virtually a connection path is created between Information Technology and Communication (IT&C), the law of system efficiency from Gordon Moore and the maximum yield for obtaining solar energy (98% is the maximum yield achieved today, being much better than the conventional one of 75% through traditional methods for obtaining solar energy). How? This will be analyzed as part of this paper through studying actual environment technologies already implemented for future pioneering.

This bold project was elaborated by Bill Gross, an atypical entrepreneur from Silicon Valley, the area for global innovation, but that is the place in which veterans and specialists in fossil fuels industry work. The passion with which he followed his idea to create "green" technology has its fruits today through pioneering the domain. He is the main shareholder from eSolar – a company that builds solar energy plants, Aptera – electric cars and Energy Innovations – advanced photovoltaic technology developer.

The project that will be highlighted during this paper is on electric energy production from solar perspective and the possible connection with agribusiness. The "lab" for this project is represented by the biggest contract for a standalone producer of green energy: offering the technology to build a solar "farm" in China that will generate 2000 megawatts, the equivalent of two high capacity nuclear plants. After this mega-project there is the building of green energy plants in Germany, the Middle East and

South Africa and if they'll be successful the development plan will be implemented in India and the US (Wood, 2010).

The work and construction principles of a solar energy power plant is to place thousands of mirrors called heliostats focused on the sun's rays, that are filled with water (which heats up) and these boilers are placed above some towers. The heat generates steam that starts a turbine which generates electricity. The pilot-plant, named Sierra, was placed in 2009 in the desert near Los Angeles, that creates 5 megawatts of energy.

This new technology is a technical and economic reorganization of the power towers, being a new management and imagistic software that controls 176,000 mirrors which generate 46 megawatts. Computing processing power precisely places the focus point of each mirror that creates a large parabolic mirror focused on the sun (Wood, 2010). The economic performance is represented by:

- the parabolic mirror formed from many smaller mirrors, that have a lower cost than a single mirror of large dimensions (the price of mirrors grows exponentially depending on size);
- lowering the surface of each mirror results in a smaller necessity to have land for construction that has a smooth surface (the acquisition cost of the land is smaller);
- deployment and manufacturing costs drop because it is easier to install.

Moore's law is used more than the laws of physics or than the steel used in production (Anderson, 2008). This new efficiency models for obtaining electricity through green methods can be made by creating innovational partnerships, like one between a green energy company and companies specialized in IT&C and innovation like Google.

An important lesson is to have a philosophical approach on green energy that is developed by computers. By Moore's law we now have the price for a processor of 5 dollars that ten years ago was priced at 5000 dollars and now we can afford to place one microprocessor in each mirror that computes statistics from second to second on its status, position, confidence coefficient of the received data, data accuracy and all are obtained individually on each mirror. The structure of a green-tech company is similar

to companies that have as an online core business – the Internet, because they need to create logs for each data entry, like every full rotation cycle of each turbine, every measurement taken from control tower, every video observation of the energy production grid, that creates an equivalent system with “data mining” and “data analysis” (Branson, Bodislav, Stoyanova, 2010).

Virtually, a classic software company is created after the passing of a transformation procedure from the technological and management process to system programming that brings an upgrade to all power plants that create “green” energy. This would be one of the great classic differences between technology and the near future technology from the solar perspective. If a large land of photovoltaic panels is created, these are yielded to resist for 25 years of continuous use. They have the same performance without any improvements that can be added.

A software upgrade can be added to each plant, and each upgrade can add 3% to the initial yield, but if it is wanted to create renewable energy for the entire planet there is a big gap in the needed capital, the efficiency grows at every 6 months through a software upgrade to enhance system performance that is implemented in the power plants (Wood, 2010). New improvements can be added to the hardware component of power plants, but even without the hardware upgrade there are software changes that can create more power.

Solar energy, IT&C and the agribusiness framework. The process presented above is a process that includes as a 2nd tier motivator the idea of helping the development of new business ventures through the main non-directly involved factor, the used energy in the process for maintaining the process in optimal parameters. Electric energy is used especially for obtaining 100% bio, eco and natural agricultural products, from the manual pumps used for seeding, to the irrigation systems used for growing the plants, to the electric powered collector vehicles used in the harvest period to the energy consumed by the automatic production lines that process the crop into ready to deliver goods or ready to consume goods. This presented model is valid for harvested crops, but it could be extrapolated to the idea of obtaining 100% organic and bio foods, as an example for growing organic chickens: the eggs are incubated in electric powered

incubators, after their hatching the chickens are fed with natural grains through feeding lines that are electrically powered and after this process, at their maturity (4 to 5 weeks from their hatch) the chickens are sent to processing lines where they are prepared to become the future offer on the shelf from the retailers. All these processes are energy intensive consumers and need the support of green energy plants. The best efficiency on the long run is created by using the new model of green energy, the computed solar energy production process, but this concept has downside, initial costs.

3. The upfront cost – main impediment

A big problem consists in the high consumption of needed capital for the implementation and development of these new approach methods for the new renewable energy, especially solar energy, but the high differentiation aspect is the fact that although renewable energy is the same with the energy obtained through classic methods, like thermo (coal), from the capital perspective it must be presented up-front for fixed costs and costs for 20 years of usage. For a thermo plant the necessary capital represents 20% from the total cost of usage and 80% represent the cost of coal consumed in 20 years.

For renewable energy, approx. 80 – 90% are the up-front cost for building the plant, but there are no costs with fuels and the only cost is the one over time for maintenance and operations, which is at a low level. The biggest constraint is represented by the advanced costs, which limit the growth and the energy' final output size of the plant (Wood, 2010).

A strategy would be the creation of an energetic hedge fund through which the client is the one that is forced to gather the necessary amount of money for building the plant. The green energizing of the planet needs lots of capital, but the main problem is that the capital must be offered up-front.

In the year 2012, in Germany there is in development and implementation one of these energy innovational mega-structures. Easy access to capital helps the direct implementation in the market for the project and through growing the recognition and the feasibility of the project. Virtually Ferrostaal (German plant developer) has the experience to develop classic thermo-plants to which the technology developed by eSolar is added.

This efficiency model for obtaining renewable energy – solar energy was implemented at large scale in China in a power plant of 2000 megawatts installed capacity. The Chinese plant represented a milestone for the global business scale, the development going smoothly through the way of approach and the necessary capital, not being busy with bank contracts that are difficult to obtain. Another advantage for China is the vast land that can be used for the deployment of power plants. China represents a good place for the development of such systems. In addition to easy capital and high growth rate, they have a big demand for energy. They don't do these implementations for global altruism (they implement it for the planet to benefit from the created innovation), they do it from necessity. They realized that the towns from China are polluted and the electric energy that is created in this moment is a great perpetual polluter for China.

The market fall created large financial constraints. The global market in this moment is more powerful than the US market and this thing is underlined by the growth of the global demand for renewable energy (Drzik, 2011). This model of power plants exists in the US too, but they can't keep the pace of global development of the energy market obtained through renewable methods. USA wants to embrace the renewable energy model by creating facilities for borrowing and to obtain necessary capital to create solar energy in innovational power plants. Another factor is the economy that must evolve for it to support this kind of evolution and banks must create ways of offering loans easier for these areas. Another problem is that for now it hasn't any support from the energy industry.

In the not so near future the balance will tip in the favor of solar energy despite the low costs of classic energy production systems because of the rising environmental standards. The future proposed standards for a plant and its products to be healthy (as in bio or organic) will include the energy used for the production process, that being considered as the equivalent of already implementing greener energy sources for the future production demand (Bodislav, 2012).

4. The vertical integration of agribusiness in the supply chain and the horizontal integration of IT&C and solar energy in agribusiness

To the fact that we need to develop plants near urban areas we will need to consider the fact that the future plant will need green energy (Bodislav, 2012). If we use the energy created from a local or regional green energy supplier, especially a solar energy supplier, we will need to include new feasibility factors like year to year sun factors, leveled ground development, once for the arable area and second for the solar energy plant. Projects that sustain the development of solar power plants are stressed by disputes linked to the impact on the ecosystems' areas where they are installed and on water consumption. Going back to the need to built in urban areas proximities we have the reduced possibility to find large arable areas, that need to be leveled, not chemically damaged and that pass all minimum requirements for the bio, eco or organic standards.

Companies that want to innovate in the environment and in the same time want to reduce pollution don't want to have an impact on virgin lands. Firstly the output yield per hectare is calculated, and the land is tested at a friendly level. Secondly the scale economy is followed. In the Sierra power plant that was created for testing, the maximum efficiency was obtained a capacity of 46 megawatts. This two tests combined help to create an "efficiency footprint" to which the location and size of the nearest economic center (town) is added.

This way 800 hectares of land are needed in order to reach the maximum economic efficiency, surface that can be found only in virgin land areas, but we can locate surfaces of 80 hectares near towns that are found in APCs or in properties that already were anthropologically modified, this way they aren't producing new modifications to the habitat. By approaching the consumer the costs for transmitting the energy drop and this thing represents another major factor for cost efficiency.

Many years are needed for the energy grid to be built from the solar power plant that are placed on vast areas of virgin land. The pilot-plant, Sierra, that has implemented the innovational system of obtaining solar based electric energy is situated near the classic energy grid, this way there is no need to build kilometers

of network that would take years only to get the necessary approvals.

The advantage obtained by placing in ex-industrial areas is a natural advantage, but it must be shaped by finding a land that is chemically not contaminated for the bio and eco crops. After the economic crisis from 2007 – 2012 vast land areas appeared near towns that aren't used or that belonged to landowners that went bankrupt and now it will represent a small portion from the total cost of the project. The cost of land represents a small portion of the project because the cost-explosion takes place when the power plant is developed.

In the future, innovations that will upgrade the actual innovations on obtaining solar based energy will be based only on cost reduction of obtaining energy to beat the coal's efficiency. The actual cost of solar energy is at the same level with the cost of energy created through gas turbines, but the volume of energy depends on the solar power in the region. Other two important factors for reducing the cost under the cost of fossil fuel based energy (coal) are:

- storage: an efficient storage model would reduce the cost by 25%;
- production efficiency through volume: the cost drops by 25% by raising the volume of produced energy.

If we developed an agricultural all levels integrated production area near the 800 hectares we would need to find a proper arable land area and the suitable crops that could be deployed there, or implement a factory for obtaining healthy meat based foods that use green energy in the production process. The second solution is more feasible because of the low price for land in these types of areas and the development of the plant can be easy to achieve, the only impediment that could be confronted is a poor roads infrastructure that could aggravate the distribution process that is integrated in the supply chain.

5. Conclusions

The fact that we could be near the "end of the game" as we know it is a good motivator for reaching maximum efficiency in maximum technological innovation in solar energy domain. This fact helps the technology for obtaining electric energy through fossil energy? No. That's why the path dependence is

anti-cyclical, but it mustn't be abandoned the idea that there is the possibility that the slow governmental evolution is given by the fact there are rich and powerful people that have as main business obtaining electric energy through traditional methods or that they own coal mines or large oil fields. The "renewable" approach versus the traditional approach in the energetic industry is stopped by bigger political barriers than technological ones.

The risk management of food represents balancing on the long run the risk of incapacity to assure food for the entire population. To this there must be added the fact to obtain an expected demand near the value obtained ex-post, for example adopting a new diet with a low carbohydrates level (Atkins diet) could lead to a big decrease in bread consumption.

One of the important factors for increasing agricultural productivity and of scaling it for satisfying the demand for food on emergent and pre-emergent markets is represented by the available water resources, this representing the limited factor with the highest degree of scarcity.

This is why the horizontal integrated model of the green energy producer yielded at the maximum possible by using the IT&C innovation power is needed because it helps to reach 0% environmental pollution level and creates producing and processing factories that don't harm the environment. To this model we can add the vertical integrated model that introduces the agribusiness system in the supply or distribution chain, which has as ultimate goal satisfying the customer with total quality indicators and creating a faster connection between the customer and its needs, this way creating a correct expected demand that will help implement an expected volume and expected products solution.

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LOCALLY OR GLOBALLY: AGRIBUSINESS FROM THE GLOBALIZATION PERSPECTIVE

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Abstract. Commercial tradeoffs between retailers, agricultural producers and clients are done on time regarding the perishable character of goods. They need a higher efficiency in the distribution structure that can imply an extra-cost, which is mainly supported by the client. These tradeoffs are limited also through the geographical placement of the used arable land, the transportation infrastructure and the population's distribution, this way to underline the links between retailers, agricultural producers and clients there must be designed the connections and the competitive advantage that is developed through technological progress. The technological progress created through the used transportation infrastructure, the used innovative agricultural systems and the distribution path used for delivering to the client in real time, to which we can also add the optimal development of production facilities and not to enter in a continuous exogenous or endogenous production cycles.

Key-words: agribusiness, distribution, innovation, operations management, perishable agricultural products

1. Introduction

The agricultural industry based on the distribution to retailer and to client (a business to business and business to client model) from the agricultural producer through time is based on scale economic processes that are streamlined and that include three factors of evolution: creating work standards, implementing at scale and optimizing downtime. As example we can take the evolution of a tomato, which despite the fact that it represents a natural process, can be controlled and anthropogenically manipulated. A plant that produces tomato-based goods (tomato sauce, ketchup, canned whole tomatoes, etc.) needs a

technological flow optimized for low costs and no downtime. The framework of the harvesting process – consumer must be optimized also through the on time distribution system. As the whole picture to be complete there must be considered the fact there are the environmental and health standards on the crop that need to be met (if the harvested vegetables are bio, eco or gmo's – genetically modified organisms), these being now factors that are also valued by the consumer, not only by the responsible agencies (Low, Vogel, 2011). If we take as an evaluation pool the large retailers, the first three being in 2011: Wal-Mart, Tesco and Carrefour, we can observe that they give higher priority to giving "greener" products to the customer by creating spaces that are addressed to the client depending on their preferences and on the product's geographic origin. On their origin the study is done on the American market especially (Kummer, 2010), where Wal-Mart is trying to lower the gap between the agricultural producer and the end consumer, going to that level that they demand to the local conglomerates to create a policy to financially sustain the subcontracted farmers (Whole Foods, 2011). Through these new products characteristics there are resulted new needs from the distribution chain, lowering the completion pathway, but increasing the work cadence. To grow the efficiency of distribution to the retailer (also to the final consumer) the work and development strategy was sourced to the carrier, because they can optimize the downtime by calculating production, harvesting, processing and transportation time intervals to the retailer and to whom it can offer a life cycle for the product big enough not to create losses because of the expiration date of the products (also known as shelf date).

Here we can introduce the idea that a retailer is the symbol of operational efficiency through the fact that big retailers come from developed countries that have access to global distribution and development, creating a scale model for optimal productivity (understood as volume and time). To access the high "shelf" date the big retailers incorporate local producers, that are independent in their production decision, but not on their delivery and volume decisions. To lower the costs for the producer, for the subcontracts of the agricultural conglomerate and the acquisitions costs for the retailer, the producer is specialized on only one agricultural product or on an agricultural class. This chosen path

was partially imposed because a relevant study suggests that there are quality losses through industrial production methods and from the nutritive perspective, and also from the minimum met standards (USDA). In the 1950 – 2000 timeframe, crops had a nutritional loss of 6% in proteins and of 38% in riboflavin (Davis et al. 2004 and Ata et al. 2012), but with a gain in the level of used pesticides (Ata et al. 2012 and Environmental Working Group, 2011) and of the chemical fertilizers that through nature's cycle are found also in the groundwater from the agricultural area (Beman et al., 2005). Why are these results that influence the product's quality, the environment and consumer's healthcare found? Because they have an increased shelf date, the productivity is above normal average, and these products look "healthy" and always fresh. These are the characteristics of mass production, of poor nutritional quality and that spend a huge part of its life cycle in the distribution flow. Today's alternative is given by local production that beside the indirect support given to the local economy and to the national macroeconomic indicators also has some specific qualitative characteristics:

- The crop doesn't spend much time processing (time = money; less consumed time, lower the unit price and the possibility of higher profits);
- "Healthy" fresh (the product is kept fresh in a natural way, without chemical boosters);
- The agricultural production method is environmental friendly.

There can be observed the production process as a horizontal development component in the agribusiness process that is part of the vertical distribution chain to the end consumer, who through his payment sustains other complementary industries. Local production becomes the first step to agricultural recovery, but against global production, that is over industrialized or over chemically processed.

It can be considered as one of the rare models of outsourcing viable on the long term. In the case of a company the outsourcing process has the tendency on the long run to destroy the organizational culture and to slow down the company, creating a malignant dependence by the chance of creating a competitor from the subcontracted company. The created equilibrium through the production outsourcing process by an

agricultural conglomerate is unique because it represents a win – win situation on the long run. To outsource a local process of a global conglomerate it must be synchronized with the distribution system of the retailer by shifting the work structure of distribution network, in practice by optimizing the relation between the agricultural producer/processer and the store chain of the retailer or by creating deposits with continuous flow, from where to supply the retailer's stores (here there are created costs for extra-storage and new distribution costs on the deposit – store relation), and the high competition level doesn't allow creating some price gaps. Wal-Mart developed Heritage Agriculture Program through which they value both distribution structures, but by underlining the local character and keeping the pace with the competition's prices.

In the production and development cycle for the subcontracted producer (the outsourced) there is also the need to implement the agricultural cycle that includes the crop's efficiency through exogenous factors (weather and pests). In agricultural production models there is the "Three Sisters" model that is based on alternated crops: corn, beans and pumpkins in the same time on the same arable land (corn offers the vertical structure for beans to grow, the beans give the nitrogen that is needed for corn to grow, and the pumpkins don't allow pests to access the roots of the corn plants and cover the soil – Ata et al., 2012). This practical equilibrium represents a basic model for agricultural hedging.

For the outsourcing model we have as major implications also the development of product and brand standards according to the conglomerate or the retailer that contracted the crops, here we can include especially processed products, but in the case of non-processed products (for example: tomatoes delivered to retailers) those must have the specs as asked by the USDA or the European Commission, but those specs do not cover taste quality or nutritional factors.

If the focus is on the olfactory senses we can observe that there are major differences between a "garden" tomato and a tomato produced for the market, although both look the same. Here are getting involved local producers, subcontracted by agricultural conglomerates or by retailers because they can bring

as an advantage against the competition through the following characteristics:

- Natural taste;
- High nutritional values;
- Ecological harvesting methods.

2. Literature review

On the specialized literature we can underline the approaches of other authors on perishable products management. Blackburn and Scudder in 2009 developed an article on the idea of creating a distribution chain starting from the harvest. Ferguson and Koenigsberg in 2007 approached the idea of selling products depending on their shelf date, lowering their prices depending on the time remained until the expiration date, the client having the option to buy the product regarding its freshness, on the same path there were Li et al. in 2009, but from the perspective of the market developed price and the inventory flow of the retailer. On the operational links between industrial production and the local one, but from the perspective of creating a mathematical model that should underline the competitive pressure on the producer/agricultural conglomerate/retailer, they created a research working paper: Ata et al. in 2012.

On optimizing the production, inventory, systems for distribution to other locations and developing scaled production systems Cohen and Lee (1988) and Zuo et al. (1991) were the pioneers on these research niches. For a 360 degrees approach that would have an approach on environment protection we have the studies of Guide and Van Wassenhove (2009) for the continuous flow distribution chain, Calvin and Cook (2001), Cook (2005) and King et al. (2010). The papers that are mentioned above represent the foundation of the horizontal and vertical development of 360 degrees approaches on this paper's subject, the optimum for the globalization of the agricultural products, the local model or the global model (industrial), based on valuing specialization (scale economies) versus the cost of transportation (long distances created through global production).

3. The standard model for the production – processing - distribution system for the perishable agricultural products

Any model that is founded on a distribution process for perishable products starts from the producer that harvests the product, the producer is subcontracted or has his products reserved through contracts by the retailer that offers them to the consumer. In this article's introduction we approached as a product exemplification the tomatoes and on them we will develop the structure. The sole factor that can be quantified in advance with a high rate for compliance with reality is the expected aggregate demand for the offered product. Considering the short shelf duration of the product the expected demand is easy to quantify because it is met on the short run and this way retailers will put fixed orders to the producers, with whom they develop long term commercial relations and to whom, depending on the order, there can be added new producers, but always for non-processed products they can buy on the spot market. Short term relations between the agricultural producer and the retailer can be developed after some temporary excesses in consumer demand and because of the surplus of some producers (Tropp et al. 2008).

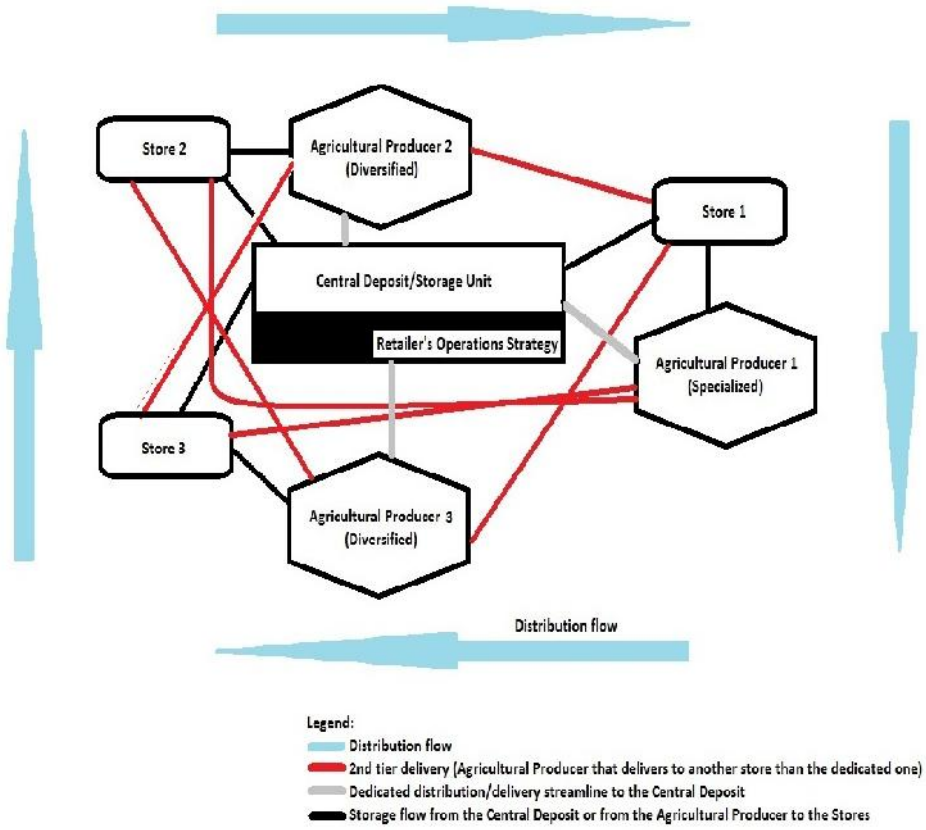

Figure 1. The Distribution chain Agricultural Producer – Store/Central Deposit for product with shelf date
Source: authors' view on the classical distribution chain

If we consider as example the existence of three geographic locations and in each location we have an agricultural producer (tomatoes) and in each store (any retailer owns a large number of stores). In each store the tomato demand is continuous; this way the chance to have a right expected demand can be perfectly correlated. A retailer owns all three stores from the three locations, but he integrates the distributor too (large retailers integrate distribution companies), then when the retailer will want to distribute the contracted product from the local producer, he will start distributing from the nearest located store, and if there is a surplus on the order, it is delivered to the nearest store (with a higher price because of the longer distance for transportation). An element that must be considered is the storage variable, through

which the retailer creates its own storage unit where he delivers the distributed agricultural products (tomatoes) and from there those are distributed in the store chain, this approached model by the retailers that have continuous store development (the corporate governance policy is expansionary) and that is not based on hypermarkets, but on supermarkets (that need frequent delivery of perishable goods in low volumes). This model with a central storage unit system creates high costs for the retailer and erodes its profit rate.

Going back to the agricultural producer, he has two options:

- **Agricultural production hedging:** he could produce limited amounts from many products and founded on contractual relations with one or many retailers;
- **Specialization on a sole agricultural product (the tomatoes):** he increases his risk on reaching optimal production, but also on the demand for the retailer (this risk is optimized through the contract with the retailer).

To the discussion we can join in with the idea of competitive advantage and comparative advantage got by a unique agricultural producer who through the assumed risk can assure a selling price under the competition, for a harvested quantity on the hectare bigger than the competition's and a profit rate above average. Considering that we do not have to deal with complex production or with too many variables in the production model it results that including production factors on the product is the same for the producer with only one product and for the diversified one.

In this moment there appears the choice done by the retailer to protect his continuous distribution flow; if he will buy the tomatoes from only one producer that covers its needs (supplier monopoly) he will obtain a good price that will allow him to add a higher profit margin, bigger than the average profit rates. If it doesn't include distribution, then this variable is negotiated and covered totally or partially by one of the contractual parts. On the model based on storage before distribution we'll have to cover a supplementary cost over the initial ones and over modifying the transportation cost structure, like handling costs for check in and check out from the deposit to which is added the inventory cost. The cost structure for

transportation in the distribution system does not represent the subject of this paper that is why we'll only draw the general mark lines:

- **The agricultural producer:** if the agricultural producer supports the transportation cost to the storage unit or to the retailers store he will have to include it in the price demanded to the retailer. Variables like distance crossed with transported volume results in the truck models used, and if these are included in the owned fleet or it's an outsourced service. Small quantities are an impediment in the development of scale economies and this way they can lose the initial competitive advantage;
- **The retailer with a central storage unit:** aggregating fresh products distribution from many categories lowers the transportation cost for the retailer, but only for average and long distances there can be observed significant gains and if only conditions through which trucks are used at maximum capacity and considering the return path to the storage unit (those trucks being empty there are paying a route that isn't paid in the case of direct delivery);
- **Direct delivery to the retailer's stores:** in this case there are created connected costs for goods inspection in each store (in the case of centralized distribution the connected costs are covered by the central deposit) and the cost of the commercial space, it is cheaper to build a deposit unit for a number of stores in an area with cheap land or in an area with old decommissioned production facilities (Greenfield versus Brownfield).

In the next part of this research paper we will approach the idea of competitiveness and competitive advantage based on the price, price that covers the costs of operations from global production to shelf placement or inventory check in. In commercial businesses that are founded on perishable goods timing is the critical element. The challenges of this kind of business consist in the delay for the forecasting process on production because harvesting takes a long period of time, from seeding the soil to the harvest until the delivery to the retailer. Here it cannot be implemented the Japanese management technique: JIT (Just In Time), that involves production (agricultural, in the given case) that is in line with demand

development because there is the long term development of the business process, from here resulting the long term relation developed with some suppliers. The global trend is to produce closer to your area of influence (the central deposit or the retailers).

To show the real value of the distribution cost as main selection factor among the local agricultural producers despite the system based on scale economies we will approach the dispersion of positioning the arable land and of the central deposit or of the retailers store, according to the retailer's storage path. Besides the approached idea of a sole good, the tomato in our case, there must be also justified the placement of the arable land and of the distribution system for agricultural production.

Let's suppose that the three producers are situated at the same distance from the central deposit or from the retailer's stores, and they can produce the same quantity, using the soil at maximum potential, the differences being in the choice to be specialized or diversified. Let's suppose that one of them decides to be specialized in growing tomatoes and the others decide to do production hedging. After harvest, the contractor retailer chooses the final supplier and defines its strategy, that could be the sole supplier for one product or with many suppliers per agricultural product (here the quantity is the same in both cases, resulting that they will have to share the quantity demanded by the retailer). In the retailers strategy is also found the inventory/depositing model, be it through a central deposit unit, be it depositing directly in the store.

The work equilibrium for the retailer is based on the balance between long distance transportation from many suppliers versus sole supplier that offers the maximum load for transportation to the central storage unit. The distance between the deposit and allocated stores must be calculated for a flow with only one return to headquarters route (all stores are powered and there is only one route with an empty truck). According to the distance between the central deposit unit and the store (or the delivery order in the distribution process) there are some differences in the prices that are found in stores for the same agricultural product, from the same stock. Practically, the costs for a deposit unit are in part amortized through the disappearance of some quality control and inventory check in positions in each

store, this process taking place at the deposit and the inventory being electronically managed. Checking product quality is a procedure that takes out from the work flow at least an employee and the ones responsible with this fact are most of the time occupied with the reception of other goods in the store.

At the same time, the price paid to the agricultural producer becomes a cost for the retailer, but the good becomes an intermediate good in the flow to the consumer. This product cost is surrounded by handling and transportation costs that depending on the personnel is standard, but the delivery costs can create sizable differences between the profit rate per product and its competitiveness among others, and an influence can be brought by the external variables, especially on the transport infrastructure that can decrease delivery timing if it's optimally conceived and this being the defining element in creating a scale economy overall (including here the production of the agricultural good, distribution and the competitive price that is implemented on shelf). Going back to the element presented earlier in this paper, that of cost of space in a store per square meter, here goes the comparison between paid rent per square meter and the daily or bi-weekly distribution policy for products, this way limiting the storage surface in a store. The flow from the producer cannot be on a daily cycle, that is why there is needed a storage unit to maintain perishable (agricultural) products before entering the retailer's stores.

Going back to producer's choice to specialize in the production of a sole agricultural good (tomatoes production), this was the way opened to a scale economy, but with the assumed risk of all bets on only one product that becomes a competitive advantage that is possible to be averaged by the relation with the retailer, if the agricultural producer assures the transport to the store (most often we see the transport to be done to the deposit unit from which the stores are supplied). If the producer must deliver to a number of stores, the delivery must be done in the same delivery frame (it is preferred to be done with the same truck for decreasing the costs), and the cost per kilometer is possible to be bigger represented as economic value or as consumed time, regarding the fact that stores are situated in crowded areas and the time spent in traffic is higher, to which is

added the discharge and receiving time for checking in the delivered product.

4. Geographical distribution and the agricultural producer's development

The geographic placement of the agricultural producer is important. It is preferable for the arable land to be found near the urban areas, but in the proximity of urban centers there can be done only Brownfield investments that are most of the time incompatible with the agriculture. There can be developed a direct relation between arable land of a producer and the distance to the nearest town or urban center, this way the producers have to choose between being small and local producers, and being large producers, but with global distribution. Here the choice can be done by balancing production capacity and the distance to the nearest town.

Because of the perishable factor of the agricultural goods they will not be delivered to a store that is situated far away, and that's why it cannot face the production of a large quantity, because the demand is limited. In the case that transportation costs are huge, then the used system by the retailer for delivering to stores is from the deposit unit. In addition to this problem there is added the development of the population, because the global development policy of big consumer retail corporations (Wal-Mart, Tesco, Carrefour, etc.) is based on population density, where the population will grow it results that the number of stores will increase or their size will increase and the consumption will grow. The growth of population density helps to empower the scale economy of the agricultural producer, be it through extensive development (hard enough to realize because the arable land in urban areas isn't available), or be it through intensive development (as long as environmental standards or healthcare standards aren't broken). If this system isn't maintained in equilibrium it can result even in the bankruptcy of the agricultural producer (Nestle, 2002).

The solution that tips the balance in favor for the local production approach doesn't consist in specializing production but in production distribution, the cost of distribution being the key of success if it is incorporated by the producer or the retailer and still keeps the total cost lower than the competition and to

allow a profit margin at an optimal level. The transportation can be set as a secondary cost (with low influence on the final cost) if it creates an integrated system of agricultural producers, distribution system and deposits chain with their supplied stores. The most efficient integrated system is the one created by Wal-Mart, called Heritage Agriculture Program that is based on the proximity distribution at maximum potential for all transportation units (used trucks).

Following profits lead to valuating the vertical differentiation, empowering the local agricultural producer by creating new brands depending on their properties, for example through ecologic or bio crops versus mainstream agricultural products.

5. The rupture in the process created by the IT&C sector

To involve also the innovation brought by IT&C in the merchandising domain, by providing an innovative distribution system for fresh products and to meet the highest healthcare standards, and to fit their products in the bio or eco niche or to vertically fit the products offered to the market, we can underline the FarmPlate (USA) example, that with the support of the internet interconnected consumers/clients that are the supporters of the products grown locally with local producers, who are producers who are inserted according to the product type (bio, eco or mainstream) (Figure 2 for exemplification – Bodislav, 2011).

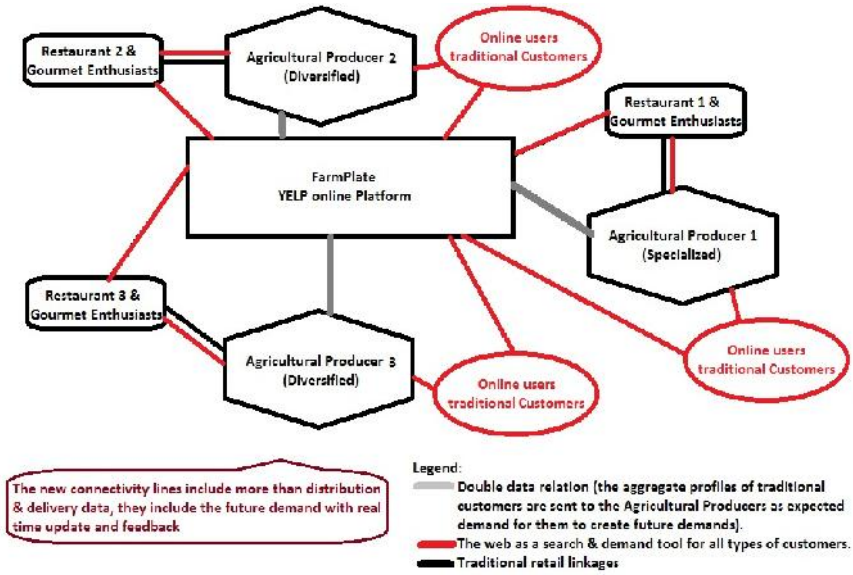

Figure 2. The Distribution chain 2.0: Agricultural Producer/Online users, Gourmet Enthusiasts & Restaurants – the online platform with real time feedback
Source: the authors' view on the new distribution chain

The clients who adopt the bio and eco products' fashion have as main characteristics a given level of professional training and above average incomes. Those from FarmPlate took advantage of their client's characteristics and created the foundation for "a community for the consumers of sustainable agricultural products" (sustainable understood as bio and eco products) that represent YELP, an online platform (informational market) between those who search sustainable agricultural products and those who offer, but also the reviews that are posted for each product. Client data forms a data base that represents an expectations model for future consumption, this way becoming a valuable deliverable offered to agricultural producers, followed by restaurant owners and healthy gastronomic freaks. For a fee of 195 dollars, clients receive customizable online accounts and they are linked with local agricultural producers. As an example, an owner of a pastry from New York City is linked with a producer of beef products from New Jersey and with a producer of Swiss cheese products from the New York state (Holmes, 2012). Yelp's platform' credibility is given by their total transparency of the business, which imprint professionalism to those that are part of

the platform, this way showing their support for sustainable products and foods. In the United States of America the bio, eco, organic and natural fashion became almost omnipresent and with the tendency to spread as mainstream, this way traditional consumers of "healthy and environmental friendly" products that are found on the shelf, this given alternative represents the validation of theories based on the group membership (through the decision for local products consumption) and they also represent a business opportunity on the long run, because on the long run it links the demand with the supply, having big chances to take out the retailer from the merchandising process equation. To cover more certified areas for their product quality, FarmPlate signed in partnerships with Vermont Food Bank and Northeast Organic Farming Association of New York to give the assurance for the quality of producers to the "seekers" for sustainable products, to which is added the social character, each new producer that enrolled into the platform undertakes to provide 50 meals to needy families from Vermont (Holmes, 2012).

The FarmPlate project was created in August 2011 and succeeded to reach in six months 40000 subscribers, an admirable fact if it is taken into account the fact that it is a platform that directly addresses to the clients that are the supporters of the bio, eco, organic and natural products.

6. Conclusions

In order to draw a conclusion on the subject for choosing between a global retailer and to keep production geographically spread or to use agricultural conglomerates that through subcontracting could produce exclusively for the retailer, but from agricultural producers perspective, we have the problematic for approaching the market, at a global, regional or local level and the costs that appear on the offered agricultural products.

To the two approaches there is also added the perishable factor of the products, these being the ones that needed a calculus for the distribution timing (that are based on the environment, producer and processing for distribution and retailer). Creating an optimal framework between process timings, harvest production and geographical distribution (be it distances, be it population density). Reducing costs with transportation and products differentiation bring higher profit margins to the agricultural

producers and to retailers, but the balance tends to lean to the surplus of profitability for the retailer, because it can monetize the marketing targeted on the client (profit margins are bigger in the relations business to consumer, then in the relations business to business). Developing some distribution strategies can be the model to attract a bigger retail group as a future client for the agricultural producers, all things happening detrimental to another supplier (agricultural producer), because the transportation cost incorporated by the producer leads to obtaining a supplier contract. Regarding the diversification on the same perishable good (tomatoes in our case) we have to deal with the creation of some brands based on the way for obtaining the final product, be it bio, be it eco or be it mainstream and this differentiation could be profitable for the producer because he would receive a bigger price for the differentiated offered products, but profitability is on the retailer's side because it can monetize that product through the marketing of its characteristics: local provenience (it appeals at the client's nationalism and to the group dependence sentiment), and the way for obtaining the product (bio and eco products are obtained from non-chemical spoiled soils, treated with natural products and that do not damage the environment on the long run). These two characteristics create added value for the product and for the retailer, which aren't obtained by direct quantifying some products, but they are obtained as a secondary calculus, this way the profit margin is bigger.

In the end there must be mentioned the fact that some production processes are viable only in some areas and that is why there must be followed the implementation and feasibility process after studying the soils and weather characteristics, anthropogenic environment and available infrastructure, taking into account of the relation developed during this research: the distance between a city or urban center and an agricultural producer is directly proportional with the available arable surface for harvesting needed agricultural products. On the long run, the influence of the innovation brought by the IT&C sector can be the one that could create a rupture in the production, distribution and merchandising traditional system of bio, eco, organic and natural products, which could lead to taking out from the intermediary commercial circuit the retailers, but the result would be for the benefit of the end user, the bio consumer.

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DEVELOPMENT OF EFFICIENT REGENERATION AND DIRECT GENE TRANSFER SYSTEMS IN AUENG NGERN (SILVER ORCHID)

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Abstract. This study was carried out to optimize the conditions for protocorm proliferation and protocorm development into whole plantlets together with establishing a protocol for genetic transformation of Aueng Ngern (*Dendrobium draconis*) by means of microprojectile bombardment. Seed-derived protocorms were obtained when seeds were sown on solid VW medium supplemented with 15% coconut water and 2% sucrose. Protocorm proliferation was successfully achieved by transferring seed-derived protocorms to the VW medium amended with 1 mg/l BAP. Addition of 15% coconut water in the VW medium performed the best in inducing the development of protocorms into whole plantlets. Protocorms produced a maximum of 9.44 shoots per protocorm and a maximum of 3.72 leaves per shoot was found. The average number of roots per shoot was 0.42 and the average height of stems was 10.26 mm. The introduction of an *antisense ACC oxidase* gene into protocorms by means of microprojectile bombardment was successfully achieved by employing 1-µm diameter gold microparticles with a 12-cm firing distance. Histochemically stained by GUS assay, putative transformants showed the highest transient gene expression of 15%.

Keywords: *Dendrobium draconis*, antisense ACC oxidase, microprojectile bombardment, N-6-benzyladenine, naphthalene acetic acid.

1. Introduction

Orchids are recognized as commercially important crops as cut flowers. Thailand houses a variety of orchids grown and bred within the country covering a total area of approximately 17,500 rais with an approximate value of 2,000 million baht per year, thus being regarded as the World's largest exporter of both fresh orchid flowers and orchid plants. The important buyer countries are Japan, Italy, France, Germany, The United States of America, The United Kingdom of Great Britain, The Netherlands, Austria and Belgium (Thammasiri 2004). The majority of exported fresh orchid flowers are *Dendrobium* hybrids as they have beautiful flowers with an intricate appearance of flower arrangement, are easy to grow, have a rapid rate of growth, and yield high produce. Producing orchid flowers for export requires good management in order to produce absolute quality orchids with beautiful and large-sized flower forms, performing tolerance to flower senescence and abscission, and particularly meeting the buyers' preference in terms of flower colors (Department of Agricultural Extension 1999). To date, problems occurred during transportation are flower wilting and discoloration, dried or wilted petal tips, senescence and abscission of flowers and petals during distant transportation, and short vase life. Flower wilting and blemish leading to short vase life may result from improper harvest, damage caused by equipments, and insects and diseases. Importantly, ethylene production from orchid flowers, particularly during pollination, poses the inevitable problem of flower wilting and senescence, leading to undesirable short vase life. Many approaches have been proposed as a solution to flower wilting such as harvest adjustment and chemical application, particularly silver thiosulfate complex (Yamada et al 2002); however, they are laborious and are of high investment. As a result, genetic transformation widely employed to produce desirable orchid traits is an alternative means to overcome such problem. This study reports on the optimal condition for genetic transformation of Aueng Ngern (*Dendrobium draconis*) by means of microprojectile bombardment to produce orchid plants with long vase life.

2. Materials and Methods

Seed germination. The orchid capsules aged approximately 5-8 months were gently washed with detergent and subsequently rinsed in running tap water for 30 min prior to surface sterilization in a laminar air flow cabinet. Thereafter, they were dipped into 70% (v/v) ethanol for five min, subsequently soaked in disinfectant [25% (v/v) sodium hypochlorite amended with Tween-20] with continuous shake for approximately 15 min, and then cleaned with sterile distilled water three times. Sterilization was repeated by dipping the orchid capsules into 70% (v/v) ethanol followed by flaming three times. After that, the orchid capsules were longitudinally dissected, and seeds were then picked off and transferred onto the Vacin and Went (VW) medium supplemented with the vitamins and amino acid as contained in the MS medium, 2% (w/v) sucrose, 15% (v/v) coconut water and 8 g/l agar, pH 5.2. The cultures were maintained at 25±2 C under the light intensity of 40 $\mu mol \cdot m^{-2} \cdot s^{-1}$, 16 hour light duration.

The effects of NAA and BAP on protocorm proliferation. Approximately 0.3 g of 2-month protocorms were cultured on the VW medium supplemented with 2% (w/v) sucrose, varied concentrations of naphthalene acetic acid (NAA) and benzylaminopurine (BAP) and 8 g/l agar, pH 5.2. The cultures were kept for 30 days at 25 ± 2^0C under the light intensity of 40 $\mu mol \cdot m^{-2} \cdot s^{-1}$, 16 hour light duration. Initial and final weights of treated protocorms were recorded.

The effects of coconut water and sucrose on protocorm development into whole plantlets. Protocorms reaching a size of approximately 2 mm were cultured on the VW medium amended with 0 and 15% coconut water in combination of 0, 1 and 2% sucrose, and 8 mg/l agar, pH 5.2. The cultures were maintained for 90 days at 25 ± 2^0C under the light intensity of 40 $\mu mol \cdot m^{-2} \cdot s^{-1}$, 16 hour light duration. Number of shoots, roots and leaves, and height of stems were recorded.

Genetic transformation by means of microprojectile bombardment. An *antisense ACC oxidase* gene was delivered into explants by the Biolistic PDS-1000/He particle delivery system (BioRad) employing 1 µm gold and 1.1 µm tungsten microparticles with varied distances between a stopping screen and target explants (6, 9 and 12 cm). The rupture disc

withstanding the 1,100 lb/in^2 He pressure (Sanford et al 1993) was employed to drive the plasmid pCAMBIA1305.1 (Fig. 1) containing an *antisense ACC oxidase* gene into target explants.

Histochemical GUS assay. Putative transformants (protocorms or plantlets) obtained after selection with 40 mg/l hygromycin were further cultured on a selection medium for approximately 2-3 months with monthly subculture. Thereafter, protocorms or plantlets were randomly selected to examine transient gene expression by histochemical GUS assay based on the method described by Jefferson (1987). Briefly, putative protocorms or plantlets were transferred to a microtube containing 5-bromo-4-chloro-3-indole-ß-D-glucuronide (x-gluc) and then incubated overnight at 37ºC. Blue coloration on the treated protocorms or plantlets was determined.

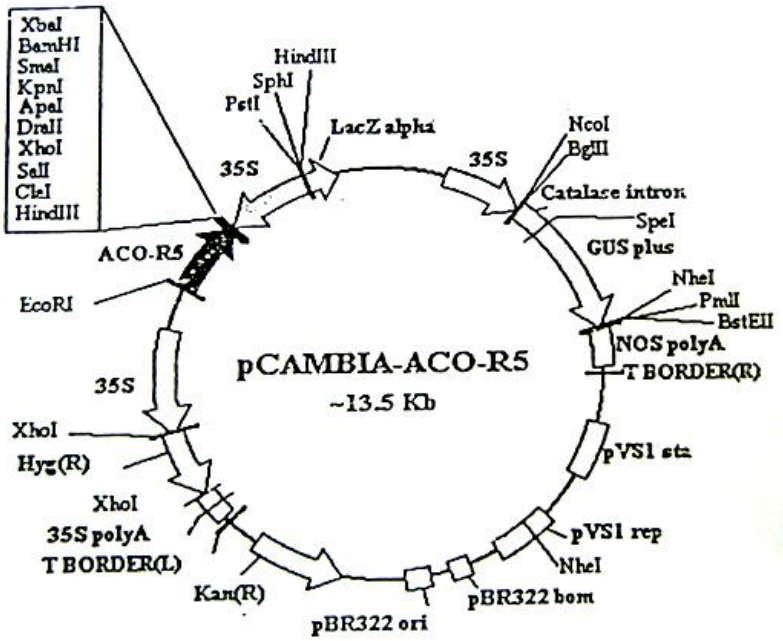

Figure 1. The construction of the plasmid pCAMBI1305.1
Source: Jefferson 1987.

3. Results and Discussion

Seed germination. It was found that orchid seeds successfully germinated on the VW medium supplemented with

the vitamins and amino acids as contained in the MS medium, 15% coconut water, 2% sucrose and 8 g/l agar, pH 5.2. In all treatments, seed germination could be apparently noticed after 30 days of culture. Thirty-day seeds gradually became swollen and developed into small green globules. Thereafter, the globules further continued developing into 1-2 mm protocorms after 45 days of culture (Fig. 2). The findings were consistent to the study by De et al (2006) reporting that the medium supplemented with 0.1 mg/l NAA and 15% coconut water was the most effective and incidentally the highest percentage (80-90%) of seed germination in *D. Chrysanthum*. Similarly, Sharma et al (2005) found that additions of 0.1 mg/l NAA and 15% coconut water into the medium showed the highest percentage (80-90%) of seed germination in *D. fimbriatum*.

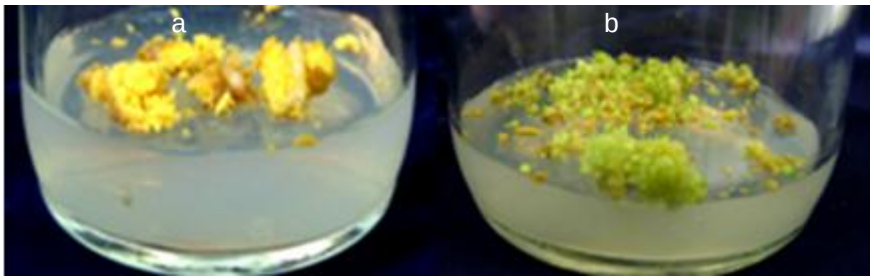

Figure 2. Seed germination on the VW medium after 45 days of culture: a) Dust-like seeds; b) Seed-derived protocorms
Source: authors' photos

The effects of NAA and BAP on protocorm proliferation. The results showed that additions of 0.5 and 1 mg/l NAA did not significantly enhance protocorm proliferation whilst those of 1 and 2 mg/l BAP evidently yielded a great number of protocorms. Also, the findings revealed that the combination of NAA and BAP did not significantly promote protocorm proliferation (Figs. 3 and 4). It could be inferred that, according to the outcomes, only BAP performed well in enhancing protocorm proliferation. The finding was agreed with the studied by Nayak *et al*. (2002) reporting that the addition of 2.5 mg/l BAP in the culture medium could improve protocorm proliferation in *D. nubile* and *Cymbidium aloifolium*. Similarly, the result was

consistent to the study be David *et al*. (2008) demonstrating that 1 and 2 mg/l BAP largely gave rise to protocorm proliferation in *Vanda helvola*. BAP has been proven to be an effective additive in stimulating PLB growth in various orchids such as *Phalaenopsis spp*. (Tanaka, 1992; Park *et al*., 2002a) and *Dendrobium nobile* (Nayak et al 2002). Moreover, Luo et al (2008) discovered that BAP concentrations ranging from 0.1 to 5.0 mg/l enhanced both PLB induction from explants, and a number of PLBs from stem segments of *Dendrobium densiflorum*.

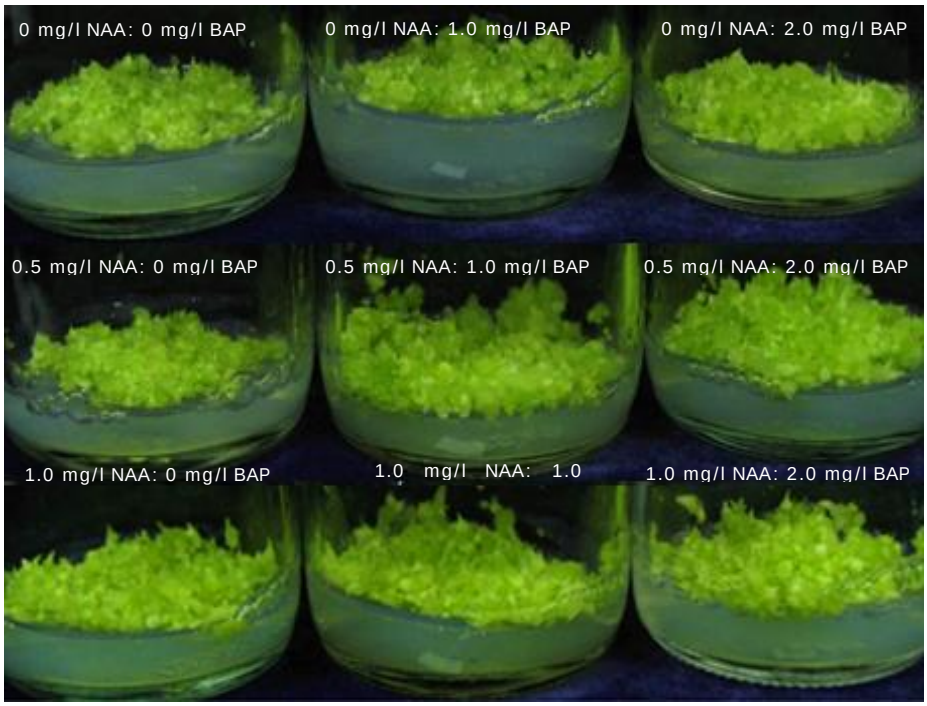

Figure 3. Protocorm growth and development on the VW medium supplemented with varied NAA/BAP concentrations for 30 days
Source: authors' photos

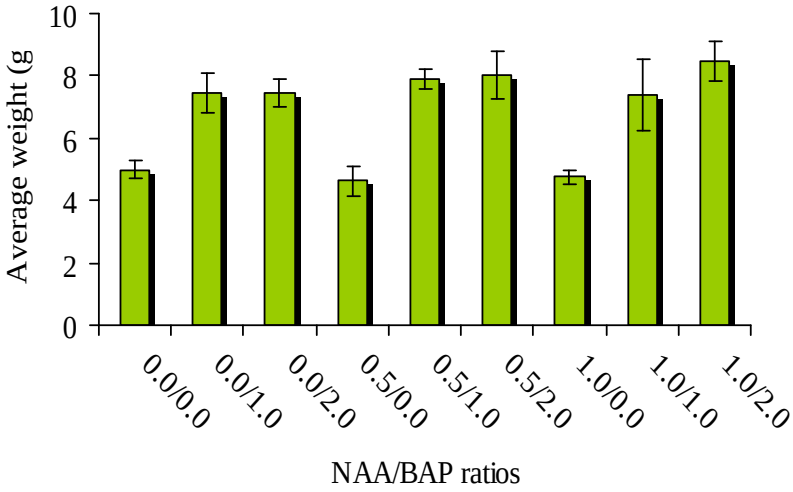

Figure 4. Fresh weights of protocorms cultured on the VW medium supplemented with varied concentrations of NAA and BAP for 30 days
Source: authors' interpretations

The effects of coconut water and sucrose on protocorm development into whole plantlets. It was found that the addition of 15% coconut water significantly enhanced protocorm development into whole plantlets, compared to control groups. Protocorms cultured on the VW medium amended with 15% coconut water produced 9.44 shoots per protocorm. Approximately 0.42 root-producing shoots could be obtained from one protocorm. The average height of stems was 10.26 mm. Each shoot composed of 3.72 leaves. It was also found that the additions of 1 and 2% sucrose did not significantly improve protocorm development into whole plantlets (Fig. 5). This could be inferred that the addition of coconut water was crucial to improve protocorm development into whole plantlets. Coconut water is a natural growth promoter containing high levels of zeatin, zeatin riboside, 1,3-diphenylurea (contains cytokinin-like activity), auxins, nitrogenous compounds, inorganic elements, organic acids, sugars and their alcohols, peptides, vitamins, amino acids and many other unknown components in its composition (Tokuhara & Mii 2001; Nasib et al 2008). It is cost-effectively used for the micropropagation of imperative species of orchids

due to its endless benefits (Peixe et al 2007). Physiologically active substances available in coconut water promote cell divisions, which further enhance shoot multiplication (George et al 2008). Mohr et al (1995) further explained that amino acids elevate a number of shoots through the induction of cell divisions, and more than ten natural N_6-substitute adenine compounds, along with zeatin present in coconut water, may be involved in cell divisions, leading towards multiple shoot formation.

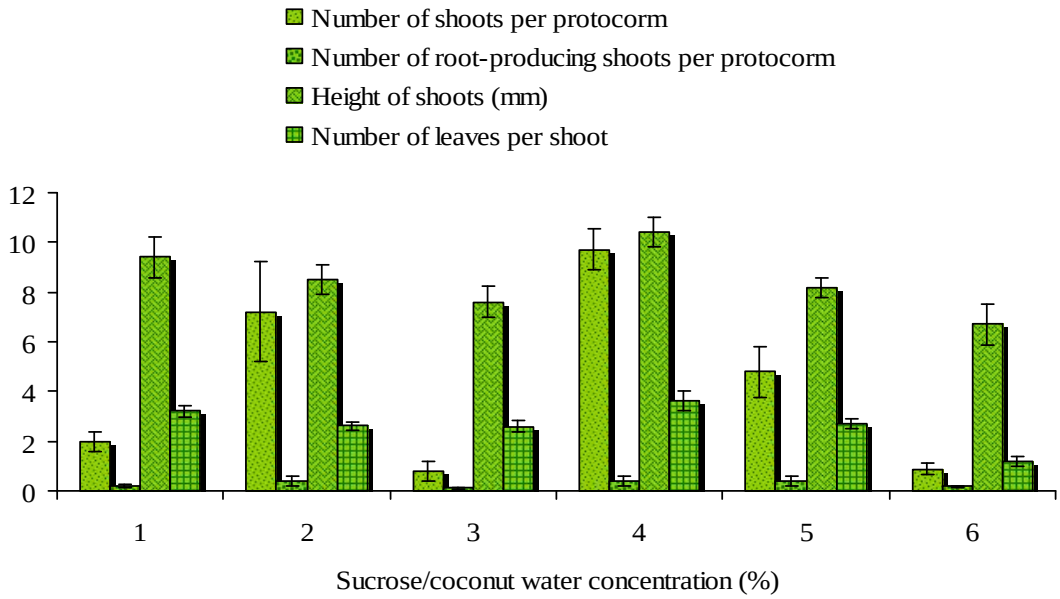

Figure 5. Numbers of shoots, roots and leaves per protocorm, and stem height of protocorms cultured on the VW medium supplemented with varied concentrations of sucrose and coconut water for 90 days
Source: authors' interpretations

Genetic transformation by means of microprojectile bombardment. A number of protocorms genetically modified by means of microprojectile bombardment could not survive when selected with hygromycin. Necrosis in treated protocorms gradually developed and numerous protocorms finally died within 4 weeks. Viable protocorms apparently showed transient gene expression. Genetic transformation efficiency was shown in table 1. According to the findings, employing tungsten microparticles

with a firing distance of 9 cm yielded the highest transient gene expression (3.75%), compared firing distances of 6 and 12 cm. Apart from that, using gold microparticles with a firing distance of 12 cm gave rise to the highest transient gene expression (15%), compared with firing distances of 6 and 9 cm. The results indicated that gold microparticles were of higher genetic transformation efficiency than tungsten microparticles (table 1 and Fig. 6). The findings implied that firing distance affected the levels of transient gene expression. The flight distance varies dependent upon species and types of explants. Schopke et al (1997) reported that using a 1100 psi with 9 cm flight distance gave higher expression in cassava cultures, while 6 cm flight distance resulted in a lower expression level. This could be due to tissue damage as tissue dislocation was observed.

Histochemical GUS assay. Transient gene expression was more likely to find in protocorm apex and base than any parts. In putative transformed plantlets, gene expression appeared in leaves, stems and roots (Fig. 7).

Table 1. Genetic transformation efficiency using tungsten and gold microparticles

Firing distance (cm)	Genetic transformation efficiency (%)	
	Gold microparticles	Tungsten microparticles
6	0	1.88
9	1.25	3.75
12	15	0

Source: authors' interpretations

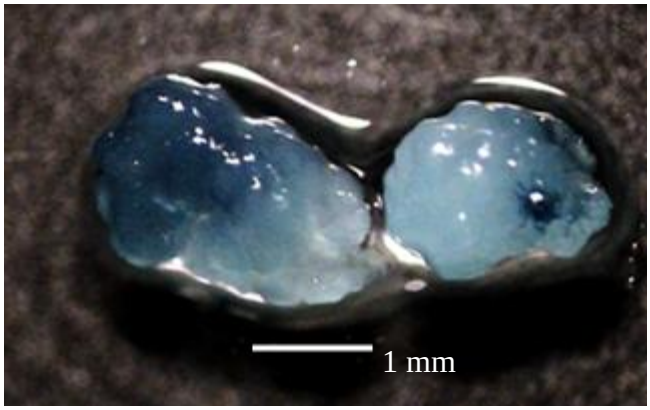

Figure 6. Transient gene expressions in protocorms
Source: authors' photos

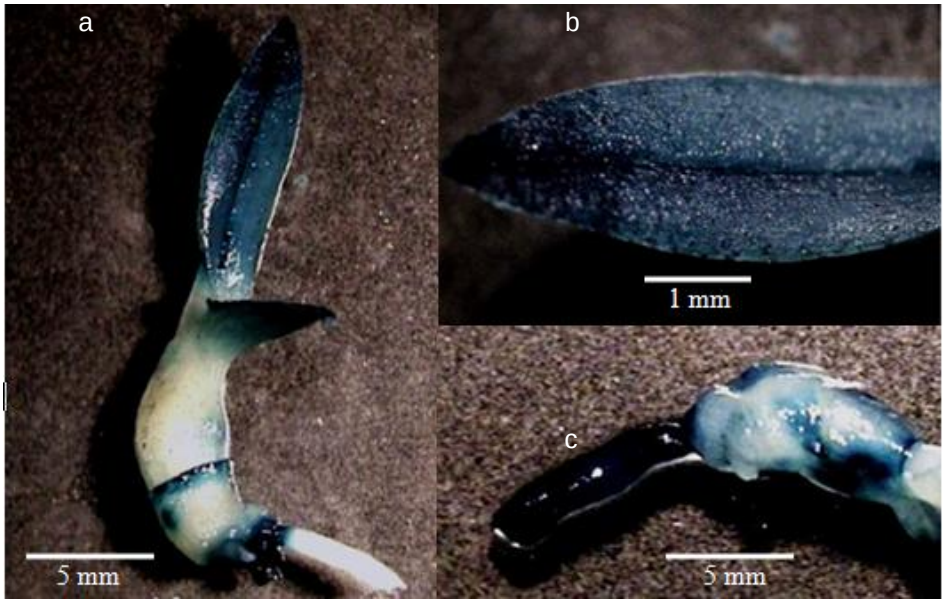

Figure 7. Transient gene expressions in different parts of plantlets: a) whole plantlet; b) leaf; c) root
Source: authors' photos

4. Conclusions

In summary, the optimal conditions for protocorm proliferation and development into whole plantlets were successfully established. Also, the condition for genetic

transformation of *D. draconis* by means of microprojectile bombardment which could be ably applied to other orchid species was suggested.

Acknowledgements. Authors are grateful to the Applied Taxonomic Research Center (ATRC), Department of Biology, Faculty of Science, the Agricultural Biotechnology Project, Faculty of Agriculture, Khon Kaen University and Thailand Institute of Scientific and Technological Research (TISTR) for financial support.

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THE INFLUENCE OF GLOBAL WARMING ON AGRICULTURE

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Abstract. The global warming is a global phenomenon that causes concern to the entire planet. The perspective of annual average terrestrial atmosphere temperature higher with up to 2^0C can have catastrophic effects on the life on Earth. Research findings associate the phenomenon with increased atmospheric concentrations of CO_2 and other greenhouse gases, nitrous oxide (N_2O) and methane (CH_4), mainly generated by activities in agriculture. At the same time, agriculture is one of the economic sectors most affected by climate change, mainly by the reduction of agricultural production. The fight against climate change effects lays on multiple levels and mainly consists in the adoption of adaptation measures, among which the extension and improvement of irrigation systems.

Key-words: global warming, agriculture, climate change, greenhouse gas emissions (GHG)

1. Introduction

Global warming – words that appear more often in the current language – a phenomenon that has gone into the concerns of scientists worldwide in the past about 50 years, represents a concern more and more due to its magnitude and might be a direct threat to the human species. Defining it, as the growth of the average temperatures recorded at the soil surface and the oceans as a result of the accumulation of CO2, leads to the possibity of climate changes more or less intense but converging towards a possible radical transformation of the environment. In this respect, more and more voices appear in the scientific and academic environment, bringing to the general public attention the disturbing conclusions reached, including: the growth of the average temperature recorded with 1,1 - 6,40C; melting glaciers;

changing the typology of the seasons; thinning of the ozone layer; changing the rate and intensity of marine and atmospheric currents.

The growth of the CO2 concentration in the Earth's atmosphere from 280 ppm before the industrial revolution at 430 ppm nowadays constitute the main cause of the greenhouse effect and of the global warming. Further growth in emissions of greenhouse gases over the natural ability of absorbing them could lead to a growth in average temperature by up to 20 ^{o}C.

The main contribution to the emissions of greenhouse gases is due to the energophage industrial branches based on coal or natural gas consumption, which has become increasingly more sophisticated, automobiles and other means of transportation freight or passengers, which are no longer a luxury today, and have entered into the daily life, etc. The emerging economies of China, India, Brazil, Australia, Asia, etc. in addition to the one of the United States come to supplement the above considerations. The primary requirement is the ratification of the Kyoto Protocol by all nations and passage without delay of all national economies in the use of clean and renewable energy sources.

2. Global warming and the greenhouse effect. Adverse and beneficial effects

The average temperature near the Earth's surface has increased over the last century with about 0.7 Celsius degree. Climate experts say that "most of the increase in the average temperature in the second half of the twentieth century is probably due to increasing concentrations of greenhouse gases of anthropogenic provenance, and the natural phenomena such as the solar variation had an effect of warming up in the 1950s."

Everywhere the negative sides of global warming are discussed. But there are advantages. Periods of global warming represented abundant eras, when civilizations have made huge leaps. Instead, the ice ages have been times in which the human development has slowed down. Australian geologist Plimer says that global warming is a phenomenon that people should embrace as a harbinger of good times to come.

It lists a series of negative effects such as the disappearance of certain species, desertification, melting glaciers and raising the seas and oceans. Another negative effect of global

warming is the "eco" charges which are paid for almost everything: for CO2 emissions, for plastic bags which are more expensive than usual and for many other products where is mentioned the amount that goes to the environmentalists.

The greenhouse effect is a natural phenomenon in which a part of terrestrial infrared radiation is retained by the Earth's atmosphere.

The greenhouse effect is caused by the quantities of carbon dioxide and other substances that accumulate in layers to form a "quilt". These substances give the ultra violet rays the possibility to pass easily, reaching the surface of the ground, turning it into a heat energy, and this energy going much harder back into the greenhouse effect. The gases let the light to penetrate, but do not allow the heat to escape, such as the glass panes in a greenhouse.

Thanks to this system, the greenhouse effect is beneficial, providing sufficient heating to the Earth in order to support the growth of plants and of life. But in quantities too large, those elements responsible for the greenhouse effect will lead to an increase in temperature, and also to the destruction of the protective ozone layer leaving way to UV radiation, which is damaging to living beings.

3. The human factor in global warming equation

The people activities seem to underlie the Earth's global warming and climate change. The simulations carried out demonstrate that, if we don’t intervene, the average temperatures will increase by a significant amount. This significant increase in the average temperature will have a disastrous impact on agriculture and water resources.

The Kyoto Protocol, signed in 1997, is an attempt of the industrialized countries to reduce pollutant emissions and also the greenhouse effect.

The objectives of the Kyoto Protocol shall include the reduction of 5.2% compared with 1990 emissions of greenhouse gases for industrialized countries, by 2008-2012. This protocol allows countries to join in order to achieve the objectives. The European Union has undertaken to achieve an overall reduction of 8% of the emissions. This commitment is taken as an average,

each Member State of the European Union distinct having fixed a percentage, depending on the national context.

A few years ago, the global warming and climate change caused by human activity were very controversial. Numerous studies have shown that the temperature has risen, on average, 0,6 degree C every hundred years. Experts state that the temperature rise was caused by increasing concentrations of greenhouse gases in the atmosphere (280 ppm of CO2 in 1750, 365 ppm in 1999). In fact, the evolution of the concentration of carbon dioxide in the atmosphere is strictly related to temperature.

The current concentration of greenhouse gases appeared to be the highest in the last 160,000 years. In the third CIEC assessment report from 2001, there were provided, depending on the model chosen, increases in temperatures between 1,4 C degrees and 5,8 C degrees, by 2100.

A large margin of variance between the two figures is due to the lack of information on certain physical phenomena. The heating process will not be uniform, being greater in the case of polar and tropical latitudes and more pronounced on the continents that the oceans.

In this context, the Global Warming Doctrine appears, supported by the interested people, fanatics among the urban elites.

Various theories which confirm the increasing temperature caused by pollution rotate around some certainties and several approximations coming in the service of a single ideology: ecology that saves the planet. But man continuously produces CO2, including when he breathes.

The climate changes are known to the geologists. These changes are cyclical and random. Some scientists argue that manking did not significantly affect the environment and the causes would be natural and normal.

4. **The double challenge of global warming for agriculture**

Agriculture represents a source of GHG emissions, though smaller in scale than other economic sectors. Agriculture is not a source of CO2 emissions – the most prevalent greenhouse gas. Furthermore, the agricultural lands, which cover more than half of

the EU territory, are retaining large quantities of carbon, and this contributes to the reduction of CO2 in the atmosphere.

However the agriculture must worry with the reduction in GHG emissions into the atmosphere and to adapt to the new climatic conditions.

Agriculture represents an important source of emissions for two greenhouse gases: nitrous oxide (N2O) and methane (CH4) (see Figure 1).

N2O is released into the atmosphere by the farmlands, mainly because of the transformations that take place under the action of microorganisms in soils treated with nitrogen-rich fertilizers. The N2O emissions represent more than half of total emissions from agriculture;

The CH4 emissions are generated by the natural fertilizers from digestion processes of the ruminant animals (mainly cows and sheep);

Also, the storage and spreading of fertilizers represent a source of emissions of CH4, and N2O.

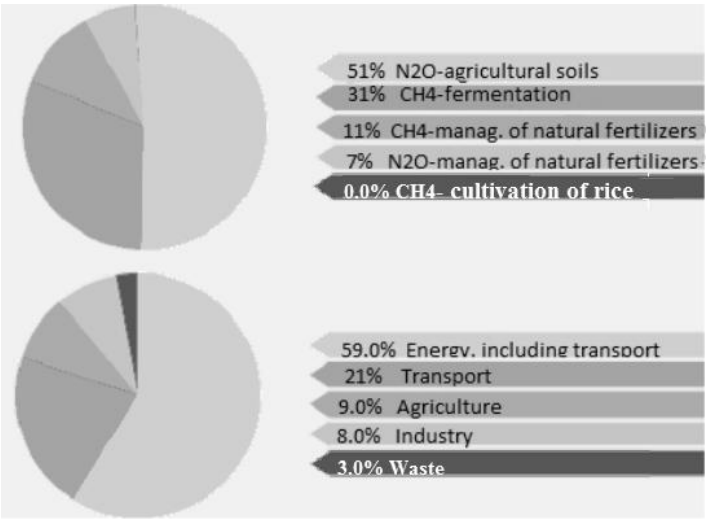

Figure 1. Allocation of GHG emissions from agriculture and share in total emissions in the EU (EU-27) - 2005
Source: European Commission, Agriculture Department, on the basis of EEA data

Climate change affects many sectors. Agriculture is one of the areas most exposed because of its dependence on weather conditions.

They affect us all in Europe, because the farms, the agricultural lands and the forests cover about 90% of the EU. Climate variability from year to year is one of the main causes of crop yields variables and one of the risks inherent to agriculture. Agriculture is therefore at the forefront in the battle against climate change effects.

5. How is the agriculture affected by global warming

Experts consider that even a small growth in global warming will reduce crop yields and will lead to higher yield variability in low latitude regions. Adverse effect on agricultural yields will be exacerbated by extreme weather events more frequent (such as floods, heat waves and drought). Small farmers and subsistence farmers will be particularly affected, because their capacity for adaptation is smaller. The increase of the risk of famine is predicted, particularly on the African continent.

While some predicted effects can be beneficial for agriculture in certain regions, particularly in northern areas (for example the extension of the season of vegetation and improving crop yields due to warmer climate), most effects will be most likely negative, leading to economic losses, these effects are particular in regions already under pressure because of the socio-economic and environmental factors, as well as water shortages.

The regional variations in the expected climatic conditions are significant. However, throughout the 21st century, the effects specified can be summarized in milder and more humid winters, hotter and drier summers and intense weather events. It is possible that the most serious consequences of changes in the weather conditions shall not be felt by 2050. However, adverse effects resulting from extreme weather events such as heat waves, droughts and frequent and prolonged flooding are predicted.

Most of the effects of climate change on agriculture are linked to water. The lack of water has a major impact on the agricultural production and on the landscape. In many areas, especially in the countries of the southern EU, irrigation is used for hundreds of years, it is part of the agricultural tradition – but

they will have to review the irrigation techniques. Agriculture must also improve its water use efficiency and reduce losses.

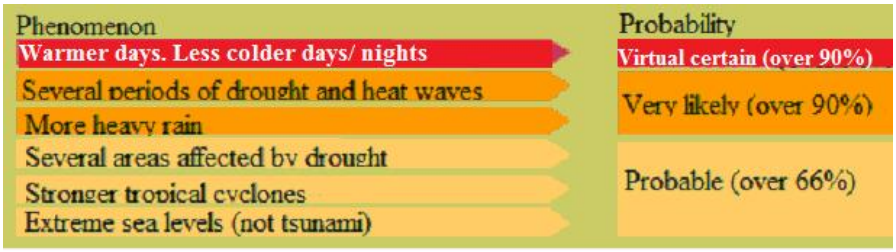

Figure 2. Climate change effects
Source: Intergovernamental Panel on Climate Change

Adverse effects are expected by increasing the likely distribution and intensity of diseases, but also the weed growth due to higher temperatures and humidity. The effect is likely to be regionalized.

Anticipated climate change will affect the level and variability of crop yields, and on the long term the cultivation of certain crops might be transferred in Northern latitude zones.

EU regions feel increasingly the adverse effects of climate change, but some areas will be more affected than others. Southern Europe and the Mediterranean will feel the combined effect of temperature increase and reduced rainfall. Also mountain areas, in particular the Alps, and small islands are particularly vulnerable. Densely populated alluvial plains are threatened by an increased risk of storms, intense rainfall and sudden flooding that will cause damage over large areas. Climate change will magnify regional differences in terms of Europe's natural resources.

The impact of the changes in weather conditions can already be seen. Numerous effects are observed: submission periods of flowering trees, extension of the vineyard season, changes of other natural cycles of plants. Changes in the timing of agricultural operations (sowing, harvesting, etc.) suggest that agricultural producers already are adapted to the new climatic conditions.

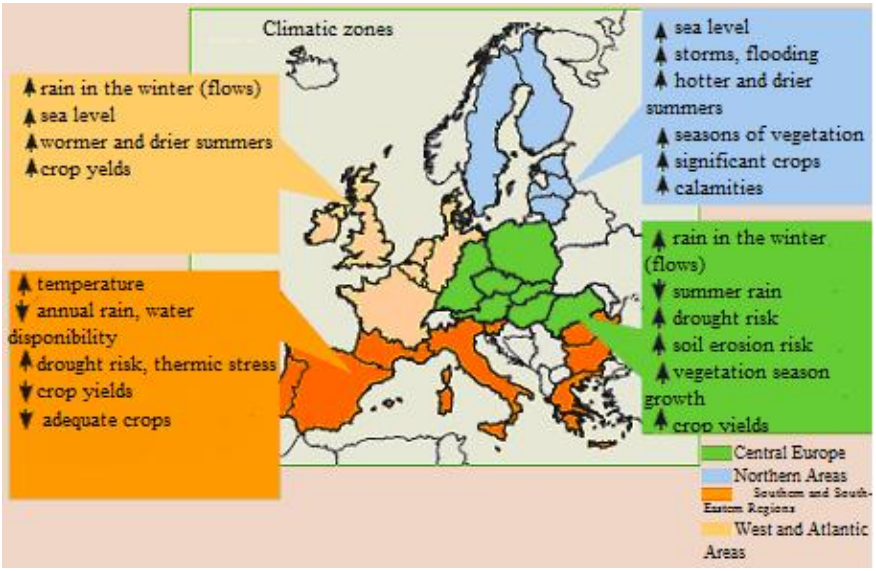

Figure 3. Predicted effects of climate change in different regions of the EU
Source: European Commission, DG Agriculture, based on publications

6. Reducing the impact of climate change in Romania by investing in irrigation

Irrigation, as one of the main and largest investment in agriculture, shall constitute one of the main factors for sustainable development of agriculture, especially in arid and semi-arid areas, where water is very necessary for the continuation of agricultural processes. Romanian members of the European Parliament, stressed in every word that: "the aid scheme for irrigation which foresaw the funding of water cost paid by farmers, could not be maintained nor lengthened, because it constitutes aid for the exploitation costs, which is prohibited by EU rules on State Aid. EU rules on State Aid grant Romania to invest in irrigation systems and energy supply systems".

Such aid shall be restricted to investments, not granted for maintenance and operating costs. Also, an evaluation of the environmental impact shall be made. It looked like irrigation cannot constitute a unique solution to face the drought, good agricultural practices should also be implemented and crop types changes should be performed. The second pillar of EU

agricultural policy includes agro-environmental measures that support the conversion of arable land in pasture, thus greatly reducing water consumption on agricultural land.

In a ranking of the investments for the Romanian economy, conducted by the Wall Street Journal, it is revealed that, "foreign investors have proposed the Romanian Government a 23 billion euro set of 10 investments, that would generate a plus of 23.7% to the GDP in the period 2011-2015, and about 445,000 new jobs. Realization of these investments, however, would entail costs to the State budget of 11.9 billion euro, and would generate revenues of just 8.9 billion euro. Development of irrigation in agriculture network and the completion of the channel Siret-Baragan was ranked in the 8th position. This would involve an investment of 2 billion euro, but that would lead to an increase of 1.1 percent of the GDP over medium term, 23.400 new jobs in medium term and to an increase of 0.6% in the medium-term budget revenues.

Also a big investment in the Baragan Area constitutes the rehabilitation of the irrigation system Biliesti-Slobozia-Ciorasti that will be completed this year, assuring the possibility of the irrigation of a surface over 15 thousand hectares of arable land. This irrigation system was started in the period 1971-1975 and expanded in 1985-1986. The completion of this system is pursued also because the chosen area was scarcely affected by the 2005 floods.

7. Conclusions

The agriculture of the millennium where we stepped in imposes a human activity that must respond to requests much wider and more serious than farming in the previous centuries and quality of life on Earth and human survival depend on the answers that it will give us.

The primary mission of the future agriculture is to ensure the security and food safety of the World’s population (probably rising towards 9 billion inhabitants in 2050), to harmoniously correlate the measures of qualitative and quantitative growth of the agricultural food production, with the requirements of biofuels production development, while protecting the ecosystems and decoupling economic growth from environmental degradation.

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ECOLOGICAL AGRICULTURE, AN ANSWER TO THE PRESENT FOOD CHALLENGE. SECTOR'S DYNAMICS IN ROMANIA

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Abstract: The prediction of a 9 billion world population at the middle of this century urges for adequate and efficient measures in order to cover the necessity of food. Under these circumstances, ecological agriculture pushes its way into people's homes from all over the world because it answers to the rigours of a healthy life, as well as to the demands for maintaining ecosystem integrity. The present paper intends to point out the dynamics of the Romanian ecological agriculture sector between 2001-2011 from the point of view of the ecological farming area and the number of ecological certified operators, reviewing at the same time some global situations as well as the benefits of ecological agriculture encountered in each case.

Key words: ecological agriculture, ecological farming area, ecological certified operators

1. Introduction

The challenge brought by the present higher food consumption and thus the necessity to enlarge food production makes us more aware than ever that we need to protect the environment, the Earth, and to shelter it in order to all enjoy and benefit, equally, from its fruits. Indeed, it seems that the world population will increase with more than 30% till 2050 with regard to the actual level, food production also rising with approximately 70% (FAO, 2009). Pretty et al. claim that there are four main reasons for which food demand will grow in the following years: population growth, economic growth that will lead to an improvement of the purchasing power, growing urbanization that will encourage people to adopt new diets, and the climate change

whose implications can be seen especially at resource and water levels (Pretty et al., 2006). Taking into consideration only the agriculture sector, the best way to answer these challenges is probably that one of choosing ecological agriculture.

2. Conceptual boundaries

In their attempt to define the term of ecological agriculture, a series of authors and specialists have brought their own conceptions and although the shape of the notion is different, the background is the same: ecological agriculture intends to use sustainable production systems, which are divers and balanced, with the purpose of preventing crop and environment pollution, thus providing the prosperity of the society and nature all over the world (Samuil, 2007). According to the International Federation of Organic Agriculture Movements (IFOAM), ecological agriculture refers to a production system that sustains soil, ecosystem and human integrity (IFOAM, 2009). It focuses on ecological processes, biodiversity and cycles adapted to local conditions, combining in the same time the tradition, innovation and science in order to promote a certain quality of life which is good for everyone involved. Having the same view, USA's National Organic Standards Board (NOSB) talks about "a management system of the ecological production that promotes and increases biodiversity, biological cycles and soil biological activity" (Iowa State University, 2011). On the other hand, some think that "ecological agriculture is the science or the art of management and control of agricultural creatures and their environment, to the long benefit of nature and mankind", wishing to harmonize the interactions between the ecological, economic and social supply of agricultural ecosystems as well as the human food, clothing and shelter needs (Fermierul, n.d.).

Although both on the European Union's territory and the American continent we can find a variety of terms assigned to the concept of "ecological agriculture", we need to underline the fact that "organic agriculture" and "biological agriculture" are synonyms to the notion mentioned above, all contribute to sustainable development, and their role is the same: to produce healthier food, more suited to the human metabolism, entirely correlated to the preservation and development of the environment (Ministerul Agriculturii şi Dezvoltării Rurale, 2012).

Thus, it is forbidden to use genetically modified organisms or their derivatives in the production stage, and to recur to additives or chemical synthesis substances in the food processing stage.

In order to be able to take into account all the aspects mentioned above, and targeting in the same time a satisfying productivity in what concerns food production and consumption, it is necessary to perform adequate investments and to adopt the best practices in the agricultural sector.

3. World ecological agriculture: from the measures adopted to the benefits gained

If in Oceania we can find the widest ecological areas, Africa occupies the last place with less than one million hectares used for this purpose (Willer et al., 2008). Narrowing our research area and focusing on a national level, it seems that Australia and Argentina held the first two places if we consider the area assigned to ecological agriculture, while China claims "the bronze medal". It is indeed widely known that the Chinese nation gained momentum in all fields in the last years, managing to outperform many countries including in the agriculture field. A series of authors have underlined the processes the republic has undergone in order to implement the principles of ecological agriculture, four out of these, namely the holistic theory, that one of harmony, of recycling and of regeneration being identified in the construction of China's ecological agriculture (Shi, 2002).

At the same time, a study conducted in Australia has shown that experience and knowledge are the key elements that influence professionals working in the agriculture field to consider ecological agriculture a positive approach and beneficial to the society and environment. More exactly, Sarah Wheeler (2008) found that age, years of tertiary education, organic knowledge and the belief in the environmental superiority of organic farming and in its financial profitability represent variables that positively influence specialists' way of thinking. On the other hand, working age, the fact that people work for a national authority of scientific research and the belief that organic farming is a return to pre-1950s agriculture form factors with a negative impact on these specialists who in the end affect largely the decisions of regular farmers.

In another paper, Goewie describes the contribution agricultural science has made to the organic sector and the challenges this sector currently faces (Goewie, 2003). The conclusion depicted is that the success of ecological agriculture depends on producers' awareness about the role they have in society. This is the reason for which these producers need to be given the chance to put into practice their holistic ideas because the success of agriculture is strongly correlated to consumer demand. The most important requests refer to safer and healthier products, contributions to animal welfare and towards a cleaner environment. Consequently, the organic sector needs qualification in order to keep its added value, finding adequate niches, providing quality assets and supporting an improved quality of life in rural areas representing the main directions needed to be adopted. Thus, not only that the income of farmers will grow, but also a continuity of this type of agriculture will be provided, creating in the same time a strong relation between producers and consumers. Moreover, transparency and certification at international level will be advantages in the fight with the other competitors that exist in the market and that practice a conventional agriculture.

Still, whilst most of us believe that bureaucracy reached such an extent and causes problems only in our country, some authors have demonstrated that bureaucratic requirements of international organic certification gained a very high level in Mexico and only large famers are favoured, although, at world level, the idea that ecological agriculture brings benefits mainly to small farmers is being supported (Gomez Tovar et al., 2005). This way, social inequalities between farmers of all sizes are pointed out, the 43% annual growth of ecological fields which surpasses the 32% annual growth of producers suggesting that larger parcels are being used in order to get organic products, which agrees to the increase of mass production. Consequently, ecological agriculture is experiencing a switch from small producers' strategy, who wish to have a certain income, to investment and diversification strategy, which is practiced by large conventional producers.

Bringing into discussion the concept of ecosystem services, more exactly those resources and natural processes that sustain life on Earth, Sandhu et al. (2010) identify some

ecosystem services related to ecological agriculture and with potential to cover world food needs without affecting people's health or the environment. In order to meet food requirements, many countries have chosen an intensive agriculture, using large quantities of fertilizers, pesticides and also intensive workforce, thus deteriorating a series of ecosystem services. And, if these activities continue, we will find ourselves in the unwanted position of not being able to produce our own food. Such as the above mentioned authors mention, agriculture is both ecosystem services consumer and producer, biological control for example being the closest option at hand so as to spare million of Euros expended annually on pesticide procurement. Some countries from East Africa and also New Zeeland have adopted this kind of practices, which proved to be successful ones, at national level. Moreover, studies have shown that ecological agriculture has a remarkable potential to develop ecological technologies that require minimum and widely available costs and contributions, without prejudicing the environment or people's health. And this ecological knowledge can be very easily used on a small scale, at farm level for example, in the less developed countries or in the emerging ones which do not afford to resort to expensive resources or technologies.

Sticking to the ecosystem services, Zhang et al. support as well the preservation of this type of services to the benefit of agriculture's productivity, but still draw the attention upon certain important aspects: a) the study of species that can be found in natural ecosystems and which generate ecological agriculture supporting services is still relatively young, b) it is necessary to spatially analyze the supply and demand of ecosystem services in order to explicitly locate suppliers and consumers of these services, c) there are no general rules about what an ecosystem service represents and that is why its importance can vary from an area to another or from a culture to another (Zhang et al., 2007).

Lapka and Cudlinova (2007) suggest that agriculture can be an important mitigation instrument of climate change effects through the funding of those interested in forestation of some areas and growth of grassland fields in order to reduce the CO_2 level. Even though a substantial part of anthropogenic emissions originate in agriculture, we feel the need to enlarge the existing definition of agriculture as to transform it into an ecological

absorption instrument of carbon dioxide emissions. Nevertheless, results have shown that there can be a relatively large arable land loss in the case of forestation and biodiversity can be affected in grassland fields.

Casado and Molina (2009) plead for a larger contribution coming from the governments with the purpose of reducing the cost required by the land where an ecological agriculture is about to be done and of supporting the latter. Their study provides some useful ideas in the improvement process of ecological agriculture sustainability, focusing on the "price" this has to pay in comparison with conventional agriculture.

However, even if we speak about conventional or ecological agriculture, there is a common denominator without which we couldn't do anything: water. As Fraiture and Wichelns (2010) underline, the usage of water in agriculture has grown significantly and will continue to grow as a consequence of some crucial factors: population, economic growth and demand of agricultural assets which are in a continuous evolution. We are thus experiencing a global issue that requires adequate and immediate actions towards improving water management and increasing water usage efficiency. It seems that at world level there are enough resources in order to produce our food for the next 50 years, but this can only happen if we employ a better water management. The same authors provide four strategies needed in order to comply with the food demands in the years to come. The first one refers to the investments required in order to increase agriculture production in rainfed regions and inherent the expansion of these areas, while the second is all about irrigated agriculture, with an emphasis on system management innovations, development of water storage facilities and promotion of wastewater recycling. The last two strategies have in view the promotion of agricultural commerce so as to compensate the existing disparities at hydrological equipment level and to limit the growth of global food demand by influencing people's diets through campaigns and a correct determination of food prices. The optimistic scenario presented by the two researchers shows that a considerable share of the necessity of food in 2050 will be covered through productivity growth. Taking into account the growth rates of the latter, at world level, crops that are rainfed will increase by approximately 58% and those ones from the irrigated

areas by 55%, even if we stick to the assumption that water consumption will augment. That is why the challenge of producers, scientists and public officials will be to determine the best investments and strategies taking into consideration the implications of alternative decisions.

4. Romania and its ecological agriculture sector

While at world level ecological agriculture is rising, Romania is doing its best to keep up with this trend, the first associations emerging in 1997 and the true momentum being gained after the year 2000 when this type of agriculture became one of the most dynamic sectors as a result of an increase in ecological farming areas, of diversification of certified crops and of a successful emergence and development of large ecological farms (Milin & Ioan, 2006).

Once our country joined the European Union, operators' status from this field as well as the entire marketing process of this kind of products have obtained a totally different dimension. The European Union's regulation regarding ecological agriculture has been transposed into our national legislation and refers, among others, to processing, labelling, trade, import, inspection and certification of ecological products. When talking about the above mentioned aspects, the table below wishes to emphasize some of the most important features of the Romanian process.

Table 1. Synthesis of the ecological production process

Hinted aspects	Characteristics
Legal framework	- Council ***Regulation*** (EC) No. 834/2007 on organic production and labelling of organic products - Commission ***Regulation*** (EC) No. 889/2008 laying down detailed rules for the implementation of Council ***Regulation*** (EC) No. 834/2007 - Order No. 219/2007 for the approval of regulations regarding the registration of operators in ecological agriculture - Council ***Regulation*** (EC) No. 3/2008 on information provision and promotion measures for agricultural products on the internal market and in third countries - Council ***Regulation*** (EC) No. 501/2008 laying down detailed rules for the application of Council Regulation (EC) No 3/2008 - Order No. 65/2010 for the approval of regulations regarding the organization of inspection and certification systems, the approval of the inspection and certification bodies supervision and inspection bodies as such - The Common Order for modification and realization of the Appendix of Order No. 317/2006 and of Order No. 190/2006 regarding the approval of specific rules regarding the labelling of ecological products
Producer obligations	- The holding must skim over a conversion period of minimum two years - To be subject of certain activity inspection visits - Solving the application in order to obtain the right to use the label - Implementation of the national and community label - To complete annually a registration chart regarding ecological agriculture
Control and	- Done by private inspection and certification

certification	organisms (13 at this moment) - These organisms are approved by the Ministry of Agriculture, Forestry and Rural Development based on some independence, impartiality and authority criteria set by the Order No. 65/2010 - The approval is preceded, imperatively, by the accreditation of organisms according to EN ISO 45011:1998
Mandatory references of the label	- Ecological production - The label itself - The name and code of the inspection and certification organism
Applying the EU logo	- It is mandatory starting with the1st of July 2010 - It is optional for imported products - Must be accompanied by the indication of the production location of agricultural raw materials - Offers a recognition of ecologically certified products throughout the entire EU
Ecologic products	- Prove that at least 95% of the ingredients were obtained according to the ecological production method - Have the name of the producer, the processor or the seller and the name or code of the inspection and certification organism

Source: author's own adaptation using the MADR data (Ministerul Agriculturii și Dezvoltării Rurale, 2012)

The Romanian organic market cannot be compared with those found in France, Italy, Spain or Germany, still, although many nations were stricken by the financial crisis, the area used for ecological purposes has increased over the last few years, being almost double in 2011 in comparison with the value registered in 2009 and more than 16 times higher than in 2001. The number of ecological certified operators has had a remarkable evolution too, especially after 2005, at the end of the last year being with 62% higher than the previous year. Figures 1 and 2 show the trends followed by these two indexes.

Wanting to summarize and to realize a correlation between the information provided by the figures above, we have chosen to use the regression function within the Microsoft Excel Software.

Thus, introducing columns 2 and 3 from table 2 as x (the number of ecological certified operators) and y (the ecological farming area) variables we have obtained the data pointed out in table 3. In the following lines we will render the results displayed by this software.

First of all, it is necessary to build the modelling equation which generally has the following shape:

$$y_i = a + bx_i + e_i \quad (1)$$

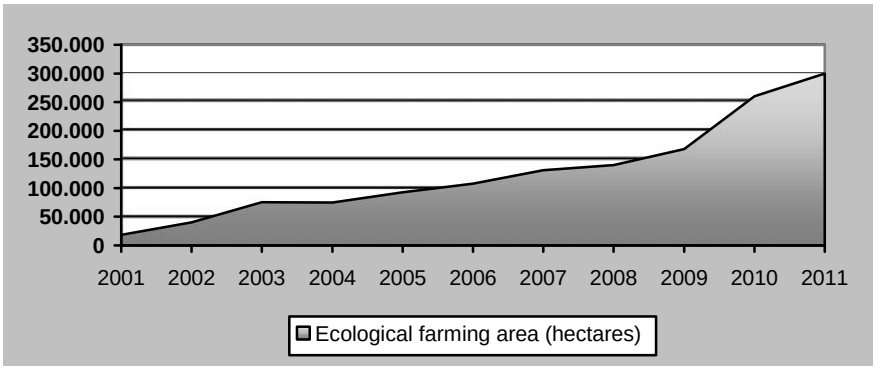

Figure 1. The evolution of the ecological farming area
Source: author's own computation using the data from Table 2

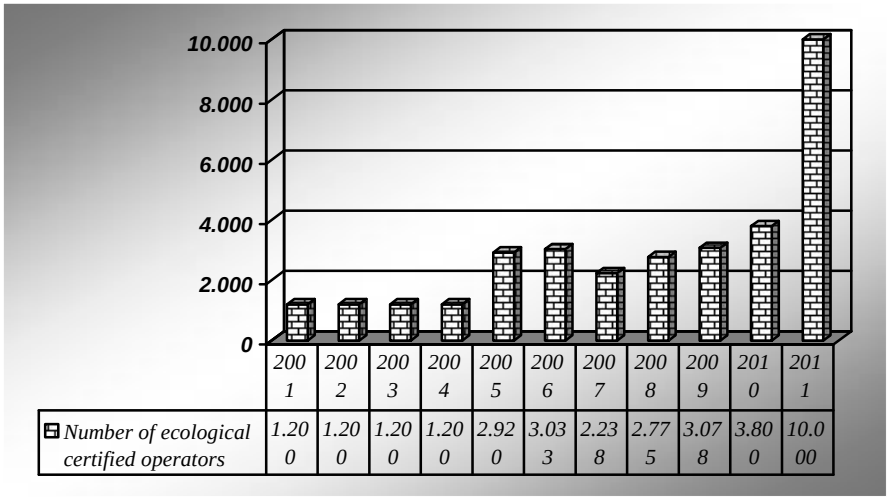

Figure 2. The dynamics of ecological certified operators
Source: author's own computation using the data from Table 2

It must be mentioned the fact that a and b are the coefficients of this function, while e_i represents the random error. Customizing and using the given parameters, the mathematical model will have the following aspect:

$$y_i = 41081.1580 + 29.3305x_i + e_i \quad (2)$$

As b>0 (because b = 29.3305), we can see that between the two variables there is a direct connection, and at each increase with one unit in the number of ecological certified operators, the farmed area according to the legislation increases with approximately 29.3 hectares.

Table 2. Evolution of the number of ecological certified operators and of the ecological farming area during 2001-2011

Year	Number of ecological certified operators	Ecological farming area (hectares)
2001*	1,200	18,690
2002*	1,200	40,000
2003*	1,200	75,500
2004*	1,200	75,000
2005**	2,920	92,770
2006**	3,033	107,578
2007**	2,238	131,401
2008**	2,775	140,132
2009**	3,078	168,288
2010***	3,800	260,000
2011***	10,000	300,000

Source: * author's own computation using FIBL (2001-2009) and Organic World (2001-2009) data, ** author's own computation using Organic World (2001-2009) data, *** author's own computation using Ekonom:east Media Group (2011) data

Table 3. The results of the regression function

SUMMARY OUTPUT		
Regression Statistics		
Multiple R	0.8476	
R Square	0.7185	
Adjusted R Square	0.6872	
Standard Error	48656.8870	
Observations	11	
ANOVA		
	df	*Significance F*
Regression	1	0.00098
Residual	9	
Total	10	
	Coefficients	*Lower 95%*
Intercept	41081.1580	-11727.5345
X Variable 1	29.3305	15.4886

Source: author's own computation using the data from Table 2

Secondly, the correlation coefficient wich value is 0.8476 shows that we are dealing with a strong correlation because its module frames the (0.75; 0.95) interval. In other words, the ecological farming area is strongly correlated to the number of existing operators in this field. Moreover, the determination coefficient of 0.7185 points out that the number of operators influences at a rate of 71.85% the variation of farmed areas. Last but not least, the plausibility of this econometric model can be checked using the Fisher-Snedecor test. Thus, as significance F indicates 0.00098, a value much smaller than the signification threshold of 5%, we can specify that the results obtained are significant.

Interested in the potential that our country has, a group of British scientists have assessed part of Romania's South-East (namely Dolj County) and have highlighted the rehabilitation possibilities of the existent land, which is mainly sandy and less fertile (Fraser & Stringer, 2009). It must be also mentioned that the area is short in what concerns rainfalls and records much higher temperatures than in other parts of the country. According to these researchers, some landowners have managed to get financing in order to afforest and reforest some locations, farmers

thus having the possibility to add value to a degraded land. Actually, they intend to use the resulting wood as fuel, but also in the industry, and to expand honey production and green certificate capitalization possibilities. Unfortunately, it seems that the socio-political uncertainty offers just vulnerability to the ecological systems, while the development does not occur with an adequate speed.

5. Advantages and disadvantages. Measures necessary to the development of ecological agriculture in Romania

The momentum gained by organic agriculture in recent years is significant, succeeding to solve some issues the current society deals with. In other words, there are many advantages of this phenomenon, but there are also drawbacks that spring up and discourage farmers and those interested in this field to put into practice their ideas. Thus, if we all generally know that ecological agriculture means unpolluted air, water and food, and also higher prices, we will try, as follows, to remember some of the advantages and disadvantages of ecological agriculture which are probably less obvious.

Although it requires more work and more trained personnel, ecological agriculture causes a higher rural job occupancy rate and encourages employee specialization. Furthermore, it creates safer working conditions for farmers whose health is not exposed to pesticide contamination or other related chemical substances. The elaborated practices follow the principles of sustainable development and natural environment protection whereas the relations set between producers and final consumers have a major role in the existence of small farms. Unfortunately, price is much higher than that one of intensive products, having the tendency, at least for the moment, to address to a certain category of people. But if we look on the bright side, we will see that production costs are being transferred to the price of the product, which means operators win. At the European Union level, co-financing is one of the main advantages that operators have and one of the most important reasons for which farmers choose the option of ecological agriculture. Another advantage that those involved benefit from is made up of the agro-ecological rewards due to the recognition of agriculture as a special system that the environment enjoys. Investments

encountered in primary production, processing and marketing levels compose other strong points. In what concerns the final consumers, they benefit from products in which they trust, documented from the point of view of their origin and processing, dealing thus with products that are guaranteed by certain inspection and certification organisms (Ciolos, n.d.).

When we speak about drawbacks we certainly refer to a production productivity which is approximately 20% lower than that one coming from conventional agriculture, situation which is not precisely comfortable under the circumstances of a higher food demand (Csibi, 2008). Nonetheless, it must be mentioned that this thing happens particularly in the conversion period from one type of agriculture to another (from the conventional to the ecological one). At the same time, an undesired feature encountered in ecological products makes us reluctant, this false appearance being certainly compensated by their nutritive value.

Soil, a key element of agriculture, has various benefits: from maintaining its durability through crop rotation, manual work or weeding, to the reduction in nutritive element loss through levigation and to the reduction of soil erosion by maintaining the land covered as much time as possible, either through mulching or through cultivation of covering crops. From here we can have a much more efficient water usage, which brings to a reduction in the costs designed for irrigation. In addition, the reduction in greenhouse gases add to the positioning of this type of agriculture among the most favoured among farmers, the carbon dioxide alone contributing to a reduction of 60% per hectare of greenhouse gases in the case of ecological agriculture in comparison to the conventional one (Albert Felecan & Voevod, 2011).

A full integration of Romania into the structures of the European Union assumes bringing the ecological production to certain standards so as the obtained products to satisfy the consumers regardless of their location or preferences. That is why, among the measures adopted so far in this matter, the following can contribute to the development of ecological agriculture and can influence our country to compete with other nations:

- proliferation of ecological stores for a better availability towards clients, thus increasing their awareness among potential consumers;
- replacement of subsistence farming, which has a predominant position in our country at the moment, with ecological agriculture;
- continuously supporting this type of agriculture through different economical levers (subsidies, tax exemption);
- trying to eliminate those producers that market conventional products and who present them to consumers as being ecological in order to gain a higher price;
- promoting the concept of ecological agriculture worldwide, thus additionally investing in the marketing programs designed for this domain;
- due to the fact that most ecological products obtained in Romania are being sent in other countries for control in laboratories, which means additional costs and a lower accessibility degree for producers to the control and certification bodies, it is necessary to improve this certification process and to invest in specialized laboratories which can be found in our country as well.

6. Conclusions

Today, almost half of world's population lives in urban areas, but this figure is expected to rise up to 70%. In the same time, income levels will improve and in order to deal with the necessity of food of this much more educated and thus food aware population ecological agriculture escalates at world levels. Even if we speak about ecological, organic or biologic agriculture or we are on the American, African or on the old European continent, we all wish to live in harmony with nature because "she" is the one that supports life on Earth. Ecological agriculture follows this principle regardless of the place where it is practiced. China already boasts with the third place at world level, while for the Australians experience and knowledge are the key elements of producers when choosing between conventional and organic agriculture. Holland claims that it is necessary to be aware of the role producers in this sector play within the society and to give them the chance to put into practice their ideas, while the Americans plead as well for the preservation of ecosystem

services to the benefit of agriculture productivity. Still, all these cannot be accomplished without a contribution on behalf of the governments, taking into account in the same time the advantages and disadvantages of ecological agriculture.

In Romania, the market of ecological products has had a timid but positive evolution, growing in terms of cultivated area more than 16 times in the last ten years. From the analysis of our country's existing data there can be seen that the number of certified operators influence in proportion of 71.85% the variation of ecological farming areas, and at each increase with one unit in the number of operators, the ecological area increases with approximately 29.3 hectares. Unfortunately, the economical uncertainty offers only vulnerability to the ecological systems and not at all solutions in order to persevere in this field where there are a lot of unconsidered measures.

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CEREAL USES IN WALLONIA: CONTEXT AND ISSUES

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Abstract. Walloon cereal production currently provides only 8 % of Belgian food chains, mainly because of low prices paid for food varieties, less favourable climate conditions and scattered plots of land. Key opportunities for non food uses are considered in a sustainable development perspective. But this can only be achieved through an exhaustive comparison of environmental and socio-economic impacts of existing and potential cereal chains. Biofuels – particularly bioethanol – are the predominant energy chains and are more and more developing in Belgium. Bioethanol industry has strongly developed since 2008 undoubtedly linked to European political support measures. The project "Alternatives for Cereals – ALT-4-CER" aims to define and to evaluate alternative scenarios for food and non food uses of cereal resources in Wallonia with the support of involved stakeholders

Keywords: cereal, biofuel, resources, environment.

1. Introduction

In the current sustainable development framework, agriculture raises major concerns in terms of productions and farmers' income diversification, competition for arable land between food and non food uses, employment preservation or creation in rural areas, climate change mitigation and natural resources protection.

In Wallonia (Belgium), more than 60 % of the arable cropped area is dedicated to cereals. In the current context of fossil energy sources depletion and growing world population, competition for cereal resources requires the identification of the most sustainable scenarios for agricultural products and co-products value chains.

Nowadays most Walloon cereal chains are classically turned towards human food and animal feed. Key opportunities for non food uses are considered in a sustainable development perspective. But this can only be achieved through an exhaustive comparison of environmental and socio-economic impacts of existing and potential cereal chains.

2. Main cereal chains in Wallonia

Wallonia is divided into 10 agricultural regions, according to soil texture and landscape of the country (Sneppe 2002). The agricultural productions of Wallonia are closely related to the opportunities offered by the soil properties or the landscape. The Northern part of Wallonia (loam area, sandy-loam area, and clayed-loam area), is particularly fertile with deep soils and is dedicated to large-scale crops, such as cereals, sugar beet and potato. The central part of Wallonia has poorer and less deep soils and is therefore dominated by forage crops (mainly forage maize). The Southern part, with a lower population density, is mostly covered by forests and by agricultural lands devoted to meadows and pastures. The Eastern Belgium area, with the highest a.s.l. elevations in Belgium, is dedicated to pastures, bocage and dairy productions; orchards are found in the Northeastern Belgium area.

Agricultural statistics show that more than 60 % of the Agricultural Area Utilized for Farming (AAUF) is dedicated to cereals in Wallonia. Arable cropped area dedicated to cereals is distributed as follows: winter wheat (36 %), winter barley (10 %), spelt (3 %), grain maize (1 %) and forage maize (16 %).

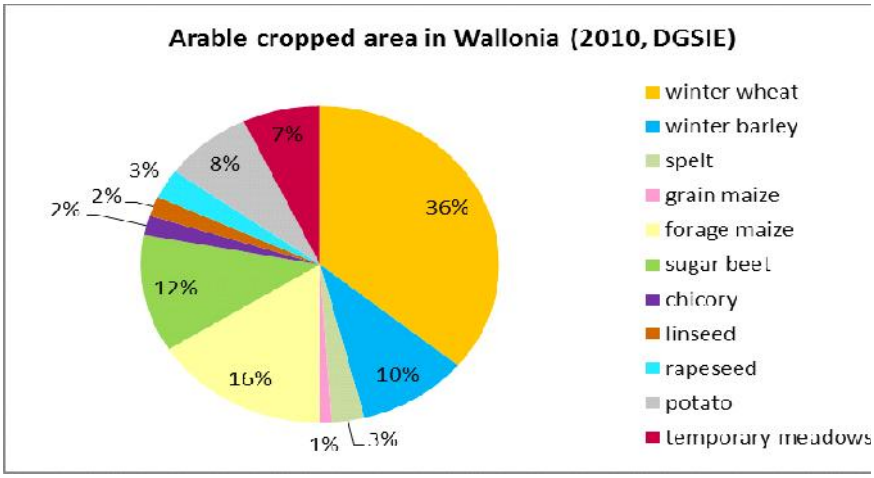

Figure 1. Characterisation, in terms of cropped species importance, of the occupation of the arable land in Wallonia
Source: DGSIE 2010

By comparison, cereals devoted to grain production covered 35 % of Flemish arable cropped area in 2009. Forage crops take up 41 % of arable cropped area, among which 67 % is forage maize. Thus distribution of cereals is perceptibly different between the two Regions of Belgium: winter wheat covers only 16 % of the Flemish arable cropped area, spelt 0.1 % and winter barley 3 %. The Flemish Region being devoted to animal rearing, grain and forage maize are essential crops with respectively 14 % and 28 % of the Flemish arable cropped area (DGSIE 2010). Moreover there is also significant contrast between Walloon and Flemish yields, according to crops and agricultural area. For example, in Wallonia, spelt yield was 5.3 t of grains/ha in Jurassic agricultural area whereas it was 8.7 t/ha in the Silty agricultural area in 2009 (DGSIE 2010). Cereal grain yield has been continuously improving for the last 15 years, particularly for grain maize, thanks to selection and to the implementation of better agricultural practices (date of seeding, tillage, etc.)

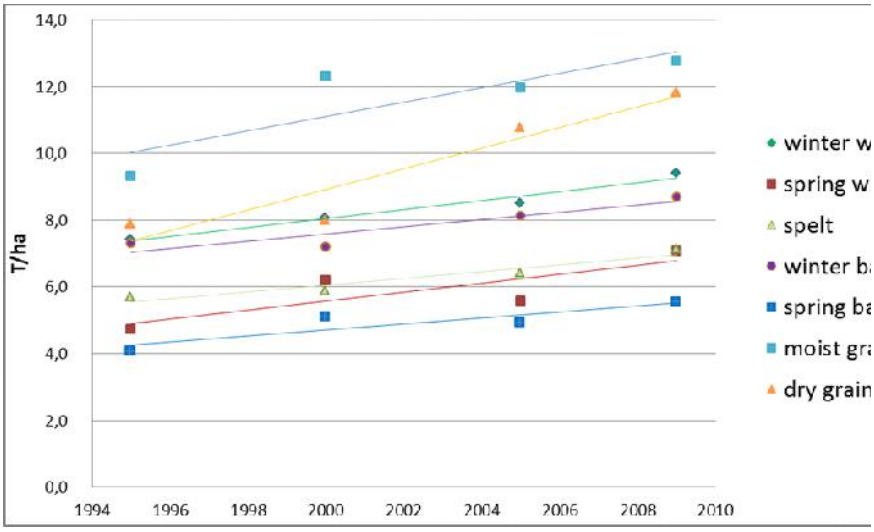

Figure 2. Evolution of cereal (grain) yield
Source: DGSIE 2010

Animal feed industry is the first cereal user. Grains can be either self-consumed or converted into industrial feed. Cereal co-products like wheat brans are also widely used in animal feed industry. More or less 90 % of Belgian production of formulated feed – and thus added value – is located in Flanders. Cereals represent 40.8 % of the raw materials used by the Belgian animal feed industry. Almost half of the cereal supply of Belgian feed industry is wheat, followed by barley and maize (BEMEFA/APFACA 2009).

Walloon cereal production currently provides only 8 % of Belgian food chains, mainly because of low prices paid for food varieties, less favourable climate conditions and scattered plots of land. Main uses are milling and malt industry. Main industrial mills are located in Flanders. Wheat is also the main raw material used in food industry. Some cereal co-products are also used for special flour like wholemeal flour for example. There is only one traditional malt factory in Wallonia, the others malt industries belong to multinational company. Walloon malting barley depicts only 4 % of Walloon barley production. Malting barley is frequently downgraded into feed barley and used in animal feed industry.

Biofuels – particularly bioethanol – are the predominant energy chains and are more and more developing in Belgium. Bioethanol industry has strongly developed since 2008 undoubtedly linked to European political support measures. There are three production plants in Belgium: Syral Belgium and Alco Bio Fuel in Flanders, and BioWanze in Wallonia. Their cereal raw materials are wheat and grain maize. The BioWanze annual production capacity is 300.000 m³ of bioethanol, comparatively to Alco Bio Fuel - the first Flemish ethanol industry - with 150.000 m³.

Finally cereal straws are currently mostly dedicated to animal litter and direct soil restoration. Sectors like green chemistry, biomaterials are still not very developed. Winter wheat is the first source of cereal straw with a yield of 4.5 ton/ha in 2009. Winter barley is the second straw source, with a yield of 3.9 ton/ha in 2009. Production of forage maize still increasing since several years with a yield of 46.9 ton/ha for the whole plant maize forage (55 % DM) and 16.6 ton/ha for the ear of maize (2009).

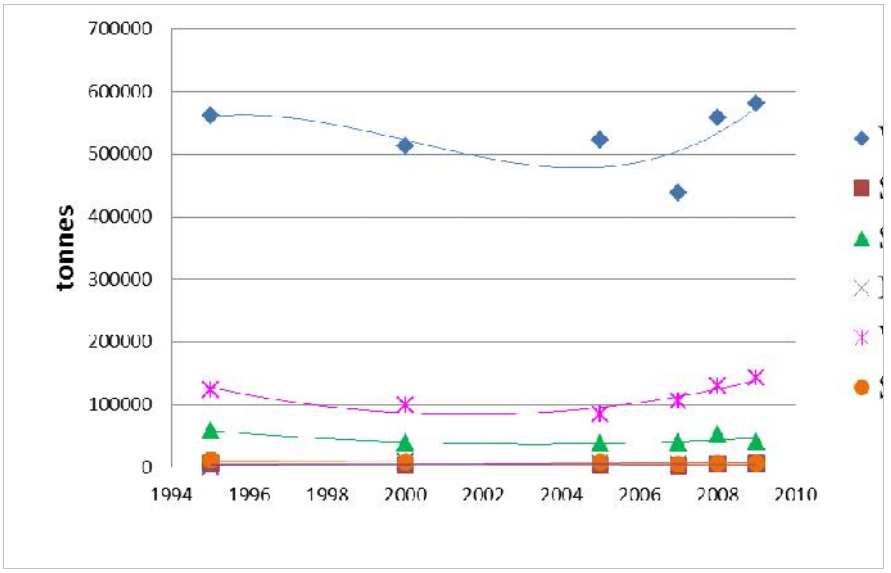

Figure 3. Evolution of cereal straw production (tonnes) in Wallonia
Source: DGSIE 2010

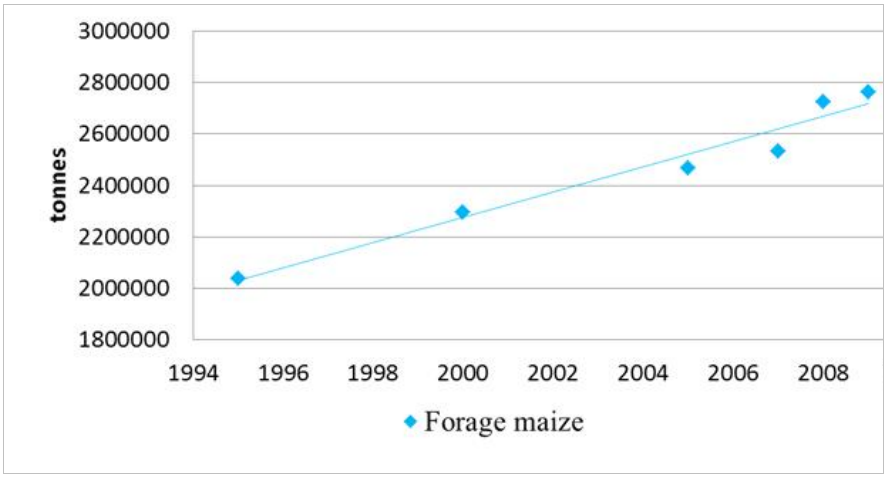

Figure 4. Evolution of maize forage production in Wallonia
Source: DGSIE 2010

Distribution of the different uses is depicted in. Feed is the principal use in Wallonia. Fibre (animal litter) and fuel uses are equivalent and food uses is the minority one. This distribution has been validated by involved actors.

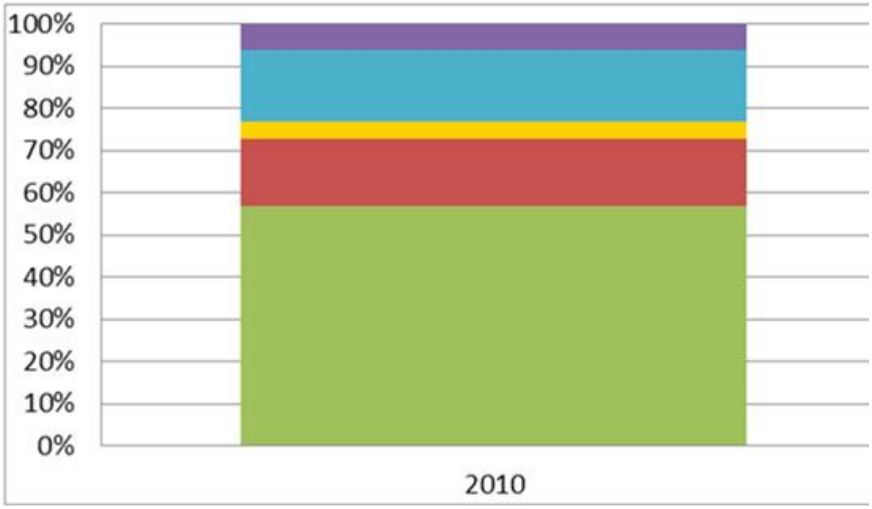

Figure 5. Production and uses of Walloon cereal resources (wheat, spelt, barley, grain and forage maize and straw), based on dry matter
Source: ALT-4-CER 2010

3. A case study: the ALT-4-CER project

Comparing current and potential cereal uses in Wallonia, the overall goal of the 3-year project "Alternatives for Cereals – ALT-4-CER", started in March 2011, is to define and to evaluate alternative scenarios for food and non food uses of cereal resources in Wallonia with the support of involved stakeholders.

In order to depict comprehensively the Walloon cereal landscape the project firstly aims at elaborating scenarios for food, feed, fuel and fibre uses of cereal resources in Wallonia (so-called "4F" scenarios). Scenarios definition is supported by the consultation of all involved actors (producers, wholesalers, processors, consumers, and decision-makers) in order to ensure a further scientific approach based on realistic existing and potential cases. Scenarios take into account interactions between chains and their co-products, as well as potential impacts on the agricultural landscape and land occupation in Wallonia.

Food and non food uses considered in ALT-4-CER are classified in "4F" categories:

- Human (Food) uses (i.e. flour mills, beer products, starch products used in agro-food industries, etc.);
- Animal (Feed) uses (i.e. feed ingredients for animal rations, agro-food and biofuel industry co-products, grain and/or straw self-consumption on farm, etc.);
- Energy (Fuel) uses (i.e. ethanol production from starch, second generation ethanol production from straw, biogas production from maize, straw direct combustion, etc.);
- Material (Fibre) uses (i.e. straw for animal litter, non food uses of starch, straw use as isolation material, biorefineries, etc.).

Based on different hypotheses, four scenarios for food, feed, fuel and fibre uses have been defined for 2030: the first scenario increases animal feed and litter uses while Walloon cereal food uses no longer exist. The second scenario balances fuel and food industry development and uses. The third scenario focuses on food use expansion – particularly through the development of new conversion plants – and diversifies fuel uses. Finally, the fourth scenario is based on an added-value fuel industry development in parallel with exportations boom.

Environmental and Social Life Cycle Analyses (E-LCA and S-LCA) will support the assessment of each scenario sustainability and relevance. Life Cycle Assessment (LCA) is able

to analyze and quantify potential impacts of a product, a service or a process from the extraction of raw materials to end of life. Moreover distribution and use of a product are generally included in LCA. Steps of LCA are:

(1) definition of goals and scope of the study

(2) inventory of available data and input and output flows along the value chain

(3) impact assessment of each cycle step, according to characterization coefficients specific to each flow, and

(4) interpretation of results and sensitive analysis (Boeglin & Veuillet 2005).

E-LCA aims at evaluating positive and negative environmental impacts for each developed chain. It will provide clues to answer key questions such as, for instance, from the environmental point of view, is it preferable to product cereal for feed or food uses?

S-LCA analyses selected social impacts, such as added-value distribution and working conditions along cereal chains. Indicators like work hours, number of work accidents, training opportunities, job satisfaction, etc. will be quantified along different value chains.

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URBAN AGRICULTURE AND THE EXTENDING PROCESS OF URBANIZATION

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Abstract. Globally, urban and peri-urban agriculture gained an important role in the increasing process of creating sustainable cities, in a framework that needs to be adjusted in terms of local policies and financial poinst of view, in order to become productive. Existing research in this area and the benefits provided by the urban agriculture have demonstrated the extent of this practice and the expansion tendency of urban agriculture, unlike the benefits determined by default on communities.

Key words: urban agriculture, pollution reduction, urbanization, urban development

1. Introduction

The many meanings of the concept of human wellbeing and quality of life have determined the need to consider environmental characteristic of both urban and rural areas, with mainly reference to the positive or negative impacts.

Environmental protection is an essential objective of general interest, and should be classified within the limits of the concept of sustainable development, the rational use of resources by present generations but without compromising the ability to satisfy the needs of future generations.

World size of environmental protection has generated a transposition of the environmental problem in one of the main concerns by international collaboration, generating the development of the environment and access to a healthy environment, that have progressively become fundamental rights.

Society – nature relation has acquired in recent decades increasingly more important values, considering that the two items are in a relationship of interdependence with a powerful impact on the environment.

The balance of this link is essential for both existing elements as its relations affect both of them; maintaining an optimum ratio between them ensures a more secure link without substantial modifications of their defining features.

Taking into consideration poverty-wealth report, reflecting the fact that 20% of the world's population consumes 80% of its resources, it establishes that the evolution of the rich natural environment is inappropriate for a viable future, at a fair exploring in order to outline a sustainable adaptability.

The main problem at the global level is represented by the contrast between the scientific and technical evolution and increasing global population, growing exponentially (Fig. 1), accompanied by the phenomenon of migration to urban areas, areas considered to be real development centers, which combine both social, economic component, and also the environmental ones.

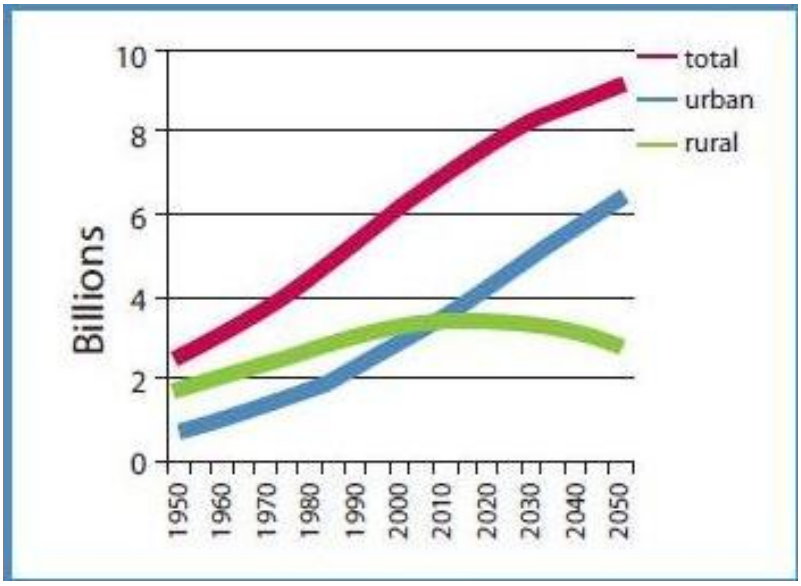

Figure 1. Global population evolution
Source: World Urbanization Prospects, United Nations Dept of Economic and Social Affairs, 2010

This emphasizes the natural system, the pressure on a region imposing adaptation or alteration of the natural environment to provide new opportunities for the population,

usually with a negative impact on the environment. It is practically accomplished a virtual migration of population from rural areas into urban ones - basically with non agricultural activities – which disrupts the ability of the necessary resources, so that it anticipates that according to the statistics of the current till 2020, 1 of 2 people will live in urban areas.

2. Urban agriculture and its determinant factors

The practice of urban agriculture in these areas is determined by 5 major factors with an important influence over it, represented by natural conditions, infrastructure, the existence of socio-cultural context, economic conditions and institutional conditions.

- Natural conditions: refer to the type of soil, climatic conditions, rainfall and temperature regime that influence the level of production.
- Infrastructure: essential requirements necessary for the practice of urban agriculture refer to the existence of space and water resources.
- Socio-cultural conditions: refer to preferences in certain areas and existing practices here.
- Institutional conditions: they create the general effort of this type of activity in urban and peri-urban areas.
- Economic conditions: refer to the urban labour market and the lack of opportunities available to the general public.

Urban agriculture refers to the growing of crops and livestocks in an urban area or around it. Urban agriculture for farming concept differentiates for the fact that it is integrated both economically and environmentally to urban space, being used in the production of typical agricultural resources, urban environment, organic waste with direct links between urban consumers and brands.

Urban farming can be practiced both inside cities-urban agriculture –and in their outlying areas for peri-urban agriculture .

Also, urban and peri-urban can be stimulated and developed on the basis of the following relationships:

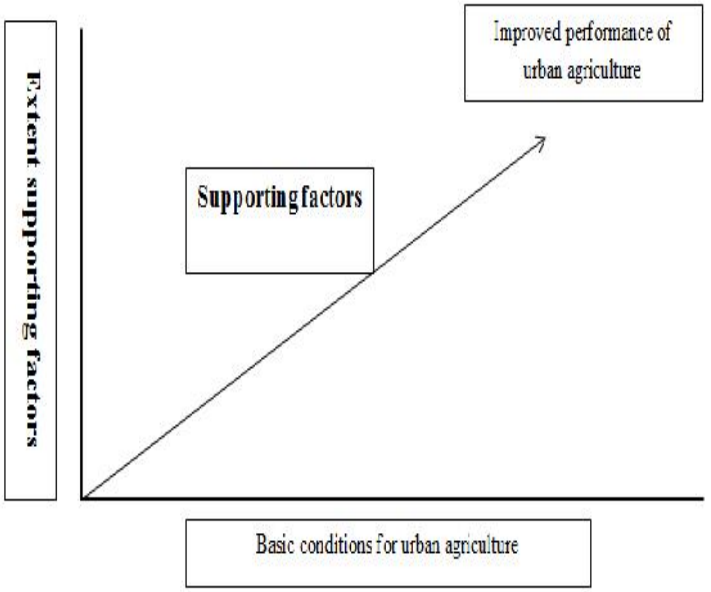

Figure 2. Stimulating factors for urban agriculture
Source: author's own computation

Urban agriculture refers to the growing of crops and livestocks in an urban area or around it. Urban agriculture for farming concept differentiates for the fact that it is integrated both economically and environmentally to urban space, being used in the production of typical agricultural resources, urban environment, organic waste with direct links between urban consumers and brands. (Christopher R. Bryant and Thomas R.R. Johnston 1992)

Urban farming can be practiced both inside cities-urban agriculture –and in their outlying areas for peri-urban agriculture . (**RUAF** Resource Centres on Urban Agriculture and Food Security, http://www.ruaf.org)

Activities undertaken in urban agriculture may take place on a variety of terrain types and surfaces:

-arable land (land)
-not worked (off-grounds)
-private land (ownership, lease)
-on public land (parks, conservation areas, along the road)
-on semi-public land (schools, hospitals, kindergartens)

The main ways of obtaining land by urban ranchers are the following : (RUAF Resource Centres on Urban Agriculture and Food Security, http://www.ruaf.org)

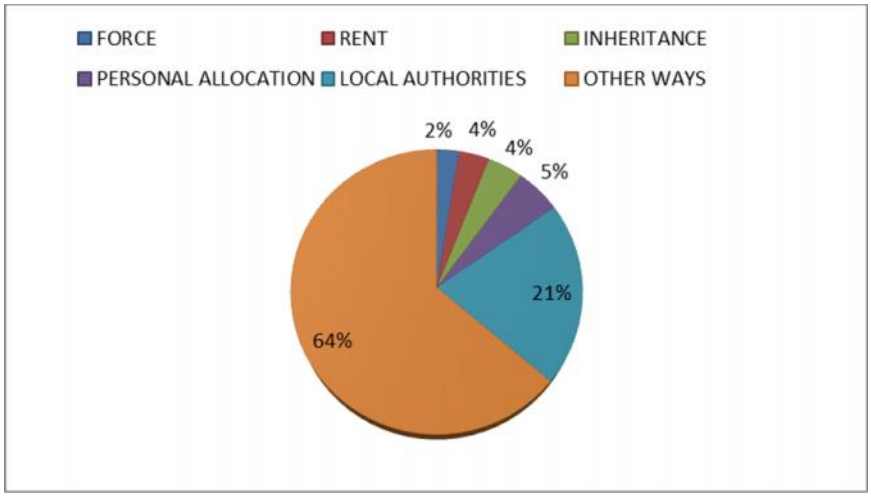

Figure 3. Main ways of obtaining urban lands
Source : http://www.cityfarmer.info

Mostly in urban space are found small farms, but rarely are being found medium or even large size farms, these being responsable for various types of activities, depending on the region in which they are located, as follows:

Table 1. Urban agriculture depending on the regions

Region	**The share of agricultural population (%)**	**Main activities**	**Characteristics**
South Africa	3	Fruits, vegatables, dairy products, cattle, goats	Heterogenous, dynamic
North Africa	6	Horticulture, poultry	Small revenue contributions
South	1	Horticulture,	Based on the farm

Region	The share of agricultural population (%)	Main activities	Characteristics
Asia		dairy, poultry	type system
South-East Asia	1	Horticulture, dairy, poultry	Often used for commercial purposes
Latin America	3	Horticulture, dairy, poultry	Focused on pershable products; limited space
Europe	7	Vegetable, poultry, pigs	Recently developed; mainly for theor own consumption, occasionally for sale

Source: FAO, 2010

Urban agriculture in terms of both production and consumption is situated in a strong link of interdependence, due to the geographical proximity of the flows of resources or of the volume of demand. In cities in developing countries, predominantly urban agricultural production is used for auto-consumption, and only the extra urban agriculture production is traded. The development of urban agriculture requires consideration of some aspects which are essential and an overview of all the elements involved in this process, as follows in Figure 4.

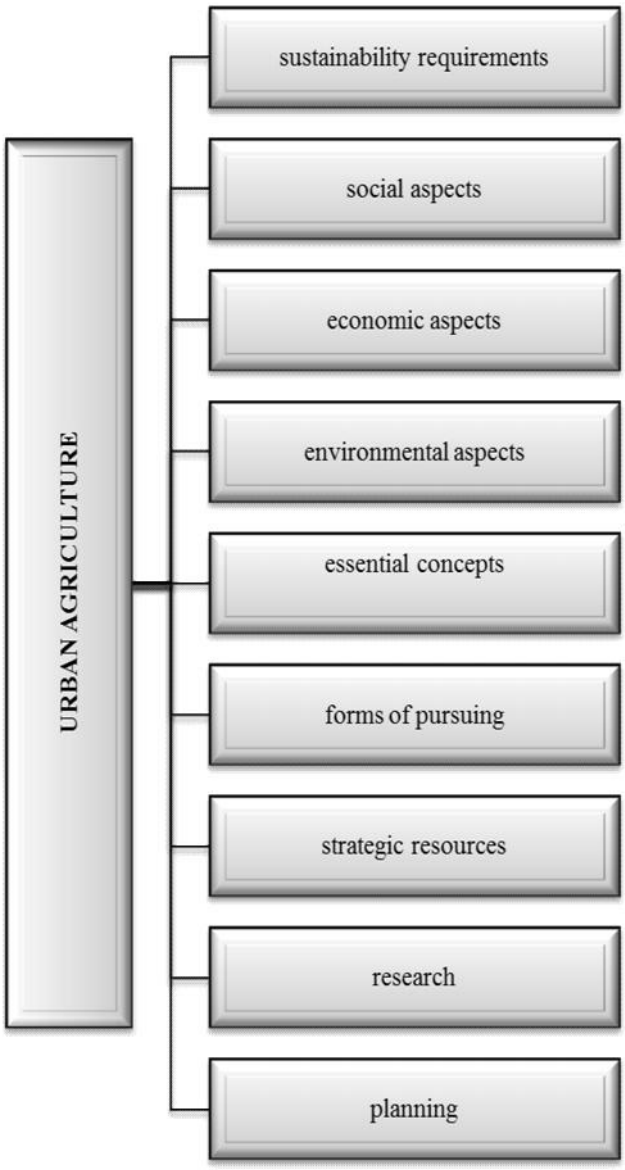

Figure 4. Elements involved in development of urban agriculture
Source: http://www.urbanagricultureworldwide.com/

Mainly, urban agriculture products are sold in fresh condition and only a small part of the total is subjected to processing. (Berg, L. van den & Veenhuizen, M. Van. 2005)

The technological level of urban agricultural enterprises is quite low, this manifested particularly in the developing countries, but, however, the tendency is directed towards a more intensive farming and more advanced and much more diverse formats.

Obvious opportunities of urban agricultural production relate to the following aspects:

• reduce the costs of storing , packing, and especially the transport;

• supporting the local economy by generating new jobs;

• the availability on the market of fresh food.

In each city, the practice of urban agriculture can be viewed from the perspective of multiple dimensions, such as:

A. types of actors: most of the people who practice agriculture in urban areas are represented by the poor population, but there are people with a very high financial potential investing in this area from the perspective of a long term investment for the development of their capital; practicing this activity lies with women as the preponderant activity can easily be mixed with daily activities.
B. types of locations: the practice of agriculture in urban areas or in peri-urban areas, plots, on the surface of public or private properties
C. types of urban agriculture: cultivated products can include a variety of products and types, such as food crops (cereals, vegetables, fruits, animals) and manufactured goods (such as herbs, medicinal and ornamental plants), or combinations thereof.
D. types of economic activities: urban agriculture includes agricultural production activities, as well as the processing, marketing and delivery. In this type of agriculture production and marketing processes are tightly linked in terms of spatial and temporal aspects
E. product destination: production coming from urban agriculture is destined for local consumption
F. the scale of production and technology used: urban farming is practiced either in individual or family farms or in trade unions, most of them having small sizes. State of the art is not very developed, but an evolutionary trend is felt, referring to practicing intensive agriculture.

3. The benefits of urban agriculture

The main benefits provided by the practice of urban agriculture refer to the reduction of two major global problems: poverty and the excess of waste.

Expansion of urban areas and intensifying the process of migration of population to urban areas in underdeveloped countries are important aspects that amplify urban agriculture, providing both a local economic regeneration and stability of the population in the area, but also promoting sustainable development and reducing the urban weaknesses.

Urban agriculture also contributes to the improvement of services provided by ecosystems, through:

- use of organic waste as compost for increasing soil fertility
- waste treatment and reduction
- expansion of green areas, a variety of crops, which provide both esthetic appearance improvement of urban area and air pollution reduction
- reduction of distances population make in order to buy the food, thus reducing the consumption of fuel used, the benefits reflecting also on the environment and on the inhabitants health
- diversity stimulation and maintainance of rare varieties
- climate-control role by reducing the greenhouse effect

Statistics denote the need for gardening through urban agriculture:

- more than 5 billion people will be living in cities by the year 2025 (Nelson, T. 1996)
- up to one billion people of the global population is faced with a high level of malnutrition
- though cities reflect a low percentage of the total surface of the globe, they use 75% of the total resources of the world (Garnett, T. 1996)

Food security is one of the essential global problems, so that food security issues have become central elements of urban agriculture, which main interests mitigate on the effects of climate change and urban pressures. Sustainable urban planning policy

and measures taken to improve land use have enabled the development of active opportunities to expand urban agriculture.

Urban policies improve the agricultural process, the opportunity in urban areas, and the ability to extend it beyond the limits of the city.

Urban agriculture describes in general the production made in the city, but also in the peri-urban areas, where production is usually more intense. (Moustier, P., Danso, G.. 2006. Local economic development and marketing of urban produced food. *In* R. van Veenhuizen. 2006. *Cities farming for the future: urban agriculture for green and productive cities.* Leusden, RUAF /IDRC/IIRR)

While data on urban agriculture are quite limited, this process became a reality especially in developing countries, as shown in the studies and research carried out by FAO, on a total of 15 countries in transition, in which up to 70% of urban households are involved in agricultural activities.

4. The potential of urban agriculture

Agriculture potential undertaken in urban and peri-urban areas is influences by the following aspects:

A. Capital
B. Incentives granted
C. Resistance
D. Security of tenure
E. Resources availability
F. Integrated management
G. Strategic positioning
H. Research
I. Planning

Urban farming enterprise, as well as conducting activities in agriculture in rural areas, include a range of opportunities and benefits, but also a set of risks to be taken into consideration in order to reduce possible losses.

The opportunities brought about by the practice of agriculture and in urban areas are:

- Reduction of quantity of material used for packaging, transport and storage of food, so an economy of resources and costs

- Ability to generate new opportunities on the labor market, to increase the incomes of the population and welfare level by default

- Increasing access and existence on the market of fresh and perishable products

- Waste recycling and reuse

- Integration policies or local policies in nutrition

The main risks in urban agriculture refer to the following aspects:

-Environmental and health risks to the general public in case of improper agricultural practices

-Reduced capacity for absorbing environmental pollution

-Raising competition for land, water, energies

Contribution of urban agriculture in raising the welfare level of the local population is directly influenced by the ability of exploiting opportunities in the field, as well as the degree of awareness of the risk, to permanent monitoring and control, in order to reduce the negative impact.

It is absolutely essential to define the circumstances in which urban agriculture or peri-urban agriculture have a comparative advantage over rural farming.

The volume of production, the products supplied or existing alternatives are relative factors for determining this advantage.

In general, urban agriculture, or the peri-urban agriculture become main factors and performance factors for ensuring the supply of agricultural products and services at the same quality, but at much lower costs for the supply of urban areas, including environmental costs. However, urban agriculture should not be developed in competition with rural agriculture or rural development, but should be a comparative advantage, such as production of fresh food, essential at the local level, in order to ensure food security in urban areas.

5. Dynamics and size of urban agriculture

Urban agriculture is heavily influenced by the dynamics of social, economic, ecological, political, territorial and spatial aspects of the corresponding area where it is instituted. (Smit, J., A. Ratta, and J. Nasr, 1996. Urban Agriculture: Food, Jobs and

Sustainable Cities. New York: United Nations Development Programme.)

The integration of environmental policy in all spheres of activity has become a real necessity, within the environmental provisions being taken into account in the development and adoption of strategies of urban design. In this respect, for the approval of the relevant environmental aspects in the work of environmental urbanism is the opinion issued in the following specific documentation and operations, as well as the environmental report.

The purpose of town planning involves the preparation of plans and programmes needed to reflect the environmental impact, but also the integration of environmental considerations in their content. The main documents are necessary to obtain the opinion on the environment are:

a. general urban plan: covers short-term regulations with regard to the delimitation of the territory, commercial, infrastructure and functional regulatory environment and long term evolution and limits designed to paths of circulation.

b. urban plan area: ensure referencing general plan with the development planning, including issues related to urban road network, architecture

c. detailed urban plan: refers to the details of the plan on the location and size of urbanistic networks, or territorial arrangement

Urban theme has become a topic of major interest, exploring the need for the integration of urban issues in environmental policies, obtaining sustainable developed cities for a proper adaption to the principles of sustainable development and the establishment of sustainable urban spaces.

Sustainable development of cities requires the following main objectives:

-Revitalization of eco-economic cities

-Reduction of pollution and the adoption of essential rules of environmental sustainability

-Awareness and adaptation of the population’s behavior

All these efforts are dedicated not only to the sustainable development of towns, as areas in which most of the population is concentrated, but also to improve the quality level of life or well-being.

The evolution of urban agriculture is influenced by the expanding phenomenon of urbanization and the exponentially growth in the number of persons living in the urban space. Urban population growth is determined by the migration of the rural population to urban space and also by the phenomenon of global numerical growth of population. (Electronic Publishing Policy and Support Branch Communication Division FAO, 2010, ”*Profitability and sustainability of urban and peri-urban agriculture*”).

The default extension of urban areas and natural resource use, acquired and became a dominant feature globally, what is involved in changing the existing relationship between mankind and its numerical growth and support capacity of the Earth.(Smit, J., A. Ratta, and J. Nasr. 1996). Urban agriculture and its expansion has become an answer to urban growth and expansion through the following aspects: (Redwood, M. (ed.) (2009)

- Opportunities and benefits of urban producers, as follows: direct access to consumers and markets, utilization of urban waste

- The corresponding context determined by the urban policies correctly

- Urban agriculture development of cities to respond the needs of sustainable agriculture, through recycling, waste management, land use, or social inclusion, depending on local needs and priorities

An essential feature of urban agriculture is represented by the diversity of the socio-economic types of parties involved, which allows understanding the system between the functions of urban agriculture and urban food system, allowing for the development and improvement of strategies and policy planning and local development. Main dimensions of urban policies and main forms of urban agriculture are the following: (Electronic Publishing Policy and Support Branch Communication Division FAO, 2010, ” *Profitability and sustainability of urban and peri-urban agriculture*”)

A. multifunctional urban agriculture: combining agriculture with other basic functions, such as recreation, orientation towards the market, food and non-food production, fresh, direct sale

B. sustenance urban agriculture,: internal consumption and production

C. commercial urban agriculture: food market, adapted to the needs of the market production.

It also involves the practice of urban agriculture and the combination of the 3 dimensions, social, economic and ecological aspects, with propagated effects, as follows:

- Social aspects: poverty reduction, food security, food quality
- Environmental aspects: urban greening, improvement of ecological footprint reduction, biodiversity and environmental education
- Revenue growth: economic issues, providing new jobs, commercial development. (Gravestein, X. and M. van Lubek. 1995)

Urban agriculture has an essential role in developing capacities of urban places, having an important role in the development of the community. The benefits of gardening, urban agriculture is not limited to the provision of food, but also the transformation of places in profitable resources inappropriately used, provide an opportunity for interaction and local cohesion. (Hull, Z., (2008), „*Sustainable Development: Premises, Understanding and Prospects*" Sustainable Development, John Wiley&Sons, Ltd and ERP Environment, vol6, nr. 2)

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SUSTAINABLE AGRICULTURE – THE WAY TO SUSTAINABLE DEVELOPMENT IN THE DANUBE DELTA BIOSPHERE RESERVE

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Abstract. Agriculture, an important branch of economy, has undergone major changes in recent decades due to the increased food demand generated by the accelerating growth of global population. Meanwhile, the connection between this and the environment has become stronger, taking into account that the natural environment is the main support for the activities. One solution has been designed and named sustainable agriculture, which gives greater importance to environmental components, as an attempt to diminish the disparities manifested in it. Such a solution is proposed for the Danube Delta Biosphere Reserve, in order to protect the ecosystem of this area.

Key words: agriculture, sustainability, environment, ecology, Danube Delta

1. Introduction

Concerns for environmental conservation have become increasingly pronounced in recent years due to increase awareness of ecological crisis. Environmental impact of economic activities manifested more acute with the overexploitation of natural resources. The concept of sustainable development has been promoted worldwide upon which they could be able to prepare actions plans for ecosystem protection, conservation or biodiversity, ensuring sustainable economic growth with minimal impact on the environmental balance.

At the same time there was an important link between agriculture and environment, practicing in an inappropriate manner with its impact on natural ecosystems. Bear in mind that the main supplier of raw materials for the agricultural sector is the environment therefore maintaining its unaltered form leads to a

longer life in terms of supply of economic activities (Bran, Rojanschi, 2004).

2. Sustainable agriculture

The link between environment and agriculture can be played briefly with the concept of "sustainable agriculture". Sustainability is the ability to satisfy the needs of present generations without jeopardizing the ability of future generations to ensure satisfaction of needs.

Sustainable agriculture integrates three dimensions: environmental health, economic profitability and social and economic equity.

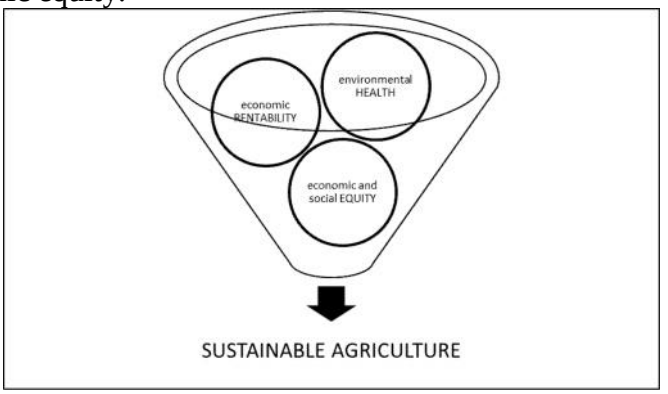

Figure 1. Dimensions of sustainable agriculture
Source:http://www.nature.com/scitable/knowledge/library/sustainable-agriculture-23562787

Sustainable agriculture is based on principles that consider:

- conservation of natural systems
- use of renewable resources
- protection of plant and wildlife habitats
- enhancing biodiversity
- integrated systems of cultivation and processing channels, equitable distribution from the economic and social point of view and in terms of environment.

The role of sustainable agriculture is to produce clean agricultural products, appropriate for the consumption without affecting human health and in harmony with the environment and respecting its needs and requirements. It is also aimed the

increasing productivity in order to obtain profit in accordance with the requirements of sustainable development.

L.C.B. Hutten Mansfeld believe that practicing sustainable agriculture requires fulfillment of the following conditions:

- the ability to regenerate natural resources and to keep the "natural" stock at an acceptable level;
- pollution and disturbance reduction to a minimum safety level;
- respects of the limits of biodiversity conservation;
- avoidance of irreversible economic and biological processes through: risk prevention strategies, technological development orientation towards environmental protection, economic decision-making, orientation towards environmental protection and wealth distribution in a fair and reasonable way (Manescu, Stefan 2005).

Sustainable agriculture must be perceived as a farm system that includes individual farms, local ecosystems and communities affected by this type of farming practice. Besides the environmental component, the effects propagate at human level by affecting their health.

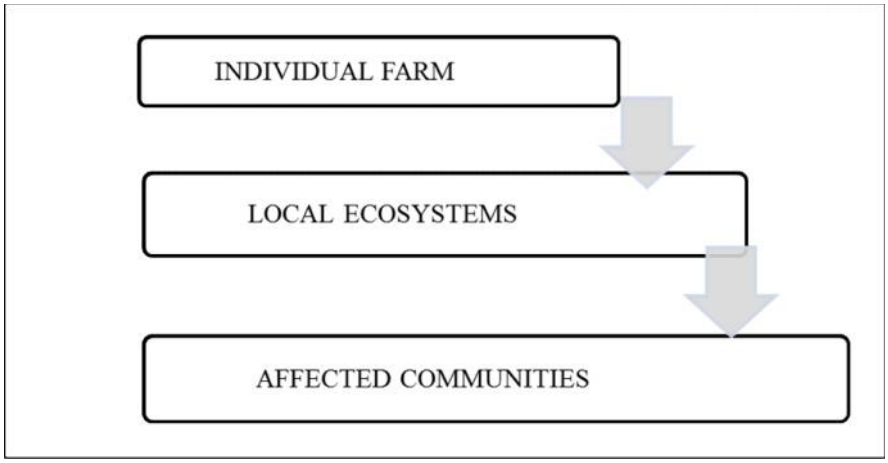

Figure 2. Effects resulted by practicing agriculture
Source: author's own computation

Transition to a sustainable agriculture is a process that must consider every action taken by the farmer, the local authorities, the authorities at central level, productivity and profit being two components that must be taken into account considering that agriculture is an important part of the economy.

Sustainable agriculture involves technologies economically viable over a long period of time with high yields obtained with lower costs. Any agricultural system must have a long-term productivity as high as possible, which is conditioned not only by the quality of the resource base, but also by the social and economic frame (Manescu, Stefan, 2005).

Promoting rural development, an important point in the Common Agricultural Policy that is included in the Agenda 2000, reconsiders the environmental component including it in the CAP agenda for conservation of ecosystems and landscape of the areas (EC, 1999).

Sustainable agriculture in Europe has seen a big boost with the inclusion of the new concept in Community policies.

In Romania, based on the information available at the District Directorates of Agriculture there have been found the following (EC, 1999):

Table 1 . Operators and surface dynamics in organic farming

Indicator	**2006**	**2007**	**2008**	**2009**	**2010**	*** 2011**
Number of registered organic operators	3409	3834	4191	3228	3155	10253
The area cultivated in organic farming, arable crops (ha)	45605	65112	86454	110014,4	148033,5	158825,4
The area cultivated in organic farming, permanent meadows and pastures	51200	57600	46006,5	39232,8	31579,11	89489,22
The area cultivated in organic farming, permanent crops (ha) pastures and meadows	294	954	1518	1869,4	3093,04	4583,85
Collection of spontaneous vegetation (ha)	38700	58728	81279	88883,4	77294,35	47101,53

Source: Records operators County Departments of Agriculture (www.madr.ro)

Farms development must comply in terms of sustainability and productivity in order to protect the environment, cultivation

technologies used must maintain the ecological balance of agricultural exploitation and of the environment (Bran, 2006).

Measures that are implemented for growing soil fertility are aimed at maximizing the soil biological activity and conservation. Combating and controlling diseases, pests and weeds are achieved through integrated control methods, as well as tillage, crop rotation, use of certain insects. These measures and the way that they are applied are intended to preserve and even increase biodiversity.

Maintaining health should be viewed in terms of three components, namely: individuals, community and ecosystem, the three depending largely from each other, healthy soils produce healthy crops which in turn have a positive effect on humans and animals, keeping their health not only by removing diseases but also maintaining the quality of life. This becomes possible through food with higher nutritional properties obtained by avoiding the use of fertilizers, pesticides, food additives.

Given the direct link between agriculture and natural living systems, the latter must be protected and supported; production must be based on ecological processes that respect the natural cycles of ecosystems. Conserving resources, reducing inputs, recycling and reducing energy and raw materials are strands in order to achieve a healthy framework for developing this activity.

Practicing sustainable agriculture cannot be achieved without risk awareness by those directly involved in this process, whether farmers, processors, distributors, sellers. Respect for people and the environment must be a trait that characterizes each individual involved in a process of sustainable agricultural development, health of others being the essential factor to be taken into account before any action.

In order to ensure healthy and sufficient food it is necessary that the management is performed in a sustainable manner, without jeopardizing future generations.

Organic agriculture should provide everyone involved a better quality of life and contribute to their food independence and poverty reduction. Purpose of organic farming is to produce enough food and other quality products.

This principle insists that animals must be provided with living conditions in accordance with their physiological

characteristics, natural behavior and wellbeing. Natural resources used for production and consumption must be managed in a fair manner socially and environmentally, and also must be taken into account the responsibility for future generations. Fairness requires production, distribution and marketing systems, honest and fair, which takes into account the real environmental and social costs.

The figure below represents the causality links between sustainable agriculture and sustainable development as a sequence of steps to be followed and which in turn implies a sustainable management of soil resources, land on which agricultural activities are performed (IFOAM, 2004).

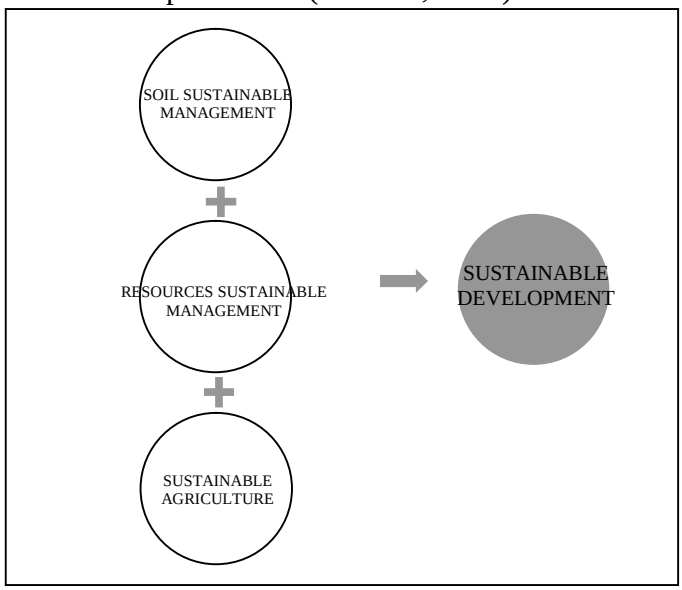

Figure 3. Causality relations, agriculture-land-resources-sustainable development
Source: author's own computation

3. Sustainable agriculture in Danube Delta biosphere reserve

Agricultural land totaling an area representing 11.6% of the Danube Delta Biosphere Reserve is mainly concentrated by approximately 68% in the river delta, more advanced in morphological and soil aspects.

Structure of use of agricultural land in the Delta is presented in the following information:

Table 2. Structure of agricultural land use in the Danube Delta

ARABLE LAND	NATURAL GRASSLANDS	VYNEYARD AND ORCHARDS
67,61%	32,04%	0,34%

Source: Danube Delta Strategy for the period 2011-2012 (www.mai.gov.ro)

From the agricultural land 54% is in agricultural premises dammed and drained, the rest being on the Chiliei field, offshore banks, the banks of the main arms and fluvial-marine banks.

Agricultural lands located offshore banks, banks of mud and under free deltaic plains are filled with flood meadows and arable patches, traditionally exploited by local people, mostly small breeders and producers of cereals, vegetables and fodder.

Predominant crops are:

- Straw cereals, corn, sunflower - 75.02%
- Flax oil, vegetables, fodder - 24.97%
- Melons, forage plants.

Arable land in the sea river delta is 0.12 ha / capita, meadows being predominant in the structure of agricultural land. Agro-ecosystems are poorly represented in terms of area and agro-productive potential.

Ownership of land in DDBR also determines their use (Table 3).

Table 3. The use and ownership of agricultural land in RBDD

Ownership	Use
Public domain of county interest	Agricultural polders
Public domain of local interest	Fisheries and meadows
Private property of individuals	Growing of cereals and other crops, livestock

Source: http://en.wikipedia.org/wiki/Danube_Delta

Agricultural activity is carried out based on environmental permits for land in category of "farmland" and based by practice permits of temporarily out of water agricultural land.

Monocultures practiced on small areas are predominant, representing a form of traditional agriculture. The resulting products are strictly satisfying family needs, treatment and crop rotation being minimal. Better results are recorded on the land temporarily out of water.

In addition to vegetable farming, breeding is practiced in the Delta, an old occupation of the population.

Most arable land are located in river delta economic area, more advanced in morphological and soil aspects. With good management, fluvial delta agricultural ecosystems can have a great capacity for cereals, corn, vegetables, potatoes, soybeans and forage.

For the practice of sustainable agriculture in the Delta there must be followed some basic principles:

- environmental protection;
- maintaining and enhancing soil fertility;
- respect to the health of consumers;
- maintaining the biodiversity of agricultural ecosystems;
- recycling of chemicals and resources as possible on the farm;
- considering the farms as entities in balance;
- maintaining the integrity of organic agricultural products from their production to marketing their crop production and livestock in harmony with natural laws;
- obtaining optimum production, not maximum;
- new and suitable technologies for organic agriculture or animal breeding with the appropriate requirements for each species.

Good agricultural practices recommended are aimed to minimize human impact on the environment.

Specific farming practices include:

- crop rotation as a premise for efficient use of farm resources.
- strict limits on the use of synthetic chemical pesticides and chemical fertilizers, antibiotics for animals, food additives and other substances used for additional processing of agricultural products
- prohibiting the use of genetically modified organisms

- enhancing existing resources on site, such as use of manure as fertilizer from animals and feed produced on the farm
- choosing plants and animals resistant to diseases and pests, adapted to local conditions
- cattle in freedom and open shelters and also feeding them with organic food
- use of animal breeding practices tailored to each race separately

Of the recommendations upon fertilizing soil and fertilizer management we mention the following:

- microbial material to maintain or increase soil fertility and biological activity
- the methods of fertilization should be composed of material of microbian source
- nutrients used in a sustainable manner
- prevention of the accumulation of heavy metals and other types of pollutants
- use of natural origin fertilizers
- it is recommended that fertilizers not to be applied directly to plant crops that are designated for human consumption
- administering substances without affecting soil nutrients, water and biodiversity
- administrations of mineral fertilizers

Recommendations on combating diseases, pests and weeds:

- crops and varieties adapted to the environment
- associated cultures
- mechanical weeding
- protection of enemies and pests by providing a favorable habitat, such as hedges, the location of nests and ecological buffer zones which preserve native vegetation in order to ensure shelters for pest enemies
- diverse ecosystems
- thermal control of weeds
- mechanical control
- spreading natural enemies (parasites)
- traps, barriers, light, noise

In addition to recommendations concerning crop cultivation, there are some practical advices given for the other

branches of agriculture like animal breeding. These targets the actual growth conditions of shelter.

Livestock in a sustainable way requires:

- ecological and qualitative fodder
- maintaining an appropriate density
- stress reduction, disease prevention, avoiding the use of drugs
- providing enough space
- air, water, food, light in appropriate amounts
- housing conditions that provide protection from climatic factors
- building materials and production equipment that will not significantly harm human or animal health
- animals should be protected from wild animals and predators

Throughout the production chain of an organic product, operators should always follow the rules set out in EU and national legislation. They must submit their work for inspection visit, carried out inspection and certification bodies in order to control compliance with the national law on organic production.

By developing competitive agricultural knowledge and private initiative, adopting strategic decisions we ensure a balance between domestic consumption potential and actual needs.

Proposed future developments:

• more efficient farming
• modernization of agricultural holdings
• increasing investment in agricultural holdings

4. Conclusions

Maintaining a healthy environment, untouched by human activities means better conditions of life for all. In this respect it is very important that we are aware of the risks if we fail to abide by minimum requirements regarding the maintenance of ecological balance of natural ecosystems. Ultimately, we all depend on the integrity of the living space in which we operate, the environment providing natural support for this.

Agriculture, the economy part that makes welfare and health of each of us directly depends on has seen major changes in recent decades due to increasing pressure exerted on it, from the economic requirements point of view, and also by the need to adapt in providing a greater quantity of food.

Pressure on natural ecosystems is increasingly emphasized, the relationship between agriculture and environment

being manifested in terms of mutual support and not by degradation due to the expansion of one of them.

We are all responsible for welfare of others, and the increasing awareness of more people in solving these acute problems is essential.

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THE AGRICULTURE – AN ESSENTIAL COMPONENT OF ECONOMY

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Abstract. The importance of agriculture is extremely high because it is the only branch that produces vegetal and animal food, without which peoples cannot exist. This article examines the current situation of Romanian agriculture within national economy, the workforce in this sector and the relations with other sectors. Agriculture must be viewed as a priority economic sector, the agricultural population should have due place in society, so that agriculture would cease to be characterized as "a supported sector". Accordingly, the average income of farmers, lower than in other economic sectors (construction, banking, for example), can be corrected if incomes are normalized by creating a sustainable economic mechanism and not by arbitrary increase in prices.

Key words: agriculture, sustainable development, employment, economy

1. Introduction

Placing Romanian society on the principles of a market economy will implicitly lead to the need to address the economic impact of agricultural development and small farms from a new point of view, to capture the complexity induced economic effects of the development process: the creation of jobs, anti-inflationary effects, competition with other sectors of the economy, the influence on the balance of payments, increase revenues through taxes system, the multiplier effect of farm income; the first to benefit directly from such income will be the directly involved in the development process: small farmers and investors.

Efficiency, in its general sense, applies to all social and economic life and can be defined as obtaining the maximum effect with minimum effort. Basically, the effectiveness of

continuous growth is an objective law which acts at all stages of development of society, and is reflected in key relationships, causal, functional in any type of breeding. In this context, the concept of efficiency subsumes all the different concerns of human rights, and the work in agriculture.

2. The place of agriculture in the economy

With 14.8 million hectares of farmland (62.2% of total), Romania is the second largest agricultural producer in Central and Eastern Europe after Poland. Both soil and climate in Romania could lead to an efficient agricultural production. Romanian agriculture has major imbalances due to negative aspects such as the share of agriculture in GDP, the share of agriculture in GVA and the share of agriculture in the agricultural employment.

The analysis of the basic indicators demonstrates a low overall efficiency of the Romanian agriculture in total economy (in 2001, 41% of the working population produced 11.4% of GDP and in 2007, 31.3% of the working population produced 6.8% of GDP). Studying Western developments, these weights should be as close as possible - for example, in France 3.9% of active farmers produce 2.4% of GDP, while in the U.S. 2.4% of the population produces 1.7% of GDP. In Romania, these indicators show a divergent trend: the share of agriculture in GDP has declined in recent years, yet Romania is a European agricultural type country (European Institute of Romania, 2002).

3. Employment in agriculture

The agriculture is the second activity for about 4.3% of the active population. The labor market in Romanian agriculture is defined by:

- a severe decline in real income of rural workers;
- a deceleration in employment compared with urban economy;
- rural household distribution of persons according to the status they occupy;
- the high percentage of pensioners, 23.7% of population
- low share of employers, 0.4% of population (European Institute of Romania, 2007)

More than half of households of pensioners (52.4%) and approximately one quarter of households of employees (23.1%)

are found in rural areas. Household composition vary greatly according to different economic opportunities in each area. The occupational structure defined by a high proportion of pensioners (34.4%), farmers (21.6%) and a very low proportion of employers (0,1%) is typical of a traditional rural society, rural economy (European Institute of Romania, 2007).

Statistical studies in Romania use five categories of households according to the employment status of the household head: employee, employer, farmer, unemployed and retired. The results of these studies reveal that people in households are concentrated in three main groups according to age:

- 34.4% in group up to 25 years
- 36.2% in the 25 – 49
- 19.4% of households are persons 50 years and older
- 10% had household head aged over 50 years (European Institute of Romania, 2007).

Underemployment in rural areas is the most evident consequence and a more serious phenomenon than unemployment. A study shows that 57.0% (Chirca, 2007) of farmers are poor, with poverty rates varying according to regional economic potential.

Although employment in agriculture has increased, the number of employees decreased continuously. This report is the result of land fragmentation and decrease the number of animals. The cash revenue of peasant households is 43.3% of total income and the amount equivalent to consumption of agricultural products from own resources of the household is 56.0%, the share varies according to region, depending on the specific economic and social conditions (Chirca, 2007).

4. Relationship agriculture - economic environment

Although agricultural development is lost in old times and therefore lack of historical information can not set a definite date as to its secondment as a distinct activity, it seems that some early forms of agriculture has been practiced in the more distant times.

The importance of agriculture in the economy and its structure varies from country to country and from one period to another. In developing countries, agriculture may be the most important in terms of contribution to GDP and the employment in this sector, generally as a sector of subsistence rather than part of

a commercial circuit. In these countries, the ties are stronger from agriculture to the macro-economy than vice versa. In contrast, in developed countries, agriculture absorbs less than 20% of the workforce and contributes to GDP with lower rates of 20%, with strong commercial links with the market, where competition is fierce for inputs and international trade in goods, agriculture plays an important role.

Social and economic organization of agriculture in countries with a market economy is based on private property and is the result of systems of government intervention and market forces within the structural adjustment process. (Zahiu, Dachin, 2001).

Agriculture, like any sector of the economy, is in competition with other sectors for inputs, such as labor and capital, provides raw materials for other sectors, ensures compliance with public demand for food and creates a component of national income. Technological advances in recent decades in agricultural products of developed countries, which mostly took place because of public investment in research and development, have helped to reduce the workforce in this sector and to reduce the terms of trade of agricultural product prices and prices of other non-agricultural products. In the long term, increased agricultural productivity contributes to increased national income. Moreover, the variability of agricultural activity associated with climate fluctuations and volatility in agricultural markets have effects on the economic sector as a whole. Many agricultural markets are characterized by a flexible price which is adjusted to meet an agricultural request / offer balance which is quite inelastic. Seasonal changes in farmers' income fall in GDP, often with multiple effects, and agricultural sector development expenditure for intermediate inputs, investment and consumption. In turn, agricultural policies have effects on the economy, for example through financial support in case of drought or flood, compensation, schemes of stabilization or price support (Berca, 2001).

In some countries agriculture contributes substantially to the trade balance, either through the share of agricultural exports in total exports, or through imports. Cumulative effect of seasonal fluctuations and global price developments may cause current account deficits, which in turn can influence the exchange rate of

national currency. The agricultural sector has a major influence on the economic environment, biodiversity and the general welfare. Choice and promotion of measures in the field and inappropriate agricultural area can significantly alter the environment and the availability of resources (land, water, ecosystems) at the expense of future generations.

Agriculture as a branch of national economy has many interdependencies with other sectors and therefore is worth studying more closely its role and macroeconomic interdependences. The contribution of agriculture to economic growth is reflected in three essential elements:

- Contribution to the product, if providing food and raw materials for downstream industries (food, textiles);
- Contribution of the market, reflected the rural population demand for industrial products from upstream industries (particularly agricultural machinery, fertilizers, pesticides, feed and others);
- Contributing factors, namely the transfer of labor and capital in and out of agriculture, the transfer of labor from agriculture to industry accelerates development.

5. European Union and the agriculture

The conversion to the European model of agriculture and the integration of Romanian agricultural sector into European structures need to ensure efficiency, increase competitiveness, consumer safety, environmental protection and natural heritage.

Labor productivity growth in terms of competitiveness and sustainable development aims at raising efficiency of agricultural holdings and private sector operators: both domestic and foreign markets can expand, using the comparative advantage which accrues to Romania for some products, both by traditional agricultural products and by obtaining organic products.

The current problem considered in the development of agriculture, focused on the effective participation in a competitive and evolving market, is to ensure competitiveness of farms, regardless of ownership.

In order to achieve an economic stabilization under conditions and competitiveness of agricultural holdings the following points are important:

● To establish a modern farm with an economically viable size;

● To purchase agricultural machinery (refurbishment);

● To target the activities which can face booming competition;

● To identify favorable markets;

● To follow the completion of optimal relationships between consumption and production and to convert them into specific products, and also between consumption and size of spending in order to ensure low production cost;

● To achieve the maximum profit to provide the increased capacity and credibility of the bank payment. In other words, the holding capacity to cope with an uncertain environment and the efficient cell;

● To develop profit distribution in order to achieve objectives, etc.

The funding, investment credit should apply with priority familial producers, who are united in associations, cooperatives, given the family relationships, work, neighboring land etc. The system can stimulate the formation of agricultural cooperatives in accordance with the recent Law on Agricultural cooperatives adopted by the Chamber of Deputies. This will be an incentive for producers to exploit the land with normal effectiveness.

The farmers can benefit at the same time of production credits of six months to one year, with the same level of interest, and the difference from the interest charged by the banks would be supported by the budget funds as credits investment. The aplication of this system of financing and credit is possible if the holdings Law no. 166/2002 is rewied (the law lays down certain sizes for commercial farming: vegetable sector - 110 ha in the plains and 50 ha in hilly areas and so on, for the animals - 15 cows, 50 head cattle for fattening, etc.) to diminish farms sizes and if the Government Decision no. 734/2002 is revised to remove limitations on state aid and bank loans (the Government Decision establishes that farms can be mix, depending on the nature of the business).

Considering the main objective of Romanian agriculture is the increase of agricultural competitiveness and increase of economic efficiency, a number of sub-objectives are outlined by Giurca and Luca (2007):

● to ensure food security through agro-food sector performance (ensure recovery of the population based on competitive advantages, development units and sectors that have competitive potential and expanding the import of other products);

● to train and expand gradually economic competitive categories;

● to train and develop competitive markets for agricultural and agro-industrial products and inputs;

● development of competitive environment in agriculture

Under the new reform of the CAP, main conditions to be fulfilled for inclusion in the 2007-2013 periods are:

● general economic development, achieving limits on macroeconomic indicators and creation of supporting agriculture;

● specific agricultural policies, trade (including a mix of liberal and statist measures, with clearly defined time horizons) targeting two major objectives:

- food security (meaning the concept in a broader sense, including the European standard quality products at prices that would reduce the share value of the food basket in the total budget to more than 25%);
- production development in the areas of complementarities, the products included in the categories set out in agreements.

● economic, financial and banking measures to boost performance and competitiveness of farms to achieve the objectives of agricultural policy on both levels;

● improvement of the institutional and legal system to be converged with the existing EU countries;

● design of a monitoring system for agricultural policies and their impact on growth and production performance and investigation a system of agriculture with appropriate correlation of upstream and downstream industries (Socol, 2004).

The main conditionality on Romanian agricultural support structures are related to:

- increasing the contribution of agriculture to added value
- formation of new structures and modernization of agricultural farm management

- elimination of practices that lead to inefficient allocation of financial resources and banking measures

6. Conclusions

Human society is aware that the centre of activity for sustainable development must become the concern for agriculture and food production. Today, given the level of knowledge attained by science, there are no alternatives to agricultural products for human consumption. From this perspective, agriculture cannot be replaced by other economic sectors. A notable obstacle in developing the real sector of national economy and, in particular in the agricultural sector is the poor quality of business environment and economic climate. The main aims of current economic activity, namely: the development of commercial agriculture, increased production and productivity per hectare, creation of a viable mechanism that would ensure improvement of the price policy, credit and taxation, which would allow system manufacturers to implement sustainable technologies have been achieved only partially. It is a historical feature of understanding of our agricultural problems, regardless of social system or form of government, creating a resulting misunderstanding of agricultural phenomenon.

If until now studies on the sustainable development of Romanian agriculture all deal with economic aspects, it is imperative for the future to include the socio-cultural assessment of the population and the environmental aspects of sustainable development.

Both realities, the European and the Romanian one, show that the local / regional development is directly subject to the completion of projects of local interest, administered locally by individuals, entrepreneurs, local / regional bodies, who know best the problems and the possibilities. Furthermore, without direct involvement and without support of local authorities it is hard to speak of a local development.

Finally, a plan remains only a theoretical scheme if it is not based on real targets, supported and promoted by factors such as decision-making, if it doesn't use locally available resources and if effort and results are not known and recognized at different levels and by the concerned target groups.

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AGRI-ENVIRONMENT MEASURES IN ROMANIA

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Abstract. Agri-environment measures are designed to encourage farmers to protect and enhance the environment on their farmland. A number of countries have experienced agri-environment measures targeting the reduction of negative externalities. In Romania agri-environmental instruments are part of National Rural Development Programme for 2007-2013. The paper describes and analyses the measures package for agri-environment projects payments.

Key words: agri-environmental measures, payments, requirements

1. Agri -environment measures in European Union

Agri-environment measures began in a few Member States in the 1980s on their own initiative, and was taken up by the European Community in 1985 in Article 19 of the Agricultural Structures Regulation, but remained optional for Member States. In 1992 it was introduced for all Member States as an "accompanying measure" to the Common Agricultural Policy (CAP) reform. It became the subject of a dedicated Regulation, and Member States were required to introduce agri-environment measures "throughout their territory". In 1999, the provisions of the Agri-environment Regulation were incorporated into the Rural Development Regulation as part of the "Agenda 2000" CAP reform.

A number of countries have experienced agri-environment measures targeting the reduction of negative externalities. Agri-environmental instruments are needed to support the sustainable development of rural areas and to respond to society's increasing demand for environmental services. Agri-environment measures provide for payments to farmers in return for a service, that of carrying out agri-environmental commitments that involve more

than the application of usual good farming practice (Helming, 2010).

Agri-environment payments are co-financed by the EU and the Member States with a contribution from the Community budget of 85 % in Objective 1 areas and 60 % in others. Agri-environment measures may be designed at national, regional or local level so that they can be adapted to the particular farming systems and environmental conditions, which vary greatly throughout the EU.

Agri-environmental measures are diverse; each measure has at least one of two broad objectives: reducing environmental risks associated with modern farming on the one hand, and preserving nature and cultivated landscapes on the other hand.

How these two objectives are expressed in measures depends on the area in question. For instance, in areas with intensive agricultural production measures are often focused on reducing environmental risks (e.g. reducing fertilizer or pesticide inputs, planting winter cover to reduce nitrate leaching etc), but there may also be measures designed to protect nature (e.g. the leaving of winter stubbles in intensive arable areas to provide food for birds). By contrast, in more extensive farming areas, the main environmental risk is generally linked to land abandonment, resulting from the abandonment of labor-intensive traditional farming practices important for the preservation of nature. In such areas measures tend to focus on continuing or re-introducing traditional farming practices with a view to nature protection (e.g. mowing grass rather than grazing it; maintaining hedgerows, etc). But in extensive areas there may also be measures designed to reduce environmental risks e.g. limits on fertilizer applications to grassland. Irrespective of area, there are clearly many measures which will have positive impacts both in reducing environmental risks with respect to soil and water and in protecting nature e.g. maintenance of hedges.

A report of EC (2005) concluded key features of agri-environment measures:

- The flexibility of agri-environment measures enables them to meet certain environmental needs which cannot be met by other means. The great diversity of implementation shows that they are able to respond to very diverse situations on the ground.

- A regional/local level for measure design makes it easier to meet environmental needs with precision. Member States can introduce agri-environment schemes at the appropriate level, and ensure that they are responsive to local conditions.
- The optional, contractual nature of agri-environment measures makes it an instrument with a high level of acceptance among farmers, and a correspondingly high level of compliance.
- Agri-environment measures serve an educational role in that its existence improves environmental awareness among farmers; they can also help to maintain/regain acceptance for farming among the general public.
- The compulsory nature of agri-environment has helped to ensure a wide application of agri-environment measures throughout the Community. This will also be important in coming years in new Member States which have no tradition of agri-environment, and limited resources with competing demands.
- Agri-environment payments can yield good results in combination with Less Favoured Area payments in particular with respect to fight land abandonment and marginalisation, which is usually environmentally damaging.
- Agri-environmental measures are not meant to solve pollution problems that are normally subject to mandatory standards.

Implications for a successful application of agri-environment measures:

- Agri-environment programmes are demanding as regards the establishment of administrative structures that are suited to managing the complexity of the programme and communicating requirements clearly to farmers.
- Because agri-environment measures are very diverse, and because the monitoring of certain environmental effects is intrinsically complex, monitoring and evaluation of agri-environmental measures require a structured and long-term approach.
- More work could usefully be done on the efficiency of measures, including an analysis of best practices. New approaches might be explored aimed at achieving better value for money (e.g. differentiating payment levels; tender procedures for the delivery of environmental services).

- In the case of national agri-environmental programmes, proper consultation of regional and local actors and stakeholders is important during programme design and implementation, as well as flexibility in the application of national programmes to local conditions.
- With a view to reinforcing a more strategic approach towards agri-environmental measures, a clearer definition of environmental objectives in programmes is essential.
- Problems were identified in certain new Member States where fragmented land ownership and short-term rental contracts are excluding many farmers from participating in agri-environmental schemes.
- Providing agri-environment services can serve as an interesting income opportunity for farmers engaged in this field.

2. Agri-environmental measures in Romania

Agri-environment measures are part of the National Rural Development Program (NRDP) which represents a continuation of the program SAPARD address to the modernization and restructuring of agro-food sector, compared with that program, NRDP is a program that provides more opportunities (MADR, 2010). Firstly, the funds allocated to rural development sector are higher forms of support and are more diverse and there are several categories of beneficiaries.

In Romania, the payments granted under the agri-environment measures encourage farmers to serve society as a whole by introducing or continuing to apply agricultural production methods compatible with the protection and improvement of the environment, in particular biodiversity, landscape and its features, natural resources and genetic diversity.

Agri-environment payments are granted to farmers who voluntarily undertake agri-environment commitments for a period of 5 years from the date of taking the commitment. Agri-environment payments cover only those commitments which go beyond the minimum requirements outlined below which are providing the unpaid reference level considered as the starting point of the drawing up of agri-environment compensation payments (MADR, 2012).

Romania has included measures in its rural development sub-measure package for agri-environment projects payments

- Package 1 „High Nature Value Grassland"

Romania holds one of the most valuable resources of semi-natural grasslands still to be found in Europe, grasslands that can be classified as High Nature Value grassland. Research carried on the Romanian grassland systems shows that these are presenting high botanical diversity. This diversity is associated with remarkable geomorphologic characteristics and a suite of rare plant species of a contrasting ecology, maintained during centuries by the traditional farming systems as part of what can be described as a sustainable system of land use.

Although the concept of High Natural Value (HNV) farming is not yet fully developed it can be considered that many HNV farming systems are present in Romania. A minimum of 3.32 million hectares of Romania's agricultural land can be classified as area where it is most likely that HNV systems are present.

An important threat is the intensification of farming in these areas, implying a possible conversion of HNV grasslands into arable land or intensively used grasslands. Some changes of farming patterns are already pointing this threat and the most visible indicator is the increase of mechanized works on grasslands. Average chemical fertilization levels are low but are expected to notably increase until 2011 hand in hand with the overall aimed increase of farming efficiency. Such increase of chemical fertilization levels would be implicitly associated with an overall decrease of botanical diversity of semi-natural grasslands and habitat loss respectively, as it is demonstrated by many international researchers.

The overall environmental challenge is to preserve this rich grassland resource facing the forthcoming socio-economic changes that will impact rural areas in the future. For achieving this it is important to sufficiently support the extensive farming practices on semi-natural grasslands in order to face the competition with more intensive farming systems, and in a wider context with other economical activities that are aggressively and market driven emerging.

- Package 2 „Traditional Farming"

Only farmers that adopted package 1 can apply for this package 2. The objective is to maintain wildlife by applying traditional farming practices, target for 2013 is 375,000 hectares.

- Package 3 „Grassland Supporting Important Birds"

This package aims to facilitate the accumulation of experience in this field due to the fact that Romania never before promoted such highly targeted agri-environmental schemes. At the same time, it is a useful exercise for the forthcoming implementation of the Natura 2000 payments. The species that are selected are *Crex crex*, *Lanius minor* and *Falco vespertinus.* These species are present in high numbers in Romania while in other areas in Europe are declining or disappeared. Romania holds approximately 97% of the European population of Lanius minor (Lesser Grey Shrike), approximately 50% of the European population of Falco vespertinus (Red-footed Falcon) and approximately 27% of the European population of Crex crex (Corncrake)

- Package 4 „Green Cover Crops" is available for arable land across Romania.

Soil erosion, especially through water, is a widespread phenomenon across Romania, which implication on the long term is the reduction of farm viability and environmental damage. The recent introduction of the Good Agricultural and Environmental Conditions (GAEC) relevant for soil erosion mitigation represents a good step towards achieving this aim, but at the same time there is a need to encourage all farmers to go beyond GAEC by adopting agri-environment practices which are ensuring a higher level of soil and water protection. Since the risk of erosion is increased greatly by the long periods when the soil has no crop cover, one of the simplest soil conservation measures is to encourage the use of appropriate "green cover crops". "Green cover crops" are planted immediately after harvest and protect the soil with a cover of green vegetation during the winter period.

This soil and water conservation package will be available in all areas of Romania and also has an important potential to reduce the risk of nutrient losses, especially nitrate leaching, during the winter period. The measure can therefore help to contribute achieving the good ecological and chemical status of all waters in accordance with the EC Water Framework Directive.

Agri-environment payments are provided as part of the measures if the farmer:

- Uses a farming area in Romania, identifiable in the Integrated System of Administration and Control, covering a minimum area of 1 hectare, and the eligible lots on this area are at least 0.3 hectare each;
- Undertakes to maintain the agri-environment commitment(s) for at least 5 years from the date of taking the commitment;
- Undertakes to observe the relevant minimum baseline requirements all over the agricultural holding area;
- Undertakes to observe the specific requirements of the agri-environment package(s) for which he/she applies.
- Undertakes to keep an evidence of farming activities connected to the agri-environment commitment(s) for which he/she applies
- Declares that he/she did not used chemical fertilizers and/or pesticides in the last five years on the parcels where he/she intends to apply package 1 “High Nature Value Grassland”. Where farmer is using those parcels from less than five years the declaration will be applicable only for the past period when the farmer used those parcels.

Romania also has included in National Development Programms 2 measures aimed at LFA: Measure “Support for mountain areas” and Measure “Support for less favored areas-other than mountain area”. On the long term, LFA support alone will not have the capacity to ensure HNV farming survival, but it has an important contribution.

3. Conclusions

In Romania, the practical experience of agri-environmental measures, both at the administrative level and local level, namely at the farm level, in line with the CAP will speed up the process of legislative harmonization. The Ministry of Agriculture and Rural Development prepared the legal context for the implementation of agri-environmental measures, and approved major elements of legislation in this field. Support for agricultural production measures to protect the environment and maintain specific areas will contribute to the multiplication of actions to achieve objectives consistent with community policies on environment.

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INTEGRATED WHEAT PESTS CONTROL IN RELATION WITH AGRO-ECOLOGICAL CHANGES AND AGRICULTURE SUSTAINABLE DEVELOPMENT

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Abstract. The paper was eaborated between 2007-2011, at Agricultural Research Station Turda and presents the research on the increase of main wheat pests abundance and the extension risk of pests attack on the agro-ecological changes in Transylvania. Entomological study has been carried out under different cultural soil technologies: classical (by plowing) and conservative (by minimum soil tillage and no tillage), in open field agroecosystems with antierosional terraces and in agroforestry belts farming system. The spring months of the last years were characterized by an increased warming and dryness periods, causing pest abundance and damages growth on wheat. Major outbreaks of thrips attack were pointed out (*Haplothrips tritici)*; wheat flies *(Chloropidae: Oscinella frit, Meromyza nigriventris, Elachiptera cornuta etc.* and *Anthomyidae: Delia coarctata, Phorbia securis, Ph. penicillifera);* stem flea beetles *(Chaetocnema aridula);* bugs *(Eurygaster maura, Aelia acuminata),* leafhoppers (*Javesella pellucida, Psammotettix alienus, Macrosteles laevis*), aphids (*Sitobion avenae, Schizaphis graminum, Rhopalosiphum padi, Metopolophium dirhodum*) etc. The research results proved the importance of integrated pests control and insecticide applications in two different moments: end of tillering phase and spike appearance, in open field with classical soil technology. Also, the integrated pests management (IPM) is a major section of soil no tillage technologies comprising a special pest control strategy, with insecticides application in 2-3 succesive treatments, entomophagous

conservation and use, environmental protection. The IPM research points out the efficiency of biological control (in the farming system with protective agro-forestry belts – favorable for the development of useful fauna), only using the entomophagous natural resources, without insecticides application.

Keywords: wheat pests, entomophagous, integrated pest control, soil technology, agroforestry belts.

1. Introduction

Agricultural entomology and applied ecology researches conducted at the Agricultural Research and Development Station in Turda (ARDS Turda), in Central Transylvania, have aimed to the elaboration of wheat integrated pest control strategy, especially under the conditions of profound agro-ecological changes caused by climate warming and also taking into consideration the new technological and economical conditions in regional agricultural exploitations (Figure 1). During the last years, the increase of pest damages was registered at the wheat crops affected intensely by climatic unfavorable conditions and by the exploitation system with incomplete or incorrect crop technologies (Malschi 2007, 2008, 2009). The study performed during 1980-2010 has shown the evolution of main cereal pests such as: Diptera, Homoptera, Thysanoptera, Coleoptera etc (Figure 2), as well as the importance of integrated pest control strategies (Malschi et al 2011).

Integrated pest management (IPM) is an agro-ecological system approach for crop protection that uses different practices to control the pest and to minimize the pesticide applications (Food and Agriculture Organisation-FAO). IPM is an environmental approach and an economical mean of pest management, comprising: the environmental and ecological factors involved in pest behaviour, the knowledge on pest lifecycles and their interaction with the environment, biological and chemical pest control methods (Baicu 1996, Bărbulescu et al 2001, Malschi Dana 2009, Malschi et al 2011, Popov et al 2009, Wetzel 1995). IPM is practiced using the following steps:

1. Weather forecasting to evaluate the risk of pest outbreaks.

2. Understanding the pests population and their habitual behaviour, using the pest trapping to analyse the stage of lifecycle and population density; monitoring to spot damaged crops, dynamics and attack level of pest populations; determining the thresholds of economical damage (TED) which refers to the population of pests that can exist on the field without causing an economical damage, considering that the total eradication of pest is not healthy for the environment.
3. Culture control methods: soil preparation, using certified healthy seeds–genetically resistant and tolerant varieties.
4. Biological controls: entomophagous predators and parasites, biological products and natural resources used to control or to limit the pest population.
5. Chemical controls: using pesticides to the pest control, only recommended if the biological methods fail and the threshold limit has been surpassed.
6. Record keeping: used to predict the attack and future investments (Food and Agriculture Organisation/FAO, www.fao.org/agriculture/crops/core-themes/theme/pests/ipm/)

Common Agricultural Policy, specifying the importance of providing environmental public goods associated with agriculture, mentions the food security, health security, rural vitality and a significant range of public goods also associated with agricultural practices and environment - such as agricultural landscapes, farmland biodiversity, soil, water and air quality, climate stability (greenhouse gas emissions), climate stability (carbon storage), farming practices in order to maintain landscape features and specific habitats, to manage natural resources of water and soils. Special public goods are associated with agriculture practices of integrated crops and pest management - such as the positive impact of integrated pests control technologies, biological pest control, conservation and use of biodiversity of beneficial entomophagous fauna and useful flora, biological agriculture, related to pollution limitation and sustainable development of environmental factors quality; the positive impact of using technological conservative systems with minimum soil tillage and no tillage, particularly in water stressed areas, etc., related to climate stability (gas emissions, carbon management and storage), (Cooper et al 2009; http://europedirect.nord-vest.ro/detaliu).

A B

Figure 1. Aspects of culture techology in ARDS Turda fields by comparison with incorrect farming systems in a zone of little crop fields
A. Applied IPM on the agroecosystems in open field with land arranged in antierrosion terraces, with classic and conservative no tillage soil technology.
B. Applied IPM on the farm with protective agro-forestry belts, in Cean-Bolduţ.
Source: Google earth images, 2009

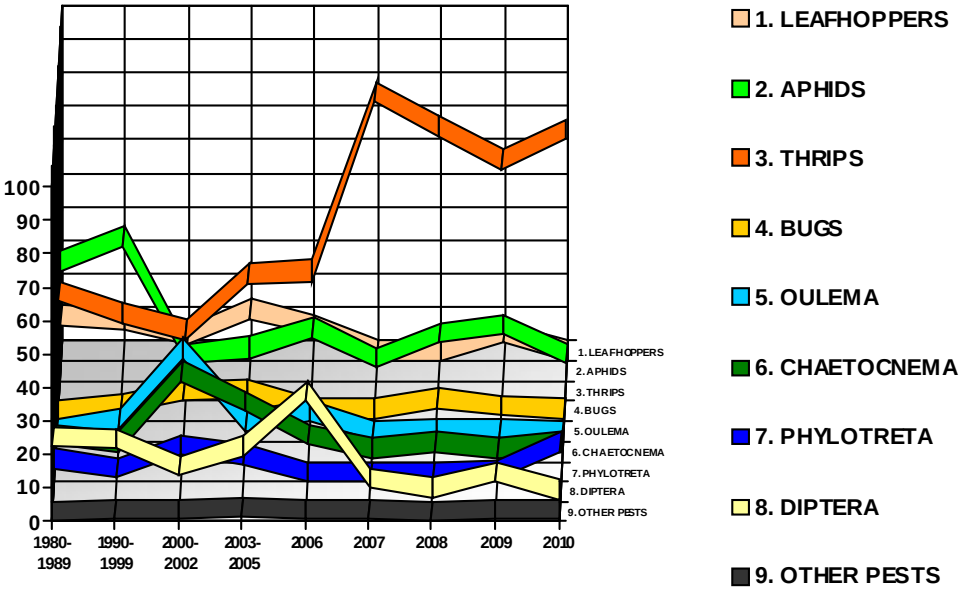

Figure 2. Dynamics of wheat pests structure (%), at ARDS Turda, in 1980-2010
Source: Malschi et al 2011

2. Research methodology

Based on authors' 30 year research studies at the Agricultural Research-Developement Station Turda of The Romanian Academy of Agriculture and Forestry Sciences, the paper presents an agro-ecological study on the population dynamics and attack evolution of wheat pests and the adequate integrated pest control methods under different cultural soil technologies: classical (by plowing) and conservative (by minimum soil tillage and no tillage), in open field agricultural system with antierosional terraces (Figure 3) and in agroforestry belts farming system.

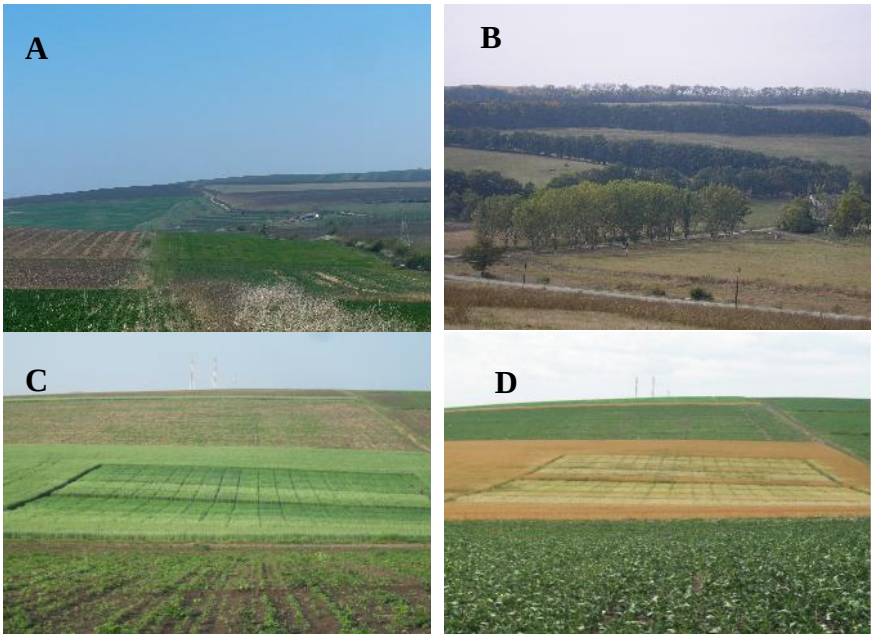

Figure 3. A. Aspects of classic (plowing) and conservative (no tillage) soil technology, in ARDS Turda fields with land arranged in antierrosional terraces; B. Aspects of the farming system with protective agroforestry belts in Cean-Bolduţ; C and D. Aspects of IPM experimental field by no tillage technology, in open area, of ARDS Turda

Source: authors' photos (A: Dana Malschi, B: Tritean, Serbanescu, C-D: Adina Ivas)

The research objectives have comprised aspects of interest such as:

- The systematic and bio-ecological study of pest species;
- The danger of attack expansion observed in increasing quotas and affecting wheat crop yields in accordance with the agro-ecological conditions;
- Testing the adequate methods of integrated pest management, which comprise preventive and modern pest control methods based on good efficiency, showing reduced side effects and a diminished negative impact on useful entomophagous fauna and environment;
- Elaboration of agro-ecologically integrated pest control strategy by researches of attack diminishing methods in accordance with technological factors such as: selective, efficient insecticides, agro-technical methods; biotic factors: natural entomophages, tolerant varieties; and environment protection factors.

During 2007-2011, the study has revealed data on species composition, damage levels and experimental field tests regarding integrated pest control, in wheat crops. Species determination has been achieved based on the abundant samples collected, performed every 10 days. The analyzed samples have been obtained by the method of complex traps, including pitfall soil recipients (the Barber traps for the epigeous arthropod fauna) and captures in 100 double sweep-net catches, for the arthropod fauna at the plant level. The structure and dynamics of the pest species populations interacting with predatory arthropod fauna have been studied in wheat crops.

3. Results and discussions

In order to optimize the environment-agriculture-sustainable development relationship, scientific and technological knowledge regarding the modernization of pest control management needs complex research approaches in a systemic, agro-ecologically integrated manner (Malschi 2007, 2008, 2009).

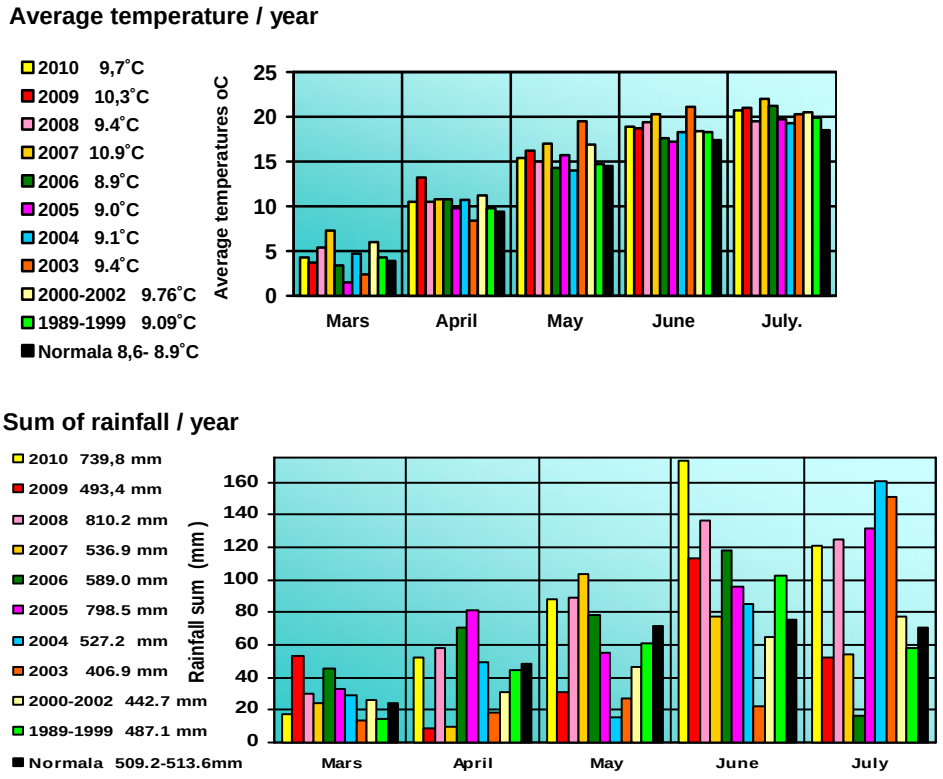

Figure 4. Average temperatures and sum of rainfall at Turda conditions by month, from March to July and by year, in 1989-2010.
Source: authors' interpretations

The changes in the level of regional climate, represented by warming and excessive draught, ample alternation of temperatures and the presence of extremely warm periods especially in spring (Figure 4), have caused the burst of pest populations which may cause unexpectedly important damages to wheat crops. It was pointed out major outbreaks of attack of thrips (*Haplothrips tritici)*; wheat flies *(Chloropidae: Oscinella frit, Meromyza nigriventris, Elachiptera cornuta etc.* and *Anthomyidae: Delia coarctata, Phorbia securis, Ph. penicillifera);* stem flea beetles *(Chaetocnema aridula);* bugs *(Eurygaster maura, Aelia acuminata),* leafhoppers (*Javesella pellucida, Psammotettix alienus, Macrosteles laevis*), aphids (*Sitobion avenae, Schizaphis graminum, Rhopalosiphum padi, Metopolophium dirhodum*) etc.

During 2007-2011, at the ARDS Turda, studies have been conducted on the wheat pests such as diptera, aphids, leafhoppers, thrips, bugs, cereal leaf beetles etc, the levels of attack and the present integrated pest control strategy as part of the agro-ecological technological system of the sustainable development of wheat in Transylvania (Tables 1 and 2).

Table 1. Dynamics of wheat pests structure (%) in 1980-2010, at ARDS Turda

Wheat pests	1980-1989	1990-1999	2000-2005	2006-2010
Wheat Thrips (*Haplothrips tritici)*	30,0	23,3	26,8	69,0
Cereal Aphids (*Sitobion avenae* etc.)	32,5	40,4	6,1	9,4
Wheat Leafhoppers (*Psammotettix alienus* etc.)	10,5	9,4	8,8	3,6
Cereal Flies *(Chloropidae, Anthomyiidae* etc.)	16,5	16,0	10,6	8,4
Wheat Fleas *(Chaetocnema, Phylotreta)*	9,0	4,1	26,0	4,5
Cereal Leaf Beetle (*Oulema)*	1,0	4,0	14,1	2,0
Cereal Bugs, sunn pest (*Eurygaster, Aelia)*	0,2	2,3	6,2	2,0
European Wheat Stem Sawfly *(Cephus pygmaeus) etc.*	0,3	0,7	1,2	0,8

Source: Malschi et al 2011

Pests	Attack level	Classic technology, by plowing, Turda 2000-2005	Conservative no tillage technology, Turda 2006-2010	Technology with agro-forestry belts, Cean-Bolduţ 2000-2010
Wheat Thrips	**adults/ear**	11	10,0	4
	larvae/ear	14	18,3	4
Aphids	**aphids/ear**	21	3,7	2
Cereal flies	**deadheart tillers**	46 %	40,1 %	9 %
Cereal bugs	**bugs/m^2**	5	2,0	0,5

Source: Malschi et al 2011

A decrease in the species range and an increase of the population abundance have been recorded in the problematic

pests, especially in the monovoltin species or favored by monoculture single crops and regional cereal agroecosystems presence (*Haplothrips tritici* (Figure 5), *Delia coarctata, Opomyza florum, Phorbia penicillifera, Oulema melanopus* and *Chaetocnema aridula* (Figure 9), *Eurygaster maura and Aelia acuminate (Figure 10), Zabrus tenebrioides* and others, or aphids (Figure 6) and leafhoppers (Figure 7), or polivoltine diptera species (Figure 8) of Chloropidae - *Oscinella frit, Elachiptera cornuta, Meromyza nigriventris etc.* and Anthomyiidae - *Phorbia securis, Delia platura* and others). Due to aridization and climate warming, the critical attack moments of different species have been recorded 3-4 weeks earlier than normally, and overlapped (Table 3).

Table 3. Aparition and dynamics of main pests of wheat (ARDS Turda, 2011) (no/100 sweepnet catches)

Classic technologal system (by plowing)									
	20.04	**21.04**	**28.04**	**11.05**	**18.05**	**27.05**	**1.06**	**6.06**	**15.06**
Thrips			6	230	29	85	15	7	10
Aphids		3			1	6	34	37	9
Leafhoppers	4	1	10	3	1	10	1	12	5
Cereal flies	2	5	7	7	3	10			3
Wheat fleas	3	3	4						1
Leaf beetle	2	3	5						
Conservative no tillage soil technology									
	20.04	**21.04**	**28.04**	**11.05**	**18.05**	**27.05**	**1.06**	**6.06**	**15.06**
Thrips			3	150	34	67	25	6	9
Aphids	3			3		16	24	24	21
Leafhoppers	9	4		6	1	18		5	1
Cereal flies	6	5	6	8	13	10	1	3	3
Wheat fleas	1		5						
Leaf Beetle			7		6				

Source: authors' data

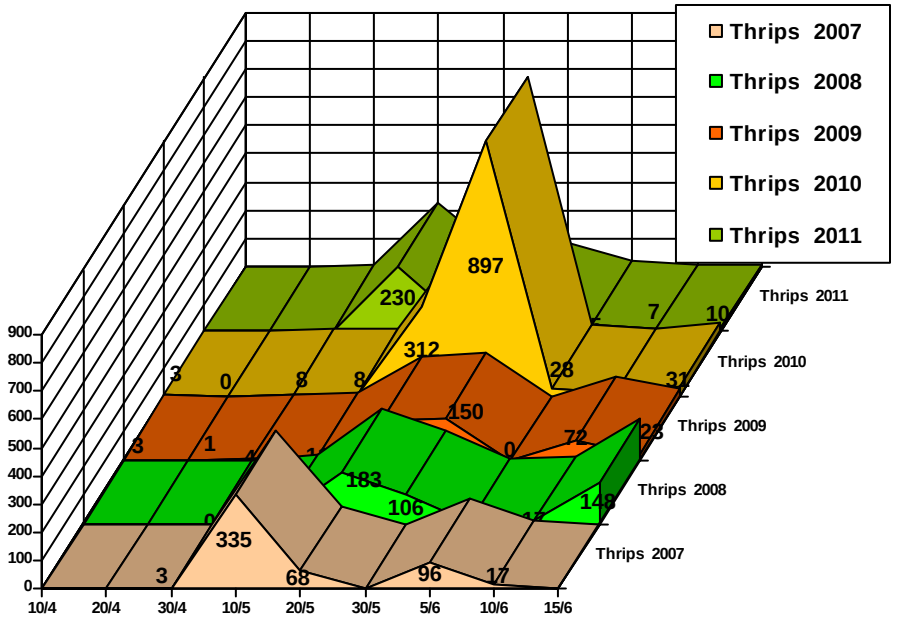

Figure 5. Dynamics of wheat thrips (No/100 sweep net catches)
Source: authors' data, original interpretation

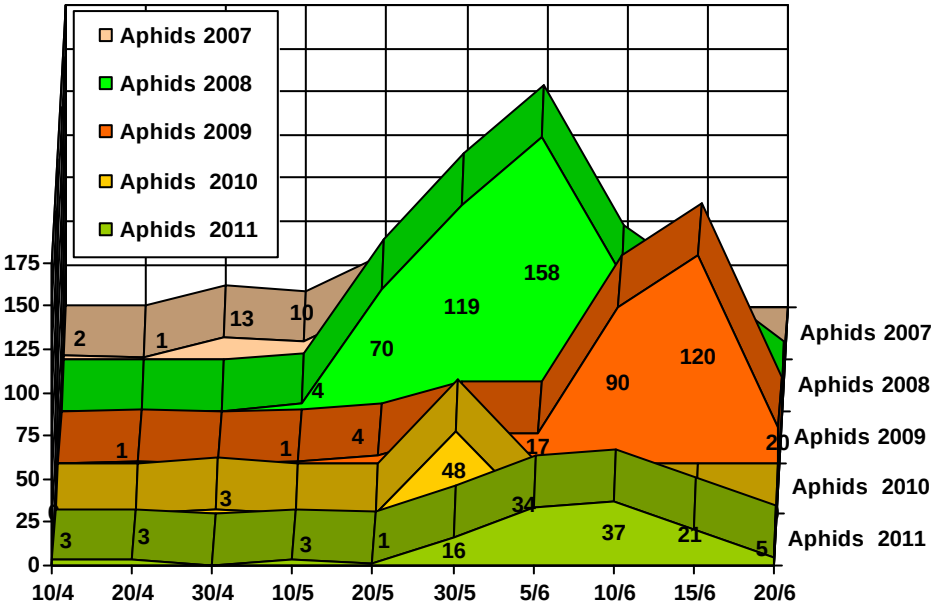

Figure 6. Dynamics of wheat aphids (No/100 sweep net catches)
Source: authors' data, original interpretation

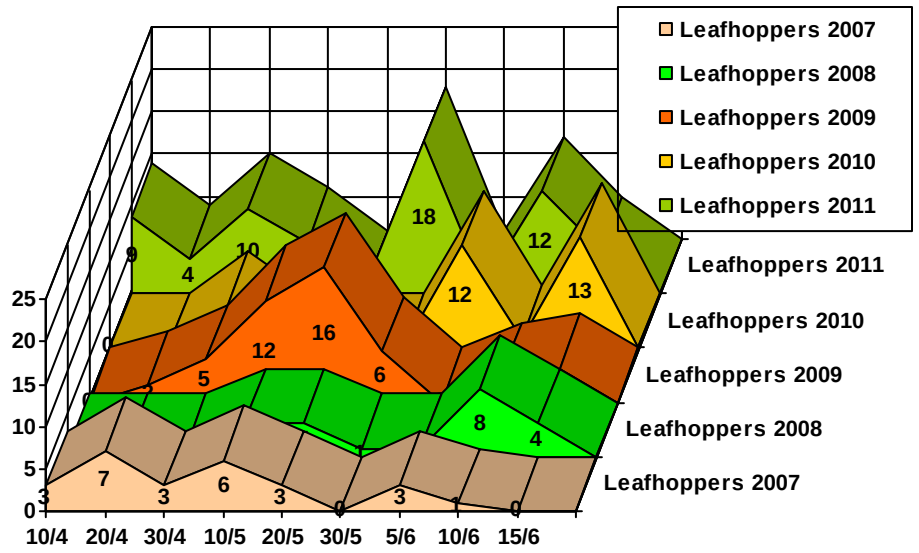

Figure 7. Dynamics of wheat leafhoppers (No/100 sweep net catches)
Source: authors' data, original interpretation

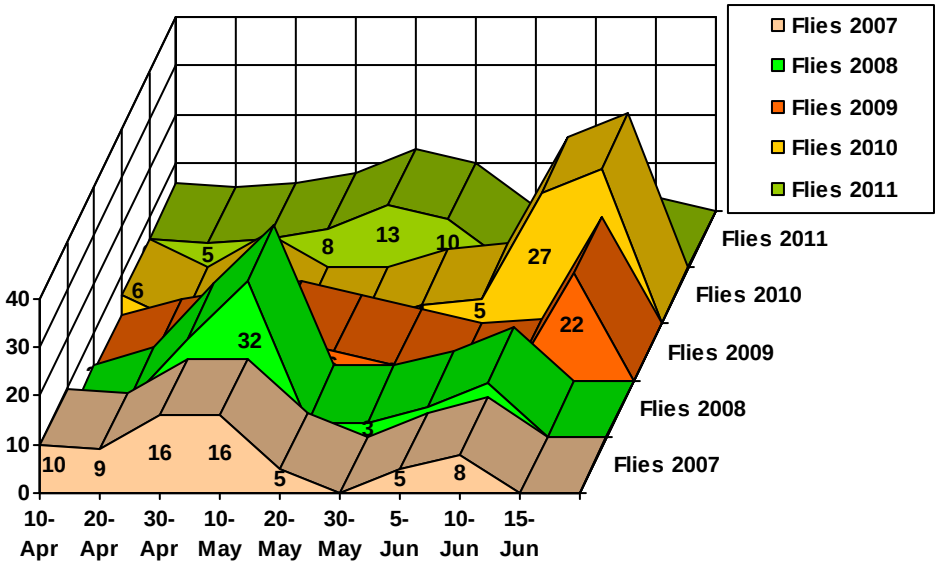

Figure 8. Dynamics of wheat flies (No/100 sweep net catches)
Source: authors' data, original interpretation

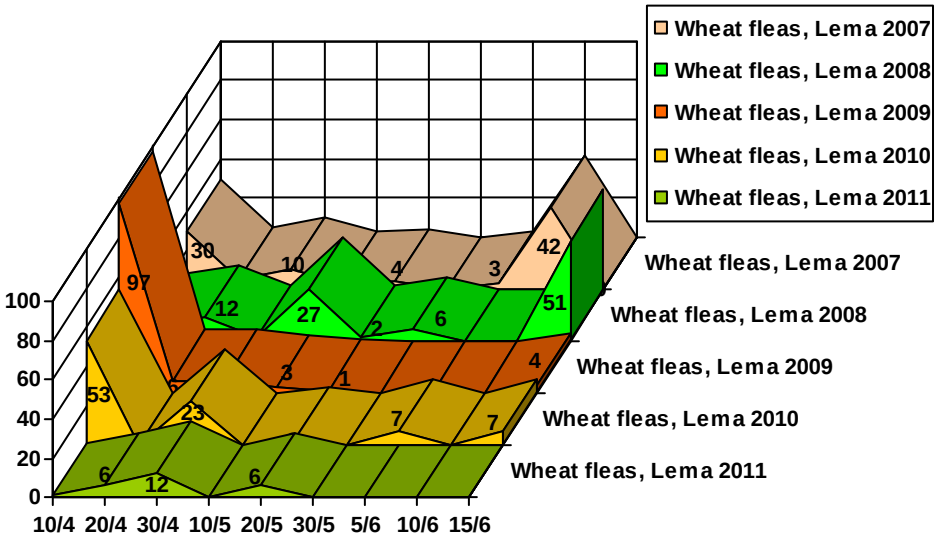

Figure 9. Dynamics of wheat fleas and leaf beetles (No/100 sweep net catches
Source: authors' data, original interpretation

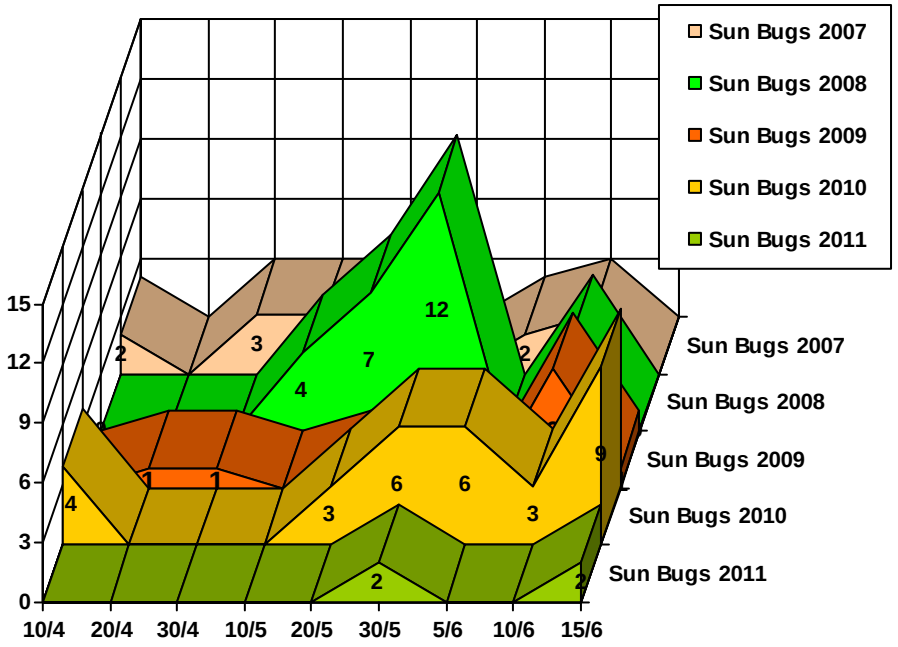

Figure 10. Dynamics of wheat bugs (No/100 sweep net catches
Source: authors' data, original interpretation

In the structure of entomofauna of winter wheat crops in open field agricultural system the pest achieved 79% and the entomophagous – 21 %. *Haplothrips tritici* – reached 73,5%; flies: 7%; aphids: 8,2%; leafhoppers 4,3%, in the pest structure, showing an important attack potential (Table 4).

An entomocenotic balance was maintained in Cean Bolduţ agroforestry belts farming system. The wheat pests had a structural share of 67% and the entomophagous achieved 33% on the favorable conditions due to the forestry belts. Thrips showed 30% only and flies 27,8%, aphids 24%, leafhoppers 3,9% in the pest structure (Table 4).

Haplothrips tritici is the most abondant and important pest of wheat in classical (by plowing) and conservative (by minimum soil tillage and no tillage) technologies.

Comparative research on the abundance and structure of wheat pests in classical and conservative soil technologies proved a greater abundance and importance of the populations of flies, aphids, leafhoppers, wireworms in conservative no tillage technology, in open field agricultural system (Table 5).

Table 4. Abundance and structure of pests and entomophages in wheat crops in open field agroecosystem in Turda and in the farming system with forestry belts in Cean–Bolduţ, ARDS Turda 2009-2011 (No / 100 sweepnet catches)

	Agroecosystem in open field area, Turda				**Agroecosystem with protective forestry belts, Cean-Bolduţ**			
	2010		**2011**		**2010**		**2011**	
Phytophagous	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
Thrips (*Haplothrips tritici)*	1257	84.00	756	73,5	134	25.0	129	30,0
Diptera (*Meromyza)*	4	0.30	10	1,0	17	3.0	11	2,5
Diptera *(Oscinella etc.)*	38	3.00	52	5,1	184	34.0	91	21,3
Diptera *(Delia, Phorbia)*	7	0.45	9	0,9	5	1.0	16	4,0
Col. *Oulema melanopus*	2	0.13	8	0,8	6	1.1	20	5,0

Col. ***Chaetocnema aridula***	24	3.00	26	2,5	46	8.0	18	4,2
Col. ***Phyllotreta vitulla***	55	4.00	3	0,3	11	2.0	4	1,0
Aphids(*Sitobion etc.)*	51	3.40	84	8,2	23	4.0	104	24,0
Leafhoppers (*Macrosteles*)	12	1.00	25	2,4	21	4.0	12	3,0
Leafhoppers (*Psammottetix*)	4	0.30	17	1,5	17	3.0	1	0,2
Leafhoppers (*Javesella*)	3	0.20	4	0,4			3	0,7
Bugs ***(Eurygaster, Aelia)***	12	1.00	11	1,1	46	8.0	3	0,7
Het. ***(Trygonothylus)***	5	0.32	14	1,4	26	5.0	9	2,0
Hym. ***Cephus, Trachelus***	-				4	1.0		
Orthoptera	3	0.20	2	0,2	3	0.5	3	0,7
Wireworms (*Agriotes) etc.*	10	0.70	7	0,7	2	0,4	3	0,7
Entomophagous								
Coccinellidae ***(Coccinella, etc.)***	11	5.5	9	3,4	4	2,0	2	1,0
Malachiidae ***(Malachius bipust.)***	1	0.5	6	2,3	1	1. 0	2	1,0
Nabidae ***(Nabis ferus)***	5	5.0	10	3,6	17	8.5	13	6,0
Staphylinidae (*Tachyporus hypn.)*	4	2.0	1	0,4				
Chrysopidae ***(Chrysopa carnea)***	1	0.5	3	1,1	5	3.0	3	1,5
Syrphidae ***(Episyrphus, etc.)***	10	5.0	34	13,0	4	2.0	16	7,5
Empididae (*Platypalpus)*	8	4.0	27	10,1	15	8.0	15	7,0
Chloropidae	4	2.0	3	1,1	4	2.0	29	14,0

(Thaumatomyia)								
Hymenoptera *dif. parasites*	4	2.0	72	27,0	38	19.5	60	28,5
Hym. *Formicidae*	2	1.0			8	4.0	1	0,5
Aranea	56	26.2	101	38,0	95	50.0	72	34,0
Culicidae	95	46.3						
Phytophagouss Total	**1487**	**88 %**	**1028**	**79 %**	**545**	**74 %**	**427**	**67 %**
Entomophagous Total	**201**	**12 %**	**266**	**21 %**	**191**	**26 %**	**213**	**33 %**
Total no	**1688**		**1294**		**731**		**640**	

Source: authors' data

Table 5. Dynamics of abundance and structure of pests and entomophages in wheat crops, in two soil technologies, in open field agricultural system: classic system (by plowing) and conservative no tillage system, at ARDS Turda, 2009-2011

	Abundance (no./100 sweepnet catches)						**Structure (%)**					
	Classic			**Conservative**			**Classic**			**Conservative**		
	2009	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**
Thrips	874	1896	384	802	970	294	67.4	85.50	64,2	69.0	78.0	54,4
Aphids	106	66	90	162	67	91	8.2	3.00	15,0	14.0	5.0	17,0
Leafhoppers	70	13	47	64	4	61	5.4	0.63	7,8	5.5	0.3	11,3
Cereal flies	82	20	38	68	36	55	6.3	0.92	6,5	5.8	0.9	10,1
Fleas and Leaf beetles	48	201	26	30	149	19	3.7	9.13	4,3	2.6	12.2	3,5
Cereal bugs	98	12	3	24	7	4	7.5	0.54	0,5	2.1	1.0	0,7
Wireworms etc.	18	6	10	12	8	16	1.5	0.28	1,7	1,0	0.62	3,0
Phytophages	**1296**	**2214**	**598**	**1162**	**1241**	**540**	**82.7**	**93.00**	**68,7**	**81.6**	**90.0**	**74,0**
Entomophages	**272**	**165**	**272**	**262**	**140**	**189**	**17.3**	**7.0**	**31,3**	**18.4**	**10.0**	**26,0**
Total no.	**1568**	**2379**	**870**	**1424**	**1381**	**729**						

Source: authors' data

In order to provide a sustainable developement of winter wheat crop under the present conditions that are marked by the increase of pest abundance and attack, based on the accumulation of the effects of the unfavorable agro-ecological and technological factors in the agricultural exploitations, the adequate prevention and control measures have been required.

4. Testing the efficiency of the integrated pest control methods

Testing has been carried out under different technological crop systems in open field area with antierosional terraces: classical system and conservative system (soil minimum tillage and no tillage) - protective against drought, and in the agroforestry belts farming system. Within the testing experiements of economically and ecologically efficient insecticides, optimal application time in an integrated technological system has been studied, including herbicides, fungicides and complex treatments for other wheat pest control, fertilizers applications etc (Table 6).

Table 6. Average effect of conservative system, in wheat (Arieşan variety) ARDS Turda, 2008, 2009, 2010

Tillages	**Classic system by plowing**			**Conservative system no tillage**			**% Impact of no tillage technology**
Complex treatments	**Grain production (kg/ha)**			**Grain production (kg/ha)**			
Insecticedes application moments	**Average**	**%**	**Dif.**	**Average**	**%**	**Dif.**	
C1(T1+…+T3+T4)	4155	100.0	+0	4358	100.0	+0	104.9
C2 (...+T2+T3+...)	4046	97.4	-110	4419	101.4	+61	109.2
C3 (...+T2+T3+T4)	3883	93.5	-272	4250	97.5	-108	109.5
C4 (...+T2+…+T4)	4059	97.7	-96	4487	103.0	+129	110.5
DL 5%			+284			+265	

T1 (early spring) - Calypso 480 SC 100 ml/ha;

T2 (end of tillering)-Calypso 480 SC 100 ml/ha;

T3 (flag-leaf) - Proteus OD 110 400 ml/ha;

T4 (end of flowering) - Proteus OD110 400 ml/ha.

Complex treatments with herbicides, fertilizers or fungicides:

C1(T1 + T3 + T4); C2(T2 + T3); C3(T2 + T3 + T4); C4(T2 + T4)

Tillages Complex treatments Insecticedes application moments	Classic system by plowing Grain production (kg/ha) Average	%	Dif.	Conservative system no tillage Grain production (kg/ha) Average	%	Dif.	% Impact of no tillage technology
C1(T1+…+T3+T4)	4155	100.0	+0	4358	100.0	+0	104.9
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C3 (...+T2+T3+T4)	3883	93.5	-272	4250	97.5	-108	109.5
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T4 (end of flowering) - Proteus OD110 400 ml/ha.

Complex treatments with herbicides, fertilizers or fungicides:

C1(T1 + T3 + T4); C2(T2 + T3); C3(T2 + T3 + T4); C4(T2 + T4)

Source: Malschi et al 2011

The integrated pest control methods under **classical** soil technology (by plowing), in open field agricultural system, needs special attention on: the analysis of zone and crop climate in interrelation with the periodical observation of attack potential (at crop emergence, in the spring at tillering and in the 2nd decade of May, at flag-leaf apparison and ear emergence); the use of agrotechnological measures (the sowing in the second half of October, the volunteers wheat destruction, the balanced fertilization, herbicide treatment and others); insecticide treatment on seeds or vegetation; periodical multiannual observation of the interactions with auxiliary entomophages; predator populations enrichment and protection by careful treatment application on vegetation, by protection of entomophages refuge sites (by concentration area development at crop borders, protection of marginal flora diversity, protective agroforestry belts etc., which

ensures the presence and growth of auxiliary species, fast colonization of the crops, and the occurrence of natural efficient biological pest control).

Insecticide application should be carried out when the economic damaging threshold values of pest have been exceeded. Also, insecticide application is recommended taking into account the activity of the natural reserve of predatory and parasite entomophages. Especially, the polyphagous predators diminish actively the main pests in the crops. The natural predators play an important role in decreasing the pests abundance. The well-known systematic groups of entomophagous predators: Aranea; Thysanoptera (Aeolothripidae); Heteroptera (Nabidae etc.); Coleoptera (Carabidae, Staphylinidae, Coccinellidae, Cantharidae, Malachiidae etc.); Diptera (Syrphidae, Empididae etc.); Hymenoptera (Formicidae etc.); Neuroptera (Chrysopidae) etc. were represented in the structure of arthropod fauna (Malschi 2009).

The research proved that the **insecticide treatments** applied on vegetation have been used for the prevention and control of a pest complex, in the last years, in two critical attack moments and risk situations have been reported to require treatment application:

1. The insecticide treatment applied in April, at the same time with the herbicide treatment, for diptera and wheat fleas control (*Chaetocnema)*, bug and *Oulema* adults also to reduce thrips and leafhoppers attack potential. The treatment for diptera larvae control in April, at the end of plant tillering in the 25-33 DC stage (at herbicide treatment), or earlier in some years, has been carried out by using systemic insecticides: neonicotinoids – tiacloprid, thiametoxam; organophosphorous and others, which achieved control efficiencies and yield increases. At present, the entomophagous auxiliary fauna has been at the beginning of its occurrence in the crops and less exposed to insecticides.

2. The treatment in the flag-leaf apparison and ear emergence, in the 45-59 DC stage, in May 10-25 has been applied to control wheat thrips adults (*Haplothrips tritici* Kurdj.), aphids, bugs and others. The pirethroids, neonicotinoids etc. have achieved immediate control of the pest complex with efficiencies against thrip larvae development of the ears and yield increases. At this treatment time, the most significant part of the

entomophages natural biological control activity has been carried out, most of the species being less sensitive to insecticides as eggs and pupae.

The integrated pest management research on the cereal agroecosystems with **conservative no tillage soil technology**, have been conducted in 2008-2011 and have recommended the insecticides chimical control, using 2-3 succesive insecticides treatments (Table 6).

The applied integrated pest management on favorable agroecological conditions in the **farm with protective forestry belts,** in Cean-Bolduţ shows the efficiency of biological control, using the entomophagous natural resources, without insecticides (Malschi Dana 2009, Malschi Dana et al, 2010).

Identification of efficient insecticides in pests control on vegetation, the assessment of optimal application time, the evaluation of insecticide side effects on the auxiliary entomophagous in the crops, the emergence of resistance to insecticide; have been conducted in 2007-2011, in demonstrative experiments and lots where systemic neonicotinoid insecticides (Calypso 480 SC 100 ml/ha), pyrethroids with instant shock action (Decis 25 WG 0,030 Kg/ha) and a mixture of these (Proteus OD 110 400 ml/ha), but also new formula of pyrethroids such as Cylothrin 60 CS 80 ml/ha, Alphamethrin 10 CE 100 ml/ha, Grenade SYN 75 ml/ha have been applied. The research has shown the value of some quality insecticides adequate to the present high temperatures and abundance of pests and the overlap of attack of several phytophage groups**.** Identification of adequate, quality seed-applied insecticides, biologically, economically and ecologically efficient has been conducted in experiments using the Yunta 246 FS2 l/t insectofungicide (Table 7 and 8)**.**

Table 7. Effect of insecticide treatments in the wheat flag-leaf and ear emergence stage application (Ariesan variety), ARDS Turda, 2008

Treatment variants	Ears / m^2			Kg / ha		
	Average	%	Differ.	Average	%	Differ.
V1. Untrated	463	100.0	-	5456	100.0	-
V2. Yunta 246 FS, 2 l/t TS	389	84.2	- 74.0 ^{oo}	5650	103.5	194
V3. Cylothrin 60 CS 80 ml/ha	575	124.2	112.0 ***	6850	125.5	1394 ***
V4. Alphamethrin 10 CE 100 ml/ha	504	109.0	41.0	7170	131.4	1714 ***
V5. Decis 25 WG 0,030 Kg/ha	580	125.4	117.0 ***	6793	124.5	1337 ***
V6. Proteus OD 110 400 ml/ha	488	105.5	25.0	5990	109.8	534 *
V7. Calypso 480 SC 100 ml/ha	567	122.5	104.0 ***	6150	112.7	694 *
V8. Grenade SYN 75 ml/ha	556	120.2	93.0***	5540	101.5	84
DL p 5%		9.4	43.7		9.2	503.5
DL p 1%		13.1	60.6		12.8	687.9
DL p 0.5%		18.2	84.2		17.7	969.5
	F=21.74 (2.76)			**F= 15.9 (2.76)**		

Source: Malschi 2008, 2009

Table 8. Efficiency of insecticides applied in the wheat flag-leaf and ear emergence stage application (Ariesan variety), ARDS Turda, 2008

	Aphids/ear / 11.06.2008			Thrips larvae/ear / 11.06.2008		
Treatment variants	**Average**	**%**	**Differ.**	**Average**	**%**	**Differ.**
V1. Untreated	2.50	100.0	Ctrl group	3.70	100.00	Ctrl group
V2. Yunta 246 FS, 2 l/t TS	2.50	100.0	0.00	3.70	100.00	
V3. Cylothrin 60 CS 80 ml/ha	0.20	8.0	- 2.30	0.10	2.70	ooo
V4. Alphamethrin 10 CE 100 ml/ha	0.60	24.0	- 1.90	0.05	1.35	ooo
V5. Decis 25 WG 0,030 Kg/ha	0.40	18.0	- 2.05	0.10	2.70	ooo
V6. Proteus OD 110 400 ml/ha	0.50	20.0	- 2.00	0.05	1.35	ooo
V7. Calypso 480 SC 100 ml/ha	5.35	214.0	2.85	4.00	108.11	
V8. Grenade SYN 75 ml/ha	0.05	2.0	- 2.45	0.10	2.70	ooo
DL p 5%			3.171			1.037
DL p 1%			4.396			1.438
DL p 0.5%			6.107			1.998
	F= 3.09(2.76)			**F= 31.91 (2.76)**		

Source: Malschi 2008, 2009

Insecticide control using the variety of modern products (pyrethroids, neonicotinoids, plant penetrating systemic products) has been studied in order to test the biological efficiency of the treatments, insecticide remanant capacity, the negative effects on useful entomophage fauna (Table 9 and 10).

Table 9. The side effect of Yunta 246 FS 2 l/t seed treatment on useful entomophaguos fauna in winter wheat crops, ARDS Turda, 2008

A. Abundance and mortality of auxiliary soil fauna (Summe of Barber traps catches)

Sampling date	**29.05**		**24.06**	
Variants	**V 1**	**V 2**	**V 1**	**V 2**
Brachinus explodens	3	1	25	15
Poecilus cupreus	84	28	250	150
Pseudophonus rufipes			50	30
Pterostichus melanarius	12	1	125	75
Harpalus distinguendus	2		15	9
Dolichus halensis	17	3		
Sylpha obscura	10	2	25	15
Necrophorus vespillo			10	6
Scarabeus	2			
Aranea	13	2		
Total	**145**	**37**	**500**	**300**
Mortality % - negative impact		**74.5 %**		**40.0 %**

B. Entomophagous mortality after Yunta 246 FS (no/100 sweep net catches)

Sampling date	**14.05**		**27.05**	
Variants	**V 1**	**V 2**	**V 1**	**V 2**
Coccinellidae	1		1	1
Cantharidae	17	2		
Malachiidae			2	2
Empididae (Platypalpus)			3	
Hymenoptera - parasites	13	6	8	
Formicidae	2	3	3	1
Aranea	3		2	3
Total entomophages	**36**	**11**	**19**	**8**
Mortality % - negative impact		**69 %**		**42 %**

Variants of seed treatements: V1 = whithout insecticide; V2 = with *Yunta 246 FS, 2 l/t.*

Source: Malschi 2008, 2009

Table 10. Dynamics of wheat pests after insecticide application at 30.05.2008. ARSD Turda

A. Phytophages no/100 sweep net catches. E%= insecticide efficiency

B.Entomophages no/100 sweep net catches. M%=Entomophagous Mortality

	Treatment immediate side effect/after 4 days							Insecticide side effect after 12 days.						
	Sampling date 03.06.2008							Sampling date 11.06.2008						
	Mt.	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V1**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**
A.	564	11	38	57	46	53	21	121	42	71	96	35	67	22
E %		98	93	90	92	91	96		65	41	21	71	46	82
B.	23	6	11	5	6	11	2	44	11	14	31	7	12	9
M %		74	52	78	74	52	91		75	68	30	84	80	80

	Insecticide side effect after 26 days							Insecticide side effect after 34 days						
	Sampling date 25.06.2008							Sampling date 03.07.2008						
	Mt.	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**Mt**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**
A.	111	28	30	14	40	70	12	141	58	101	80	77	107	44
E %		75	73	87	64	37	89		59	28	43	45	24	69
B.	48	15	26	26	18	39	21	96	110	103	89	66	75	82
M %		69	46	46	63	19	56				7	31	22	15

Variants: Mt. (untreated). V1=(seed whithout insecticidal treatment); V2=(Seed treated with *Yunta 246 FS, 2 l/t. V3=Cylothrin 60 CS 80 ml/ha; V4=Alphamethrin 10 CE 100 ml/ha; V5=Decis 25 WG 0,030 Kg/ha; V6= Proteus OD 110 400 ml/ha;V7=Calypso 480 SC 100 ml/ha; V8=Grenade SYN 75 ml/ha. SCDA Turda, 2008.*

Source: Malschi 2008, 2009

The application of special insecticide treatments is required especially under unfavorable agroecological conditions of excessive heat and drought during the critical attack periods and plant growth, in the case of crops with incomplete or incorrect technology related to the use of single crops and early sowing,

before the regional optimal time and in no tillage and minimum soil tillage technologies, also (Carlier et al 2006; Guş & Rusu 2008; Haş et al 2008; Malschi et al 2010, 2011).

5. Conclusions

A complex technology as part of the integrated pest control system has been recommended, comprising the use of crop agro-technical measures, having an overall role in the prevention and decrease of the pest attack, virtually achieved by:

- Crop rotation ensuring the optimum precursory plant and avoidance of monoculture single crops;
- Soil preparation and maintenance, soil activities (tilling, discing, wheat volontiers destruction, other conservative technology - specific of minimum tillage and no tillage technologies). They diminish mechanically a part of the biological pest reserve;
- Keeping density and optimal sowing time (October 10-20), so that wheat crop emergence avoids massive infestation by pests (diptera, aphids, leafhoppers) and provides good plant growing rhythm and vigor; balanced application of fertilizers, herbicides and disease control treatments which provide a good plant growth.

The integrated control of wheat pests by optimizing the technological factors such as: sowing time, insecto-fungicide seed treatments, insecticide vegetation treatments, fertilization, and by optimizing the biotic factors: natural entomophags, environment protection, preservation and sustainable use of biodiversity has been studied in experimental lots where the optimized technological system has been used (complex phytosanitary treatments with insecticides, fungicides, fertilizers, including preventive seed treatments**),** in the vegetation years 2007-2011**.**

The economic and ecological efficiency of the integrated wheat pest management system in Transylvania can be achieved by using the prevention and risk control strategy due to the present pest abundance and aggressiveness, by protection and sustainable use of the natural resources of biodiversity, including the activity of auxiliary entomophage activity in the crops.

The thrips, flies, aphids and leafhoppers were dominant in the structure of wheat pests, with abundant populations, well efficiency redused by the applied insecticides.

The IPM research on the cereal agroecosystems in open field area with classic plowing and conservative no tillage soil technology, in ARDS Turda pointed out and recommended the insecticides chimical control, using 2-3 succesive insecticides treatments. The recommended attack diminishing methods of wheat pests include the application of insecticides, with economic and ecological efficiency, in two different selective moments: 1 - for the control of wheat flies larvae, leafhoppers and other pests, in April, at the end of tillering phase (13-33 DC stage); 2 - for the ear pests control – thrips, aphids, bugs, leafhoppers and other pests at spike appearance in 45-59 DC stage, in the period of May, 10^{th}-25^{th}; the conservation and use of biological factors (tolerant varieties, entomophagous limiters). Yield results have shown that the technological system provided the control of risk factors, and the harvest results at the level of yielding capacity.

Special attention should be given to the farming system with agroforestry belts which provide auxiliary entomophage conservation and development and the natural biological pest limitation, not to mention the antierosion role. The applied IPM on favorable agroecological conditions in the farm with protective forestry belts, in Cean-Bolduţ shows the efficiency of biological control, using the entomophagous natural resources, without insecticides.

The knowledge concerning the integrated pest management system achieved in accordance with the contemporary expectations regarding the optimization of the relations between environment, agriculture and sustainable development has been delineated. The integrated wheat pest management has a special significance because it represents one of the priorities of agricultural sustainable development. The objectives are the achievement of yield safety under risky conditions caused by the attack of these pests in relation with the climate and regional agroecological changes, the implementation of economic and ecological efficiency of the control methods; the protection of environment and food quality; preservation and use of biodiversity.

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IMPERATIVE QUALITY FACTORS WHICH INFLUENCE NUTRITIONAL VALUE OF PIGEONPEA [(*CAJANUS CAJAN* (L.) MILLSP.)]

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Abstract: Protein availability in developing countries at present is about one-third of its normal requirements and with ever growing human population; various nutritional development programs are facing a tough challenge to meet the targeted protein demand. Pigeonpea (*Cajanus cajan* (L.) Millsp.) is one of the most important grain legume component of subsistence farming systems in the semi-arid tropics. It offers a relatively inexpensive source of protein, carbohydrates, vitamins and certain minerals, which is valuable for developing countries. Pigeonpea has versatile uses such as green pods for fresh consumption; split seeds are cooked to make *dhal*, leaves and husk are fed to domestic animals and dry stems as fuel. Food value of seeds of this plant is high; they have about the same calories per unit weight as are the cereals. The protein content in pigeonpea is generally about double that of most cereals and they are rich in essential amino acid lysine in which cereals are relatively deficient. However, the protein quality are known to be inferior due to the deficiency of sulphur containing amino acids like, tryptophan and methionine as well as low digestibility and presence of antinutritional factors. In India it was consumed with a mixed diet of cereals, as a result the deficiency in sulphur containing amino acids automatically corrected by the mode of their consumption. In the tropics and sub-tropics pigeonpea is considered as life line of subsistence farming.

Key words: Pigeonpea (*Cajanus cajan* (L.) Millsp.), quality, nutritive value, anti-nutritional factors.

1. Introduction

Pulses are the important crops, providing high value food and nutritional security for eliminating malnutrition of poor masses. They play a vital role in improving soil fertility and conserve natural resources which are essential for sustainable agriculture. Protein availability in developing countries at present is about one-third of its normal requirements and with ever growing human population; various nutritional development programs are facing a tough challenge to meet the targeted protein demand. Legumes in the developing world are known to offer food proteins that are generally grown under risk-prone marginal lands with low inputs. Among the various grain legumes grown, pigeonpea [*Cajanus cajan* (L.) Millsp.] is one of the most important pulse crop of India. It is also called Arhar, Red gram or Tur. Pigeonpea has versatile uses as food, feed, fuel and fodder. It is a rich source of protein, carbohydrate, vitamins (thiamine, riboflavin and niacin), lipids and certain minerals (Ca, Fe, Zn, Cu, P, Mg, Na etc.).

Pigeonpea is cultivated in more than 25 tropical and sub-tropical countries, either as a sole crop or intermixed with such cereals such as sorghum [*Sorghum bicolor* (L.) Moench], pearl millet [*Pennisetum glaucum* L.], or maize (*Zea mays* L.) (Reddy et al 1993). In India, dehulled split cotyledons of pigeonpea seeds are cooked to make *dhal* for eating with bread and rice while; in southern and eastern Africa, and South America its whole dry seeds are used in a porridge like recipe. However, the fully grown seeds of pigeonpea when harvested green before losing their green color, are used as fresh, frozen, or canned vegetable. Its broken seeds, skin, and pod walls are fed to domestic animals; and the dry stems are used as domestic fuel wood. In tropics and sub tropics pigeonpea is considered a life line of subsistence agriculture (Saxena et al 2002, 2010). Pigeonpea plant is known to provide several benefits to soil such as fixing atmospheric nitrogen, adding organic matter and micronutrients, and breaking hard plough pan with its long tap roots and, thereby sometimes referred as “biological plough”. Pigeonpea can be grown successfully in a wide range of soil types and is capable of producing reasonable quantities of nutritive food even in the degraded soils and with minimum external inputs.

2. Different quality traits in pigeonpea

Quality of a plant product is primarily determined by the component of interest to consumer. In case of pigeonpea crop produce quality means "The degree of excellence for a specific use or to serve specific purpose". Therefore, the precise meaning of quality will vary from crop to crop, its implied use, human needs and available technologies, etc (Singh, 2005). Some aspects of quality are obvious to the consumer, and they greatly affect the consumer preference for the produce. Such traits are potent factors in determining the popularity of a variety. We are much concerned with the traits related to produce quality which are important in breeding programme. Particularly in pigeonpea traits like, seed size, colour, protein content, water absorption, cooking time, total amylase, soluble sugars and starch content are important. The various quality traits may be classified into five broad groups:

1. Morphological traits: These traits are related to produce appearance and they are mainly concerned with size and colour of produce e.g., size, shape and colour of grains and pods etc. These traits are easily observable, and usually play the main role in determining consumer acceptance of the produce.

2. Organoleptic traits: These traits are concerned with palatability of the produce e.g., taste, aroma, smell, juiciness, softness etc. They are easily detectable and very important in influencing consumer preferences.

3. Nutritional quality traits: These traits determine the value of the produce in human/animal nutrition. The nutritional traits include protein content and quality, vitamin content and quality, carbohydrates, fat, lipids, minerals and also antinutritional factors. The traits are not easily appreciated by consumer and farmers, but they are of paramount value in determining human and animal health.

4. Biological quality traits: The traits included in this groups define the actual usefulness of the produce when consumed by experimental animals; their usefulness to humans is usually predicted on this basis e.g., protein efficiency ratio (PER ratio), biological value (BV), body weight gain etc. PER and BV depend on digestibility of the protein. These traits are not obvious to

consumers, but are extremely valuable in determining the utility of produce for human and animal consumption.

5. Other quality traits: This category includes all other quality traits that are not included in the above categories e.g., cooking quality, processing quality, storage quality etc. Many of the traits in this group are of prime importance in determining the usefulness of the concerned produce.

3. Key quality parameters which influence nutritive value of pigeonpea

Pigeonpea offers a relatively inexpensive source of protein which is valuable for developing countries. The food value of seeds of this plant is high; they have about the same calorie value per unit weight as cereals and are fair source of vitamins and minerals. The important parameters which influence the quality of pigeonpea and ultimately the nutritive value from the point of human consumption are as follows:

1. Protein: The crude protein content in pigeonpea is varies from 18.8 to 24.6 % (Table 1). The proteins are located in cotyledons and the embryonic axis with only a small amount being present in the seed coat. Because of major proportion of cotyledon in the seed, cotyledon contributes the major amount of protein to the whole seed. The seed coat of pigeonpea contains 5.6 % crude protein, while the cotyledon and embryonic axis have 24.3 and 48.1 % respectively. Protein of pigeonpea is of primarily two types: *metabolic proteins* (both enzymatic and structural) which are responsible for normal cellular activities including the synthesis of structural proteins, and *storage proteins* which are relatively smaller in number and account for about 70 % of seed nitrogen. The storage proteins occur within the cell in discrete protein bodies.

There is a wide variability in protein content which is observed even in the same year but from two different plants and the position of the pods. The amino acid composition of pigeonpea proteins has been widely studied and it was observed that it is deficient in sulpur containing amino acids and tryptophan, but is rich in lysine in which cereals are relatively deficient. Pigeonpea protein contains lysine 3.8, methionine 1.1 and tryptophan 0.8 g/16gN. Environmental factors under which it was grown influence the amino acid composition. Application of

phosphorus, molybdenum and nitrogen has been shown to increase the level of methionine.

The nutritive value of pigeonpea protein has been extensively studied and it was observed that biological value of pigeonpea protein ranges 46-74 %. This has been attributed to the relatively low concentration of sulphur containing amino acids. Low methionine is the cause of lower biological value and it was reported that addition of methionine 0.3% increases the protein efficiency ratio (PER). Addition of tryptophan is having synergetic effect in improving PER of pigeonpea. The proteins in pigeonpea are known to have low digestibility. There is a considerable variation in digestibility, not only between species, but also within species. It has been recognized for many years that the nutritive value and protein digestibility of pigeonpea is very poor, unless subjected to cooking or some other form of heat treatment (table 1). The depression in protein value and digestibility has been generally attributed to the presence of protease inhibitors, digestibility of protein and interference in protein utilization by other anti-nutritional factors. The availability and utilization of protein are influenced by the amino acid composition, digestibility of proteins and by the presence of anti-nutritional factors.

2. Carbohydrates: The carbohydrates are present in enormous amount in pulses. In pigeonpea, it ranges from 57.3 to 58.7%. These carbohydrates include mono- and oligosaccharides starch and other polysaccharides. Starch is the most abundant pulse carbohydrate and varies from 48.4 to 57.6%. Amylose constitutes a significant portion of starch and the amount of amylose in starch influences starch solubility, lipid binding and other functional properties. However, soluble sugars represent only a small percentage of total carbohydrates and ranges from 3.1 to 5.2%. Crude fiber, also considered as roughage, consists of cellulose, hemicelluloses, lignin, pectin and cutin substances. Green seeds contains the highest amount of crude fiber (8.2%) compared to mature seeds (6.6%) while; in *dhal* it is the lowest (1.2%). Carbohydrate digestibility has been reported to vary among pigeonpea. Several processes *viz;* boiling, roasting and germination have been reported to be effective in increasing the carbohydrate digestibility. The carbohydrate digestibility is highest when is boiled (44.7%) followed by germinated seeds

(34.0%) and roasted seeds (32.3%) as compared to raw seeds (24.8%). Thus, ungerminated seeds are less digestible when compared to germinated and other processed pulses. Germination can be considered as a process for improving digestibility and reducing or eliminating flatus factors. Roasting and boiling or cooking also improves carbohydrate digestibility in pigeonpea.

Table 1. Important parameters which influence the quality and nutritive value of pigeonpea

Constituent	Green seed	Mature seed	Dhal
Protein (%)	21	18.8	24.6
Protein digestibility (%)	66.8	58.5	60.5
Starch content (%)	48.4	53	57.6
Starch digestibility (%)	53	36.2	-
Soluble sugars (%)	5.1	3.1	5.2
Crude fibre (%)	8.2	6.6	1.2
Fat (%)	2.3	1.9	1.6
Minerals and trace elements (mg $100g^{-1}$)			
Calcium	94.6	120.8	16.3
Magnesium	113.7	122	78.9
Copper	1.4	1.3	1.3
Iron	4.6	3.9	2.9
Zinc	2.5	2.3	3
Cooking time (min)	13	53	18
Antinutritional factors			
Trypsin inhibitor (mg^{-1})	2.8	9.9	13.5
Amylase inhibitor (mg^{-1})	17.3	26.9	-
Flatulence factors (g $100g^{-1}$souble sugar)	10.3	53.5	-

Source: Faris et al., (1987)

3. Lipids: Lipids are organic compounds that include fats, waxes, phospholipids, glycolipids and sterols. All of them are present in almost every living cell. In nature, they are synthesized from trihydric alcohol, glycerol and fatty acids and upon oxidation release a huge amount of energy. Thus, the lipids serve as the prime fuel reserve for metabolism (Verma 2003). It is a group of heterogeneous components classified together because of their solubility in organic solvents. This heterogeneous group includes free fatty acids, mono, di and triacyl glycerol,

phospholipids, sterols, sterol esters glycolipids and lipoproteins. The total lipid content in pigeonpea is 2.19% and varies with variety, origin, location, climate, environmental conditions and type of soil on which they are grown. Fat content (Table 1) in pigeonpea is highest in green seeds (2.3%) and it gradually decreases in mature seeds (1.9 %) and *dhal* (1.6%). The lipids are comprised of several classes e.g. neutral lipids, phospholipids and glycolipids. The fatty acids are the main components of neutral lipids phospholipids and glycolipids. Lipids in pigeonpea are also characteristically containing substantial amounts of saturated fatty acids (palmitic acid 20.50% and steric acid 6.50%). The main unsaturated fatty acids are oleic acid (10.50%), linoleic acid (56.30%) and linolenic acid (5.00%). High proportions of either linoleic or linolenic acid are associated with pulses containing insignificant amount of lipids. The time of harvest and maturity also play a role in the fatty acid composition of seed. Usually, the amounts of steric acid and oleic acid are greater in mature seeds than in immature seeds and the amounts of linoleic and other fatty acids are lower. At maturity neutral lipids are about 92% of the total lipids, phospholipids are 6.1 % and glycolipids are 1.9%.

The fatty acids are important from nutrition point of view. The unsaturated fatty acids are used for esterification of cholesterol content and subsequently reduce cholesterol in the serum and liver. In absence of linoleic and linolenic acid the cholesterol is esterified with more saturated fatty acids and tends to accumulate in the arterial blood, reducing the metabolism of cholesterol and resulting in the hardening of the inner walls of arteries (arterosclerosis). Linoleic acid is hypo-cholesterolemic while, palmitic acid hyper-cholesterolemic.

4. Vitamins: Pigeonpea is a good source of thiamin, riboflavin and niacin (0.45, 0.19 and 2.9 mg $100g^{-1}$ respectively). A small amount of carotene (132 µg $100g^{-1}$) is also present in pigeonpea. However, they do not contribute much as precursor of vitamin A to the diets. The thiamin content is approximately equivalent or slightly exceeds that of whole cereals. Dry seeds are almost devoid of ascorbic acid. This vitamin disappears after a long storage. Presence of non-digestible polysaccharides and lignin which composes dietary fiber reduces the availability of B6 for intestinal absorption. The undecorticated seeds contain

vitamin E (tocopherol) in somewhat larger amounts than whole cereals. Pigeonpea is also a good source of folic acid.

5. Minerals: Pigeonpea is a good source of minerals such as calcium, iron, copper, zinc, potassium and magnesium. It is considerably richer in calcium and magnesium than are most cereals. Pigeonpea is a moderately good source of iron containing on an average about 2.9-4.6 mg $100g^{-1}$ of seed (table 1). Significant amount (304 mg $100g^{-1}$) of phosphorus also present as phytic acid. Copper (1.3-1.4 mg $100g^{-1}$) and zinc (2.5-3 mg $100g^{-1}$) in a trace amount also present in pigeonpea.

6. Anti-nutritional factors: Like other legumes, pigeonpea seeds also contain some anti-nutritional factors (table 2). These include oligosaccharides (raffinose and verbascose), polyphenols (phenols and tannins), phytolectins, and enzyme inhibitors (trypsin, chymotrypsin, and amylase). Pigeonpea seeds also have some amounts of unavailable carbohydrates which adversely affect the bioavailability of certain vital nutrients. Some of the anti-nutritional factors such as phytolectins are heat sensitive and are destroyed during cooking.

Table 2. Genotypic variation for major anti-nutritional factors in pigeonpea

Factors	Genotypes	Range
Total phenols (mg g^{-1})	14	3.0-18.3
Tannins (mg g-1)	10	0.0-0.2
Trypsin inhibitor (mg g^{-1})	9	8.1-12.1
Chymotrypsin inhibitor (mg g^{-1})	9	2.1-3.6
Amylase inhibitor (mg g^{-1})	9	22.5-34.2
Raffinose (g 100 g^{-1})	10	0.24-1.05
Stachyose (g 100 g^{-1})	9	0.35-0.86
Stachyose + verbascose (g 100 g^{-1})	-	41.60-2.30

Source: Singh 1988

Godbole et al. (1994) reported protease inhibitors in 7 day old seeds; while Ambekar et al (1996) found that such inhibitors

are either not synthesized or inactive up to 28 days of the seed development. No other plant part except seed exhibited trypsin or chymotrypsin inhibitors. The white seeded pigeonpea cultivars contain relatively less amounts of polyphenols. Such cultivars are preferred in many countries where de-hulling facilities are not available and whole seeds are consumed. In comparison to the white seeded cultivars the red seeded types contain three times greater quantity of polyphenols. Similarly, the enzyme inhibition activity was also greater in the colored seeds of pigeonpea. Since in India almost entire pigeonpea production is dehulled and converted into *dhal* for consumption, the tannins present in the colored seed coat pose no nutritional problem.

4. Cooking quality

Pigeonpea seeds in the form of either dry, green or split peas are invariably consumed after cooking. Therefore, besides various nutritional aspects the cooking time and other related parameters assume importance. Consumers always prefer a *dhal* that cooks fast and produces more volume upon cooking with high consistency and flavor. Cooking time of *dhal* is independent of taste and flavor. Various physico-chemical characters of pigeonpea are studied by a number of researchers, and it was observed that quick cooking trait of *dhal* was associated with large seed size, high solid dispersal, more water absorption, and high nitrogen solubility. There is a positive association of cooking time of pigeonpea seeds with their calcium and magnesium contents. According to Salunkhe (1982) cooking of pigeonpea improved the bio-availability of nutrients and at the same time destoryed some anti-nutritional factors. Heat treatment of pigeonpea seeds is also known to enhance their starch digestibility. The lines, which take long time to cook, generally face the danger of losing important vitamins from food. Cooking pigeonpea seed after germination enhances their starch digestibility but reduces the levels of oligosaccharides. The fermentation of seeds helps in reducing inhibitory activity of digestive enzymes. The thiamine and riboflavine were destroyed by heat but niacin content was unaltered during boiling, pressure cooking, and roasting of pigeonpea seeds. However, availability of lysine and methionine decreased on roasting but the available methionine increased on boiling and pressure-cooking.

5. Nutritional value of pigeonpea

The protein content in pigeonpea is generally about double that of most cereals and they are rich in essential amino acid lysine in which cereals are relatively deficient. However, the protein quality is known to be inferior quality due to the deficiency of sulphur containing amino acids like tryptophan and methionine as well as low digestibility and presence of antinutritional factors. In India it was consumed with a mixed diet of cereals and, as a result the deficiency in sulphur containing amino acids, is automatically corrected by the mode of their consumption. Thus, the combination of cereals and pulses provides a good balance of amino acids since cereals usually supply adequate methionine and tryptophan while pulses supply lysine to cereals. The quality of protein is determined by its quantity and digestibility, and amino acid contents. In pigeonpea the amino acids such as lysine and threonines are in good proportions, while methionine and cystine are deficient. Pigeonpea cotyledons are also rich in calcium and iron.

Protein content in cultivated types can be enhanced through conventional breeding. Singh et al (1990) assessed high protein lines for their chemical composition. They reported large differences between the levels of protein in high-protein (28.7 to 31.1%) lines and control cultivars (23.1 to 24.8%). As expected, the starch component in high protein lines was relatively less (54.3 to 55.6 %) than that of controls (58.7 to 59.3%). Also the high protein lines were marginally lower (2.5 to 2.6%) in fat content when compared with control cultivars (2.9 to 3.1%). The differences in the major protein fractions of the high and normal-protein lines were also large. In comparison to controls (60.3 to 60.5%), the globulin fraction was higher (63.5 to 66.2%) in the high-protein lines and the reverse was true for glutelin.

6. Conclusions

Pulse crops are a rich source of food proteins that are generally grown under risk prone marginal lands. Among various food legumes, pigeonpea occupies an important place and has been rated the best as far as its biological value is concerned. At present, the protein availability in developing countries is about one third of normal requirements and with ever growing

population; various nutritional development programs are facing a tough challenge to meet the protein demand. In pigeonpea methionine, cystine, tryptophan and threonine are the limiting essential amino acids, whereas in rice and wheat lysine is the limiting amino acid. A food combining both cereals and pulses provides a balanced diet because they complement the amino acid profiles of each other. The mutual quality compensation is closest to the ideal value when the ratio by weight of cereals to legume is roughly 70:30. In southern and eastern Africa this ratio is 90:10, reflecting shortage of protein in the diet. Supplementation of rice diet with 8.5% and 16.7% pigeonpea *dhal* markedly improved the quality of diet. It has been recommended for a balanced diet with cereals, especially to fill in the nutritional gap for proteins amongst the poorer section in developing economies that cannot afford a non-vegetarian diet. Pigeonpea is known to prevent and cure human ailments like bronchitis, coughs, pneumonia, respiratory infections, pain, dysentery, menstrual disorders, curing sores, wounds, abdominal tumors, and diabetes in traditional folk medicine.

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THE INFLUENCE OF PLANT GROWTH REGULATORS ON CALLUS INDUCTION AND CALLUS BIOMASS OF EPHEDRA *PACHYCLADA* BOISS

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Abstract. An experiment was conducted to evaluate the influence of different hormones at varied ranges on callus induction and callus biomass of *Ephedra pachyclada.* The results clearly showed that, the highest amount of callus fresh weight is achievable under the influence of NAA: 2.0, Kin 0.5 (mg L^{-1}) using a Murashinge and Skoog medium. Considerably, neither Kin nor BAP as applied Cytokinins at any ranges along 0.5 mg L^{-1} NAA as an auxin could induce callus form explants of *E. pachyclada.*

Keywords: *Ephedra*, Phytohormones, Callus culture.

1. Introduction

Plant tissue culture techniques have become vitally important for pursuing a wide range of fundamental and applied problems in researches and development. The techniques encompass a variety of procedures used for specific purposes. The growing of masses of unorganized cells (callus) on agar or in liquid suspension is widely employed in biochemical and growth studies (Gamborg et al 1976).

Phytohormones or plant growth hormones (PGRs) regulate various physiological and morphological processes in plants; they synthesize by plants but also artificially and can be added into cultures to improve the plant growth or to enhance metabolite synthesis (Bhojwani & Razdan 1983). Based on the evidences, the auxin/cytokinin ratios have always been related to the callus induction, or physiological and morphological changes at the intermediate levels of tissue growth or undifferentiated

callus (Jeong et al 2009; Mungole et al 2009). It is reported that, combination of high concentration of NAA (1-naphthaleneacetic acid) and BAP (6-benzylaminopurine) had significant influences on callus formation of *Cananga odorata*, also a high concentration of NAA gave rise to a pale, whitish and friable callus after 1 - 2 weeks (Nurazah et al 2009). Similarly, the phenotype of the *Arabidopsis* is changed by increases of the cytokinins level; the authors have also mentioned that, these changes in phenotypes had significantly been related to the anthocyanins and lignins accumulations (Chun & Xin 2004). Auxin and cytokinin participate in regulation of cell cycle, and auxin may regulate and even may lead to DNA replication while cytokinin leads to mitosis which are highly correlated to phenotype changing and cells growing in *in vitro* cultures (Hartig & Beck 2008; Pasternak et al 2000; Zhang et al 2004).

As observed in *B. montanum* and many other species, *in vitro* growth and shoot formation were not achieved without adequate concentrations of exogenous hormones. However, inadequate or excessive amount of growth hormones can cause morphological and physiological abnormalities (Sasikumar et al 2009). Cytokinins are plant growth regulators and they are used for stimulating cell division, as well as cells formation and growth of axillary buds and shoots. Particularly, auxins have influences on the plant growth, callus formation and root induction; based on the literature, among the auxins, NAA and 2, 4-D (2, 4-Dichlorophenoxyacetic acid) were the most active compounds compared to the others.

The development of tissue culture techniques rest upon two properties of plant cells: cell totipotency and cell plasticity. Cell totipotentiality is described as the genetically retained capacity that all living cells posses to originate a new genetically identical cell and as a consequence after cellular division and differentiation processes, to be able to form tissues, organs, systems and complete individuals. Cellular plasticity is the characteristic which marks the difference between plant and animal cells in their capacity of multiplication, division, differentiation and formation of a new individual.

In an experiment the effects of different types of hormones and their combinations on callus induction of *E. sinica* were studied, and the authors have indicated that the explants were

cultured on a MS medium supplemented with different plant hormones such as 2, 4-D, NAA, BA and Kin; finally, the effects of plant hormone on callus induction were compared; the growth curve of *E. sinica* callus was drawn. All in all their results showed that, in the medium which was supplemented with 2, 4-D: 2.0 mg L^{-1} + BA: 1.0 mg L^{-1}, the rate of callus induction was recorded significantly higher compared to the other treatments and in this treatment callus induction reached 77.5 (%). Relatively, the callus growth curve was reported by authors as a S type (sigmoid) and consequently, the authors have also mentioned that, the callus growth were dramatically increased after 8 days. It was reported that the best period of subculture was about every 24 days. Over all, the researchers indicated that the combination of 2, 4-D and BA was much more beneficial for callus induction of *E. sinica* (*Hong-Mei* 2009).

This paper tries to present an optimum range for callus induction of *E. pachyclada* and presents an evaluation about influences of two cytokinins on callus induction and callus biomass of *E. pachyclada.*

2. Material and Method

Ephedra pachyclada Boiss was identified and collected from N29º23' E53º10', and stems were surface sterilized in sodium hypochlorite (0.5%) containing a few drops of Tween 20 for 7 min and rinsed five times with distilled water, 0.8 ± 0.2 cm internodes were separated from the donor plant and were again surface sterilized in sodium hypochlorite (0.25%) containing Tween 20 for 1 min and rinsed three times with distilled water. The wounded parts exposed to sterilization agent were trimmed and the healthful shoot tips were used as explants in the experiment.

A standard MS medium (Murashinge and Skoog contained 30 g L^{-1} sucrose and 7 g L^{-1} agar) with various plant growth regulators including NAA as an auxin and BAP and Kin (kinetin) as cytokinins with following ranges: 0.5; 1.0; 1.5; 2.0 mg L^{-1} was used for our purposes. The pH of the medium was adjusted to 5.8 using 1 N NaOH and 1 N HCl before autoclaving. Explants which showed callus induction were kept under light (2500 – 3000 lux) at 4 ºC ± 2 for tests.

Subcultures were conducted every four weeks and continued until callus stability. The final fresh weight was recorded after the 4th subculture and relative growth rate (RGR) was measured for the species by using following formula: RGR = 3(Wf⅓ - Wi⅓) / tf-ti

Where: Wi: callus initial mass (at ti), Wf: final callus mass (at tf), t = time, tf - ti = 28 days of subculture period.

The experiment was conducted in a completely randomized design (CRD) and results were presented as the mean value ± standard deviation (n=12).

3. Results and Discussion

The recorded data according to *E. pachyclada* are presented in Tables 1 and 2; considerably, the highest callus initiation weight (17.42 ± 0.39 mg ex plant $^{-1}$) was achieved at NAA: 2.0, Kin 0.5 (mg L^{-1}) range, also the approximately needed time callus initiation and callus induction rate were determined as 16 days and 52%, respectively, at the chosen hormonal range. Hence, the final highest fresh weight (3.76 ± 0.27 g ex plant $^{-1}$) was also recorded for *E. pachyclada* with determined RGR of 0.13 ± 0.01 g g^{-1} day^{-1} at the mentioned level (Table 1).

Our results also revealed that the lowest quantity using Kin was achieved in NAA: 1.0, Kin: 2.0 (mg L^{-1}) treatment, as the amounts of 4.00 ± 0.37 mg ex plant $^{-1}$, 1.22 ± 0.09 g ex plant $^{-1}$ and 0.04 ± 0.003 g g^{-1} day^{-1} were recorded for callus initiation weight, callus fresh weight and RGR, respectively. Based on our results, there were no significant differences between NAA: 1.0, Kin: 2.0 and NAA: 1.0, Kin: 1.5 treatments in callus initiation weight, final fresh weight and RGR.

Table 1. Influence of different ranges of NAA and Kin on callus initiation time, callus initiation weight, final fresh weight, RGR, average of induction rate and callus quality

Treatments	Plant growth regulators (mg/L)		Callus initiation Time (Day)	Callus initiation weight (mg ex plant $^{-1}$)	Final fresh weight (g ex plant $^{-1}$)	RGR (g g^{-1} day $^{-1}$)	Average of Induction rate (%)	Callus quality
	NAA	Kin						
1	0.5	0.5	------	------	------	---------	------	---------
2	0.5	1.0	------	------	------	---------	------	---------
3	0.5	1.5	------	------	-------	---------	-------	---------
4	0.5	2.0	------	------	--------	---------	--------	---------
5	1.0	0.5	18	8.42 ± 0.50	1.91 ±0.10	0.07 ± 0.004	36	semi hard pale green
6	1.0	1.0	23	7.11 ± 0.31	1.71 ± 0.05	0.06 ± 0.002	32	semi hard pale green
7	1.0	1.5	23	5.98 ± 0.58	1.56 ± 0.06	0.05 ± 0.002	28	pale & brown, compact
8	1.0	2.0	23	4.00 ± 0.37	1.22 ± 0.09	0.04 ± 0.003	28	pale & brown, compact
9	1.5	0.5	18	12.34 ± 0.37	2.63 ± 0.10	0.09 ± 0.005	40	semi hard pale green
10	1.5	1.0	18	10.67± 0.70	2.34 ± 0.06	0.08 ± 0.002	40	semi hard pale green
11	1.5	1.5	23	9.33 ± 0.35	1.90 ± 0.30	0.07 ± 0.010	23	pale & brown, compact
12	1.5	2.0	23	8.45 ± 0.35	1.80 ± 0.05	0.06 ± 0.002	23	pale & brown, compact
13	2.0	0.5	16	17.42 ± 0.39	3.76 ± 0.27	0.13 ± 0.010	52	semi hard pale green
14	2.0	1.0	18	16.20 ± 0.52	3.38 ± 0.11	0.12 ± 0.003	40	semi hard pale green
15	2.0	1.5	23	12.01 ± 0.91	2.55 ± 0.12	0.09 ± 0.004	32	pale & brown, compact
16	2.0	2.0	23	7.75 ± 0.69	1.67 ± 0.90	0.06 ± 0.003	28	pale & brown, compact

Source: authors' data

Data are presented as the mean value ± standard deviation (n=12). While, obtained data from the treatment NAA: 2.0, kin: 0.5 is expressed as mean value ± standard deviation (n=25). Callus initiation time is showing the approximately needed time for callus induction and the Average of Induction rates were expressed as the percent of induced callus in 25 explants.

Table 2. Influence of different ranges of NAA and BAP on callus initiation time, callus initiation weight, final fresh weight, RGR, average of induction rate and callus quality

Treatments	Plant growth regulators (mg/L)		Callus initiation time (Day)	Callus initiation weight (mg ex plant $^{-1}$)	Final fresh weight (g ex plant $^{-1}$)	RGR (g g^{-1} day $^{-1}$)	Average of Induction rate (%)	Callus quality
	NAA	BAP						
1	0.5	0.5	------	------	------	---------	------	---------
2	0.5	1.0	------	------	------	---------	------	---------
3	0.5	1.5	------	------	-------	---------	-------	---------
4	0.5	2.0	------	------	--------	---------	-------	---------
5	1.0	0.5	23	5.72 ± 0.59	0.93 ± 0.14	0.033 ± 0.005	23	pale & brown, compact
6	1.0	1.0	23	6.40 ± 0.53	1.49 ± 0.08	0.053 ± 0.003	32	pale & brown, compact
7	1.0	1.5	23	7.55 ± 0.49	1.25 ± 0.07	0.044 ± 0.002	36	pale & brown, compact
8	1.0	2.0	23	5.06 ± 0.33	1.13 ± 0.14	0.036 ± 0.005	23	pale & brown, compact
9	1.5	0.5	23	6.40 ± 0.41	1.83 ± 0.15	0.095 ± 0.005	36	pale & brown, compact
10	1.5	1.0	16	9.62 ± 0.23	2.68 ± 0.16	0.089 ± 0.008	36	semi hard pale green
11	1.5	1.5	18	7.85 ± 0.43	2.51 ± 0.22	0.072 ± 0.005	32	semi hard pale green
12	1.5	2.0	18	7.50 ± 0.75	2.50 ± 0.16	0.070 ± 0.005	32	semi hard pale green
13	2.0	0.5	18	7.49 ± 0.61	2.25 ± 0.19	0.080 ± 0.007	40	semi hard pale green
14	2.0	1.0	16	12.52 ± 0.30	3.24 ± 0.20	0.110 ± 0.007	44	semi hard pale green
15	2.0	1.5	18	10.03 ± 0.42	2.78 ± 0.22	0.099 ± 0.008	40	semi hard pale green

Source: authors' data

Data are presented as the mean value ± standard deviation (n=12); While callus initiation time is showing the approximately needed time for callus induction and the Average of Induction rates were expressed as the percent of induced callus in 25 explants.

Notably, a compact pale and brown callus was received in the mentioned treatment while just 28 % of explants of *E. pachyclada* had induced callus.

Usage of BAP along NAA had also showed its significant influences on callus induction, callus growth and callus quality, as the highest amount of callus initiation weight (12.52 ± 0.30 mg ex plant $^{-1}$) was achieved in NAA: 2.0, BAP: 1.0 (mg L^{-1}) treatment, correspondingly, 3.24 ± 0.20 g ex plant $^{-1}$ and 0.110 ± 0.007 g g^{-1} day^{-1} were recorded for callus final fresh weight and RGR, respectively (Table 2).

Finally, our results demonstrated that, 44% of *E. pachyclada* explants induced callus where NAA: 2.0, BAP: 1.0 (mg L^{-1}) range was used in the medium, meantime the callus induction approximate time was estimated 16 days. In the counterpoint the lowest amount of callus initiation by usage of BAP was achieved from NAA: 1.0, BAP: 2.0 (mg L^{-1}) treatment (5.06 ± 0.33 mg ex plant $^{-1}$) while the lowest final fresh weight and RGR was recorded in NAA: 1.0, BAP: 0.5 mg L^{-1} treatment by amounts of 0.93 ± 0.14 g ex plant $^{-1}$ and 0.033 ± 0.005 g g^{-1} day^{-1}. In addition it seemed that, there were no significant differences between NAA: 1.0, BAP: 2.0 and NAA: 1.0, BAP: 0.5 treatments in callus initiation time, callus intention weight, final fresh weight and RGR and even the average of induction rate characters. Correspondingly, period of 23 days for callus initiation time with average of 23 (%) induction rates were recorded for NAA: 1.0, BAP: 0.5 (mg L^{-1}) treatment.

Authors reported that the young stems and hypocotyls of *E. sinica* were cultured on the mediums supplemented with different phytohormone to determine their influence on callus induction rates, and considerably the results showed that the MS medium containing 1.1 mg L^{-1} 2, 4-D + 0. 2 mg L^{-1} Kin was the optimum medium for callus induction from the hypocotyls source and callus induction was higher using MS medium containing 2.0 mg L^{-1} BA and 0.2 mg L^{-1} IAA using stem as source for callus induction (*Yu-Hong et al 2005*).

Based on the reports the callus cultures of *E. intermedia* were initiated from the segments of aseptically seedling of *E. intermedia* seedling on MS medium contained 2 mg L^{-1} 2, 4-D and 0. 5 mg L^{-1} BA (benzylaminopurine), and subcultures continued on MS medium with 0.5 mg L^{-1} 2, 4-D; 0.2 mg L^{-1}

NAA and 4 (%) sucrose. These cultures of callus were used for the establishment of suspension culture in MS liquid medium supplemented with 0.2 mg L^{-1} 2, 4-D; 0.1 mg L^{-1} BA; 0.1 mg L^{-1} NAA and 2 (%) sucrose (*Yuling & Jingfen 1995*). Vantu also reported that the *E. distachya* initiated callus while using its stem as explants in a MS standard medium contained MS; Kin- 1.0 mg L^{-1} and 1.0 mg L^{-1} 2, 4-D (Vantu 2002).

4. Conclusions

Our results indicated that neither Kin nor BAP as applied cytokines at any ranges along 0.5 (mg L^{-1}) NAA as an auxin could induce callus form explants of *E. pachyclada,* but considerably, this action was reversed when NAA ranges had been increased to 1.0 (mg L^{-1}) in the medium, and as a consequence induction rates were increased significantly, but this induction rate again was started to decrease when cytokinin ranges had been enhanced more than NAA ranges. In addition, the influences of Kin as a cytokinin were so vivid in the treatments in contrast of BAP. Somehow, callus induction rates, callus initiation weight, callus fresh weight and RGR in the medium were recorded significantly better in quantity and quality compared to BAP.

Notably, the quality of survived callus in the treatments were changed and their color were altered into the green during the subsequent subcultures, this pattern was obvious after the third subculture; these changes in callus quality and color could be related to light effects which induce of chlorophyll or the roles of plant growth regulators or even cells accommodation in the medium.

As a conclusion our results could be a pattern for the ones who seek to work on **Ephedra** *pachyclada* Boiss *in vitro* culture, and give them a better understanding on different aspects of hormonal influence on callus induction and callus growths, however comprehensive analysis on this subjects is still intensively needed.

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AGRICULTURE, WATER CONSUMPTION AND CONSUMERS' PERCEPTIONS ON WATER PRICE

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Abstract: The paper presents the links among agriculture – water consumption – consumer perceptions on water price starting from two premises: agriculture is the activity with the biggest water consumption and perceptions influence behavior. Within this context, a case study on urban residents' perceptions related to water price is discussed. Five standards are used to compare the tap water price: bottled water price, other monthly utility expenses, household income, quality of the water-sewerage services, importance of water as a natural resource. The results indicate, for the majority of tested population, an undervaluation of water, both as commodity and as natural resource.

Key words: water, price, agriculture, consumers, perceptions

1. Relationship agriculture – water consumption – consumers' perceptions

Agriculture is dependent on water and is the activity with the biggest water consumption. Human behavior has a direct impact on the water consumption and availability for agriculture, through policies, strategies establishing amounts of water to be used, pollutants limits, types of products, irrigation facilities and use, cultivation patterns etc and an indirect one, through actions that change climate, which further influence precipitations, soil moisture etc. Worldwide, agriculture accounted in 2000 for 70% of all global freshwater withdrawals, 20% go to industry and 10% to domestic use (***, *Economic valuation…*, 2004, p. 3). In developing countries the share of agriculture is even higher: 80% between 1998-2002, while in developed countries it was 40% for the same period (***, *Human Development Report*, 2006, p. 138).

This represents only the withdrawals for the direct consumption of water; the indirect consumption and the impact on water quality and on the rest of the environment are not included in these calculations. Much of the world is running out of water. Over 1 billion people worldwide do not have access to clean water. More than 2 billion people do not have proper sanitation. The UN Food and Agriculture Organization (FAO) estimates that by 2025 more than 3 billion people could be living in water-stressed countries and 14 countries will slip from water stress to water scarcity (***, *Human Development Report*, 2006, p. 136).

Perception influences behavior (Ajzen, 2006, http://people.umass.edu/aizen/tpb.diag.html). Perception on water, as a commodity and as a natural resource, and perception on water price influence each other: more important people see the water as a commercial good and as a natural resource, higher the equitable or fair price they associate to it will be. As the same time, as water becomes more expensive, people raise their evaluations of it for two reasons: because they have to give up more of a limited resource (money) to obtain it and because they use money as a measure for value. Consumers' perceptions on water price influence their behavior related to water: type of use, amount used, saving behavior, protection behavior etc.

The relationship agriculture – water consumption – consumers' perceptions functions has three directions (Figure 1.):

(1a) Consumers' perceptions on water (in general) and on water price (in particular) influence the agriculture because the decisions concerning the type of crops, of varieties to be cultivated, the extension and use of the irrigation system, the agriculture development strategies etc take into account aspects related to water and water price; the decision makers will be influenced both in their domestic and business, private and professional decisions by their beliefs on water and water price.

(1b) Consumers' perceptions on water (in general) and on water price (in particular) also influence their behavior in relation to water consumption in other fields than agriculture: pollutants limits, saving actions, protection policies etc.

(2), (3) Agriculture and other fields have a mutual influence. For instance, a national strategy stimulating organic agriculture can decrease interest for chemical fertilizers and stimulate production and commercialization of manure and

research related to it; consumers/industry demand of a certain pharmaceutical product based on a certain vegetal component can increase the cultivation of that plant; policies stimulating green energy production and use can raise production of energy crops etc.

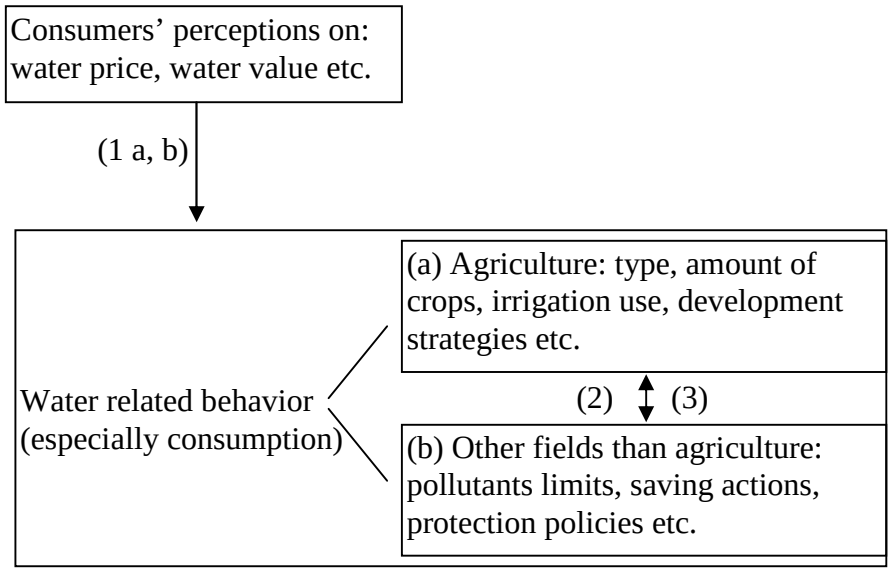


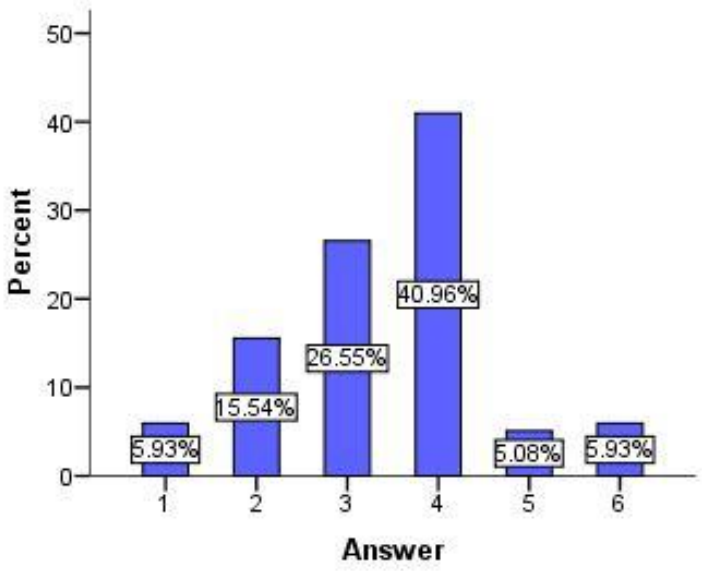
Figure 1. Relationship agriculture – water consumption – consumer perceptions
Source: author's elaboration

2. Consumers' perceptions on water price

The objective of the research described here was to evaluate the urban residents' perceptions on the tap water price. The results presented in this paper belong to a broader study on the attitudes of the customers of a regional water company (SC Compania de Apa Somes SA – CASSA) related to the services of the company, the relationship with its customers, the customers' environment oriented attitude etc, as a part of the ISPA measure ISPA 2000/RO/16/P/PE/008 Rehabilitation and Modernization of the Water and Sewerage Infrastructure for the Area of Cluj. A simple random survey was implemented and home interviews were carried on. The margin of error of the survey was 5% and confidence level was 95%. The total number of valid questionnaires completed was 384. From a geographical point of

view, the research included the municipal area of Cluj-Napoca (NW of Romania). From the survey perspective, the univers population is composed of the adult domestic customers of CASSA in Cluj-Napoca city (more precisely, domestic users of CASSA services). All the inhabitants of Cluj-Napoca are customers of the water company, so we can understand the results of the research as being valid for the entire population of the city.

The interpretation of consumers' perceptions on water price is correct only if it is clearly connected to a well defined standard. Otherwise, if consumers are not given a specific standard to which they can relate to, they will choose one themselves, unmentioned, different from one person to another, unknown to the researcher, and errors will occur. In order to have the best possible evaluation of the water price, the subjects were requested to compared it to several specified standards; these were considered to be the most representative in the interpretation of the water price: bottled water price, other monthly utility expenses, household income, quality of the water-sewerage services, importance of water as a natural resource. First, the subjects were informed about the water price, because many of them were not aware of it: "*A m3 (1000 liters) of tap water costs around 2.5 lei (0.56 euro)*"; then, they were asked to evaluate it, using a specific standard: *How do you see the water price compared with ….?*".



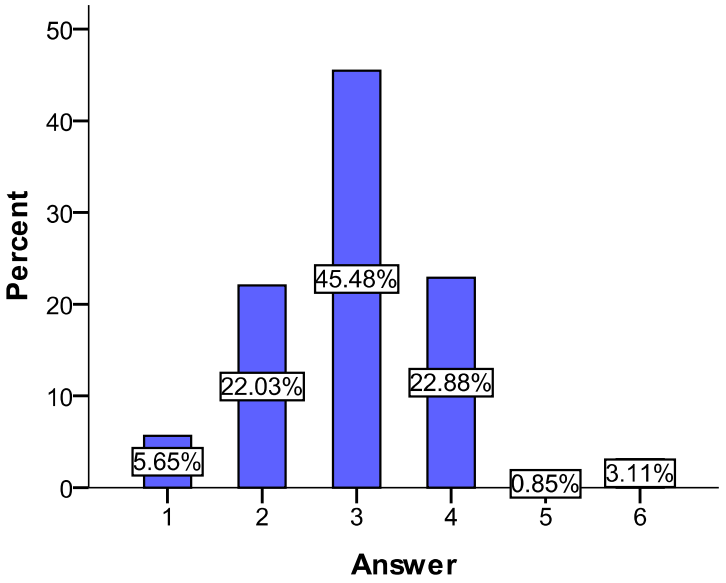
Legend: 1 – very high, 2 – high, 3 – average, 4 – low, 5 – very low, 6 – I don't know

Figure 2. Evaluation of water price, compared to bottled water price

Source: ***, 2010, *Report of the Research Project Survey…*

The average price of bottled water was also mentioned in this question, in order to have similar evaluation base for all respondents: the price of a m3 of bottled water is 3000 lei (666.67 euro), equivalent of 3 lei/l (0.67 euro/l), while tap water is 0.0025 lei/l (0.00056 euro/l). It can be stated with a probability of 95% that around one quarter of the respondents (between 16-26%) consider the tap water price high and very high and another quarter (between 22-32%) as average, while only almost half of them (between 41-51%) see it as low and very low. Taking into account that tap water price is over 1000 times (1191) cheaper than bottled water, these percentages are too high and demonstrate either a wrong perception of the reality (even in the context where the two prices were explicitly presented) or an even lower expected price for tap water (compared to the bottled one). In the case of the first interpretation, further explanations are needed in order to correct the perceptions. In the second case, it means that tap water has a perceived monetary value below its market

(relative) one: people expect it to be cheaper that it is, when they compare it to the bottled water.

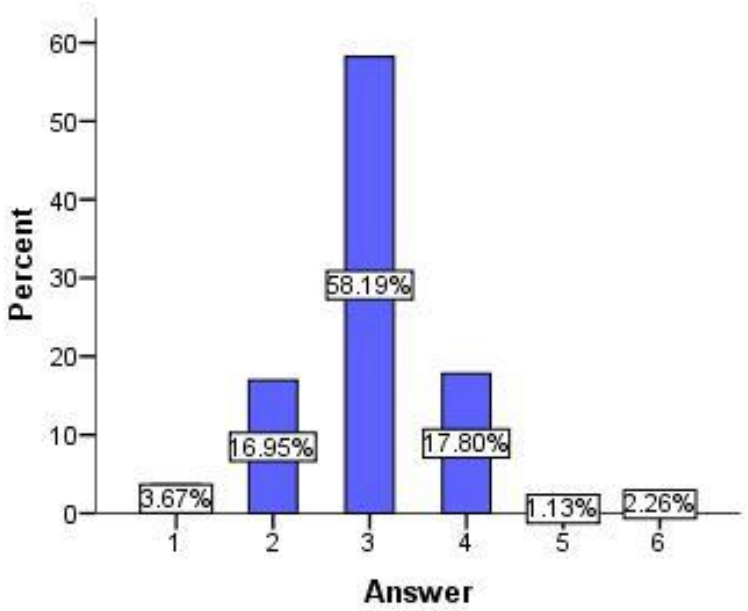


Legend: 1 – very high, 2 – high, 3 – average, 4 – low, 5 – very low, 6 – I don't know

Figure 3. Evaluation of water price, compared to other monthly utility expenses

Source: ***, 2010, *Report of the Research Project Survey…*

It can be said with a probability of 95% that around one quarter of the subjects (between 23-33%) see the price as high and very high, another quarter (between 19-29%) as low and very low and around half of them (between 40-50%) as average, compared to other monthly utility expenses. Taking into account that, in general, for the population under evaluation, the real share of water expenses is much lower than the one for gas, lower than or similar to electricity and higher only than sanitation, we can conclude either they do not know the share of each utility in total expenses or that they expect a lower water price. The action to take in the first case is better information; in the second case, between 68-78% who see the water price very high, high, average compared to other monthly utilities expenses should be guided to understand that water has a higher value than they imagine, which must be reflected in its price.

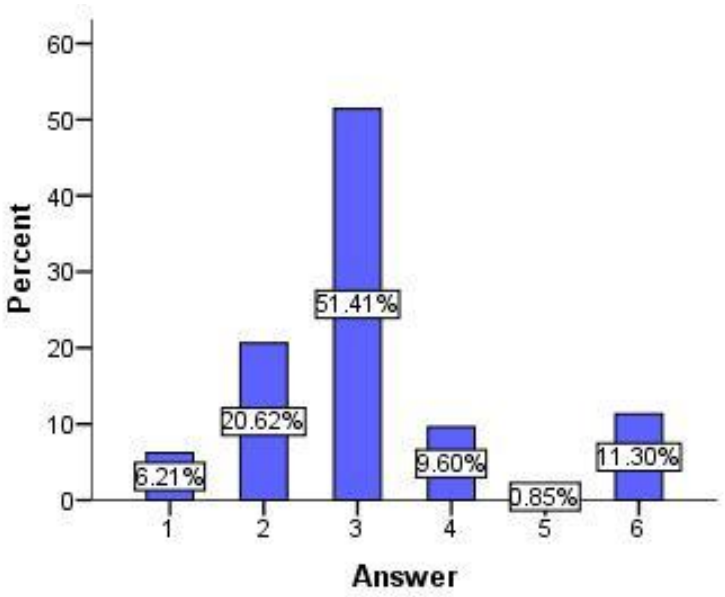


Legend: 1 – very high, 2 – high, 3 – average, 4 – low, 5 – very low, 6 – I don't know

Figure 4. Evaluation of water price, compared to household income

Source: ***, 2010, *Report of the Research Project Survey…*

It can be stated with a probability of 95% that around one quarter (between 16-26%) of the subjects feel the water price is very high and high compared to their household income, more than half (between 53-63%) as average and less than one quarter (14-24%) as low and very low. This is a good result, indicating that for between 72-82% of the population the water price is perceived as bearable when compared to income. From social point of view this is the most important aspect (from the five price related analyzed here) because the income is one of the most important variables that influence the attitude with a certain good/service. This result indicates there is a solid base on which new perceptions can be built: tap water price in relation to bottled water, to monthly utility expenses etc.

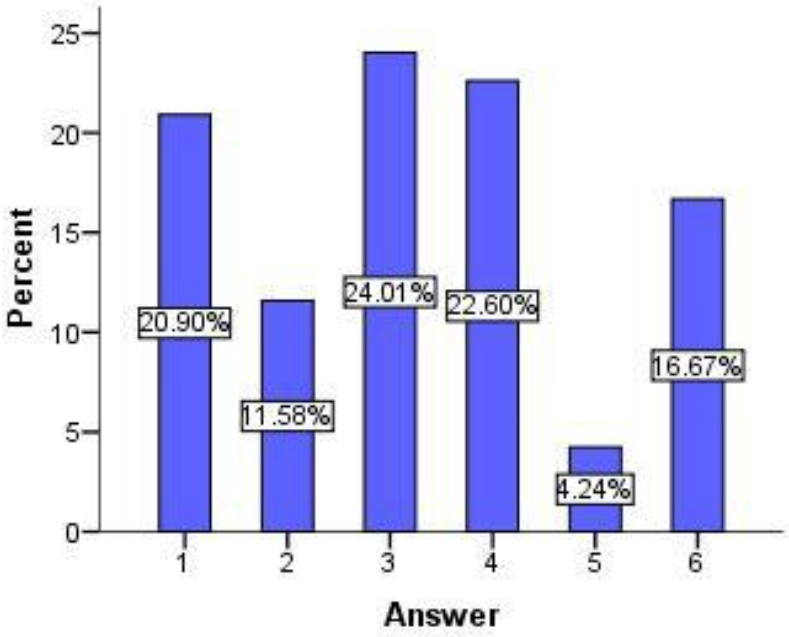


Legend: 1 – very high, 2 – high, 3 – average, 4 – low, 5 – very low, 6 – I don't know

Figure 5. Evaluation of water price, compared to the quality of the water-sewerage services

Source: ***, 2010, *Report of the Research Project Survey…*

It can be stated with a probability of 95% that around one quarter (between 22-32%) of the population perceive the tap water price as very high and high compared to the quality of the water-sewerage services; this means they see an unfavorable ratio price/quality, which generates dissatisfaction. This percentage should be decreased because the real quality of the water-sewerage services is high, respecting all the national and EU legal standards. Around half (between 46-56%) see the water price as average, meaning for them it is a balanced ratio price/quality. The rest which see the price as low (between 5-15%) and very low are very satisfied customers. Those unable to judge the ration price-quality are too many (between 6-16%) and further communication to compensate this lack is needed.



Legend: 1 – very high, 2 – high, 3 – average, 4 – low, 5 – very low, 6 – I don't know

Figure 6. Evaluation of water price, compared to the importance of water as a natural resource

Source: ***, 2010, *Report of the Research Project Survey…*

It can be stated with a probability of 95% that between 27-37% of the population consider the tap water price as very high and high compared to the importance of water as a natural resource is too big. Water is a vital resource, which becomes scarcer and more polluted every year. Its valuation is essential for its conservation. If it is not appreciated to its real value, it will be wasted and wrongly managed. Both those considering the price very high, high (27-37%) and those considering it average (between 19-29%) must change their perceptions and understand that, currently, the price is very low compared to the importance of water as a natural resource. Percentage between 22-32% understands this reality and represents a promising start. However, this share must be regarded with precaution because people often declare things that make them look good in others

eyes or in theirs (so, what they declare might not be their real belief). The percentage between 12-22% who cannot make an evaluation is too high: education, information is needed in order to create the evaluation capacity.

This research carried out through a simple random survey was very carefully implemented and respected all the statistical requirements in order to make the results of the sample representative for the entire population. Still, some limitations of the research must be taken into consideration in order to evaluate the results properly. In this respect, we mention that people tend to complain, to exaggerate their negative evaluations in order to get more attention and to increase chances to obtain what they need. Statements like "water price is very high/ high" may fit among these situations. Another limit to consider is that concern for water (environment) is probably seen by the respondents as a positive trait of a person. Naturally, people want themselves and the others to have a good image about them and because of this, in spite of the researcher and operator specific and open commitment and promise to keep the answer anonymous, the respondents might have tipped the balance towards the positive (from the point of view of environment protection) answers. The subjects might have been tempted to choose the answers indicating a positive attitude towards water (environment) either because they wanted to create a better image in the eyes of the operator or because they wanted to see themselves in such a way. The best arguments found for respecting the anonymity and the importance of true answers were presented and highlighted repeatedly by the operators to the respondents in order to obtain answers as real as possible. In conclusion, the results of the study reflect the declared perceptions of the population, which might be slightly different from the real ones.

Agriculture is mainly carried on in rural areas and the necessary water resources are also located there. Nevertheless, urban residents have the major influential power on how water is used and managed for several reasons: decision power concerning policies, legal standards etc belong mostly to them, urban population has surpassed the rural one and is increasing, trends in food consumption are driven by them and so on. Within this context, knowing urban residents perceptions on water has at least the same importance as knowing that of the rural ones.

Perceptions influence behavior and water related behavior has the major impact on how water resources are managed.

3. Conclusions

Perceptions on tap water price indicate that water is seen in most cases as being too expensive, which demonstrates an undervaluation of commodity tap water and, consequently, of the precious resources – fresh water. The respondents are urban residents, thus, being important decision factors for numerous water related issues; their perceptions influence their reasoning, actions and decisions related to water, whatever their role would be – in their private and professional or public life: as private consumers and also as representatives of government, of business, of public organizations etc. It can be concluded there is a meaningful relationship – agriculture – water consumption – consumers' perceptions, that must be analyzed, known and carefully adjusted in order to have a proper contribution to sustainable development.

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Organic Agriculture as Mediator between Urban and Rural Space in Supporting Sustainable Development

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Abstract: Organic agriculture is able to fulfill the role of mediatior to diminish the conflict between what people need and take and what nature has to offer them; at the same time, organic agriculture can mediate the tensions between urban and rural areas. The paper aims to create a model that reflects the interactions between rural and urban space, through organic agriculture (and consumption of organic agricultural products), in the context of sustainable development. The purpose of the model is to systematize these influences, to facilitate their understanding and highlight the usefulness, necessity and importance of production and consumption of organic agricultural products to sustainable development.

Key words: organic agriculture, interaction, urban, rural, sustainable development

1. Perpetual Conflict between Society Needs and Natural Balance

Opposite interests derived from the pressure to cover the demand of a society with increasing needs and from the necessity to maintain the natural resources and services between some limits that allow this society to exist and progress generate a perpetual conflict. Environmental indicators (depletion of resources – water, forests etc, increase of waste, climatic changes etc) and scientific progress that reveal new aspects of human negative impact on nature indicate rather an escalation of this conflict over decades than its mitigation, because mankind continuously distances the state of the environment from the ideal natural balance. However, progress towards diminishing the conflict exists and, compared to the strength of the opposing

forces, can be considered as an encouraging success. According to UN, some of such positive results are:

- The net loss worldwide of forests decreased over the last 20 years, from -8.3 million hectares per year in the 1990s to -5.2 million hectares per year in the last decade.
- Overexploitation of global fisheries has stabilized, but steep challenges remain to ensure their sustainability.
- More than 200 million people gained access to improved water sources, improved sanitation facilities, or durable or less crowded housing. The number of people using improved drinking water sources reached 6.1 billion in 2010, up by over 2 billion since 1990. In 2010, 89 percent of the world's population was using improved water sources, up from 76 percent in 1990. The share of urban slum residents in the developing world declined from 39 percent in 2000 to 33 percent in 2012.
- A reduction of over 98 percent in the consumption of ozone-depleting substances was achieved between 1989-2012. (***, 2012, *The Millennium Development Goals Report 2012*)

The above mentioned progress consists of two main elements: (a) increase of the awareness on the need to protect the environment and of the willingness to do it and (b) implementation of numerous actions, measures, programs etc that have four important groups of results: they slow down the peace of environmental degradation, restore damages, prevent future ones, educate – raise the awareness on human impact on environment and on the necessity to protect it. Among these, conversion from convetional to organic activities bring important contribution to sustainability.

2. Organic Agriculture as Conflict Mediator between Human Demand and Nature's Offer

Agriculture is a vital sector of human activity, because it generates almost all the food the people consume. Agricultural activities are carried out (with very few exceptions) in rural areas,

that, in the European Union account for 90% of its surface and host about 50% of its population (cf. http://www.wecf.eu/english/about-wecf/ issues-projects/projects/eu-organic-farming.php).

At the same time, agriculture has a huge impact on the natural environment. If we discuss only the water consumption, we see that 70% of it is absorbed by agriculture (remaining 20% and 10% go to industry and domestic use). At the same time, water becomes scarcer and more polluted: the water available for human consumption represents less than 1% of the total water on Earth and is unevenly distributed in relation to needs, freshwater withdrawals have tripled over the last 50 years, demand for freshwater increases by about 64 billion m3/year (1 m3 = 1.000 l) (cf. http://www.worldometers.info/water/). Additionaly, short-term social or economic interests have directed agriculture towards development models that distroy profoundly the natural environment: huge areas of rainforest are cleared to make way for soybean crop necessary for husbandry, monoculture devastates biodiversity in many areas, pesticides, fertilizers and other chemicals used in agriculture poison soil, air, water, destroying many of the plants and animals they reach, energy also pollutes.

According to Codex Alimentarius Commission, "Organic agriculture is a holistic production management system which promotes and enhances agroecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, cultural, biological and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system." (Codex Alimentarius Commission – Guidelines for the production, processing, labeling and marketing of organically produced foods, CAC/GL 32-1999, p. 2.) The terms of bio, ecological and organic agriculture (or farming) are considered here as synonyms.

Within this context, organic agriculture has an essential contribution to improve environmental and human health and, therefore, to increase people's quality of life. Transition to organic farming is one of the solutions that contribute to sustainable development. Implicitly, consumption of organic

agricultural products supports sustainable development. Thus, organic agriculture is a *double mediator*: (1) between the human demand and natural offer, which are opposite in most cases, and (2) between the urban and rural spaces, which depend on and compete whith each other at the same time. One mediation function sustains the other, they are interconnected and are indispensable in creating sustainable development.

Organic farming is based on a number of objectives, principles and best practices designed to minimize human impact on the environment, while ensuring that the agricultural system operates as naturally as possible. Thus, organic farming creates conditions for sustainable development in a much greater extent than conventional agriculture.

Basic *principles* of organic agriculture can be summarized as follows: (1) Health: Organic Agriculture should sustain and enhance the health of soil, plants, animals, people and planet as one and indivisible; (2) Ecology: Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them; (3) Fairness: Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities; (4) Care: Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment (http://www.ifoam.org/about_ifoam/principles/index.html). These principles reflect the *concern* for: (a) Environmental protection (b) Maintainance and improvement of soil fertility, (c) Respect for consumer health, (d) Maintainance of agricultural ecosystems biodiversity, (e) Recycling of chemicals and resources as much as possible within the farms, (f) Understanding of farms as entities in equilibrium, (g) Maintainance of the integrity of organic agricultural products from their production to commercialization, (h) Plant and animal breeding, in harmony with natural laws; (i) Generation of the optimal output, not the maximum one, (j) Use of new and suitable technologies for organic farming system, (k) Breeding of livestock respecting the requirements of each species. General organic farming *practices* include: (a) Wide crop rotation as a prerequisite for an efficient use of on-site resources, (b) Very strict limits on chemical synthetic pesticide and synthetic fertiliser use, livestock antibiotics, food additives and processing aids and

other inputs, (c) Absolute prohibition of the use of genetically modified organisms, (d) Taking advantage of on-site resources, such as livestock manure for fertiliser or feed produced on the farm, (e) Choosing plant and animal species that are resistant to disease and adapted to local conditions, (f) Raising livestock in free-range, open-air systems and providing them with organic feed, (g) Using animal husbandry practices appropriate to different livestock species (cf. http://ec.europa.eu/agriculture/organic/organic-farming/what-organic_en).

For over two decades, organic agricultre has a positive trend in EU, reflected by both quantitative and qualitative increases: of cultivated land, quantities produced and sold, cash flow etc. EU occupies the first place in the world as share of organic agricultural land of total agricultural land (Table 1.). Approximately one quarter of all organic cultivated area in the world (37.2 million ha) is located in Europe (9.2 million ha). Also, the share of organically cultivated land in the total utilised agricultural land has increased constantly in EU (Figure 1.) It is estimated that the EU market for organic products increases by 10-15% per year (http://ec.europa.eu/agriculture/organic/organic-farming/what-organic_en).

Some of the factors that stimulated the deveopment of organic sector are: progress made by specialists in understanding the relationship agriculture-food-health-environment protection; dissemination of this information to the public (consumers, business, government, etc.); raising of population and other actors concern about personal health, environmental balance, animal welfare; creation of an institutional framework that allowed the development of organic agriculture – creation and implementation of legislation, allocation of funds, creation of support policies, action plans to stimulate the research, etc. Existence of links between organic agriculture and other sectors (sustainable development, rural development, regional development, tourism, etc.) also favors its growth and positive effects generated in every sector will reinforce each other and produce an overall result higher that one obtained detached from the others.

There are, however, strong obstacles hampering a more rapid development of organic sector: from the administrative ones (high bureaucracy for certification) to the cultural (bias,

inadequate education level) and economic ones (low income, competition of conventional agriculture).

Table 1. Share of organic agricultural land in total agricultural land by region (2009)

Region	Agr. land (ha)	Share of regions
Africa	1.026.632	0,1%
Asia	3.581.918	0,3%
Europe	9.259.934	1,9%
European Union	*8.346.372*	*4,7%*
Latin America	8.558.910	1,4%
Oceania	12.152.108	2,8%
North America	2.652.624	0,7%
Total	37.232.127	0,9%

Source: H. Willer, 2011, p. 15

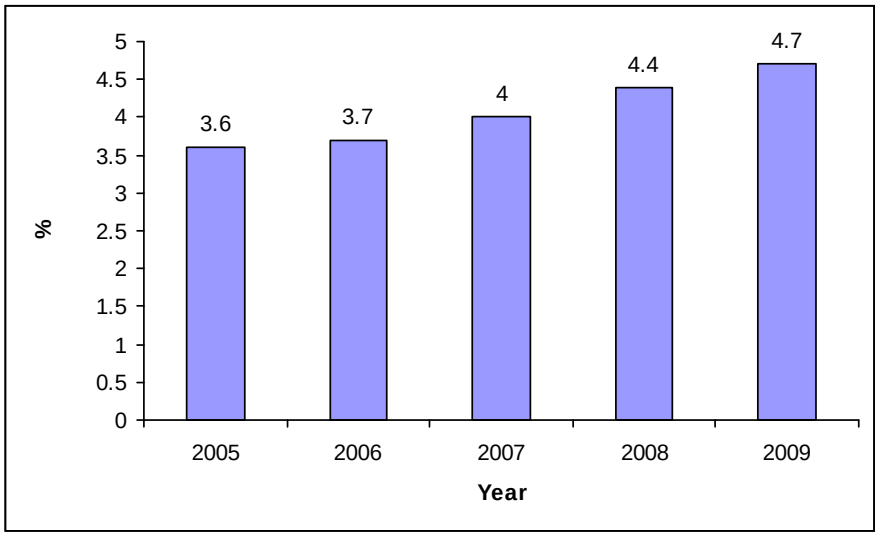

Figure 1. Evolution of share of area under organic farming in total utilised agricultural area (2005-2009, EU)
Source: author's representation using data from http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdpc440

3. Model of Mediation between Urban and Rural Space through Organic Agriculture

The most important benefit of organic farming is the contribution to achieving sustainable development in all its three components – environment, economy and society. Organic agriculture combines tradition, innovation, science for the benefit of natual and human environment. (Petrescu-Mag, R., M., Petrescu, DC, 2010, p 121). The extension of urban area and the growth of urban population increase the pressure on the environment (through pollution, break of natural life rhythms, stress, etc.): 33% in 1960, 50.5% in 2010 of world population was urban and the trend continues. Organic farming is a way to partially offset the damage caused to nature (and society) by humans and urbanization. Because organic farming takes place mainly in rural areas, it can be seen as a link between these two types of housing, facilitating the transmission of many benefits from each other.

The urban space (and the rural one) is understood here as the total group of characteristics of this urban (or rural) area – surface, society, production etc.

Various traits of organic farming (production traits, its components, consequences of its practice, etc.) have influence on both the rural and the urban space and generate connections between them. This set of traits (factors, influences) can be analyzed, structured and presented within an interactions model among organic agriculture – rural space – urban space (IOARU). IOARU model presented below identifies the most important factors that may be associated with organic farming mediating the interactions between rural and urban areas and explains how they manifest in each type of habitat (rural and urban), contributing to sustainable development.

1. Organic agriculture (OA) has specific location of production and consumption			
RURAL	The rural area provides physical space for the realization of OA. The location legitimates claims for support and protection to the decision-making power (which is generally located in urban	Urban area cannot provide physical space for the realization of organic agriculture (with quantitatively insignificant exceptions). Most of organic products (certificated) consumption	**URBAN**

	areas). Location stimulates the consumption of organic agricultural products in rural areas through increased availability of organic products associated with proximity to them, due to the existence of local producers.	takes place in urban dwellings. Location generates dependence of urban residents on the existence of rural areas. The interest of urban areas residents for rural space protection – from natural, social, economical point of view – increases.	

2. Distance to consumer in OA: it is preferably short, local products are preferred			
RURAL	Rural areas closer to the cities are preferred compared to more remote ones. Transport distance is shortened and, as consequence: fuel consumption, delivery time, number of intermediaries are reduced, prices are lower, delivered quality is better at destination, the sold quantities increase, household incomes increase. Relations with neighboring urban areas are strengthened, increasing opportunities for rural development, for extension and diversification of agricultural and other activities.	Transition to local organic agriculture in areas closer to towns is encouraged (respecting minimum threshold necessary to obtain an organic production). Transport distance is shortened and, as consequence: fuel consumption, delivery time, number of intermediaries are reduced, prices are lower, quality is better at destination, food (raw materials) costs are lower, product quality is better at destination, quantities purchased increase, impact of nutrition on health is improved. Relations with neighboring rural areas are strengthened, increasing opportunities for other activities.	**URBAN**

3. OA generates jobs			
RUR	OA creates jobs in rural areas. Organic production is an	Creates jobs in urban areas in: research, production of goods	**URB**

AL	attractive alternative because the demand for organic products is growing. At the same time, organic farming requires more people than the conventional one.	using organic agricultural raw materials, etc.	**AN**

4. OA generates revenue for organic farmers			
RURAL	Producers' incomes increase, stimulating improvement in the quality of life, revitalizing the area, generating revenue for its protection, etc. Through jobs creation and generation of income, organic agriculture contributes to increase the chance to equal opportunities between rural and urban areas.	Business opportunities increase, number of potential customers raises, because farmers have purchasing power to purchase various products and services offered by urban areas.	**URBAN**

5. OA delivers raw materials for other activities			
RURAL	Diversification increases the chances of earning money, of development. Organic agriculture helps keeping a cleaner environment, which stimulates other activities – related to recreation, health etc.	Many activities use organic agricultural products as raw materials: textile, cosmetics, restaurant services etc. Consumers are thus provided with other organic products than food.	**URBAN**

6. OA perpetuates ancient valuable knowledge			
RURAL	OA prizes old valuable knowledge, which has proved effective, uses and preserves it. OA is a living archive and a testing laboratory for the selection of best practices.	Urban dwellers benefit of a range of skills and knowledge preserved in rural areas through OA and which would be lost if they disappear from rural areas; these can be used for effective future innovations in agriculture or	**URBAN**

		in other areas.	

7. OA helps preserving a culture and a particular lifestyle			
RURAL	OA ensures incomes to rural inhabitants, thus offering them the chance to continue living there, to combine old and new practices, preventing rural desertification, allowing preservation of culture and traditional lifestyle.	Urban dwellers have a chance to learn about and enjoy a different lifestyle than their own – having access to a space for recreation, for spiritual and culture enrichment.	**URBAN**

8. OA stimulates diversity			
RURAL	OA boosts diversity in different forms: habitat type (because it preserves rural areas), cultural, biological, and also that concerning farming – because the variety of conditions, problems, needs is addressed with local, particular, solutions tailored to their features, avoiding standard, generalized, answers. Thus, OA stimulates creativity and agricultural offer becomes more varied. For example, farmers will offer different varieties of organic products, adapted to particular conditions (weather, soil, parasites etc).	Consumers in cities will have a much broader range of products. Diversity also includes social and natural environment they have access to: a different lifestyle, another culture, another kind of landscape, natural conditions, etc.	**URBAN**

10. OA helps to restore and preserve human health			
RURAL	A cleaner environment and a healthy diet have positive effects on human mental and physical health.	A cleaner environment and a healthy diet have positive effects on human mental and physical health.	**URBAN**

11. OA helps to restore and preserve the natural balance			
RURAL	OA contributes to create a cleaner environment, in relation to each of its components: biodiversity, soil, air, water, climate, etc., with all the resulting positive consequences. Genetic changes are not engineered in the laboratory, with un-natural speed and separated from the rest of the natural elements with which that genetically modified organism is brought into contact when it is introduced in the production cycle; improvements, adaptations occur gradually in the rhythm of nature, preserving the natural balance.	The benefits of a cleaner environment are felt beyond the physical surface on which OA is practiced and neighboring urban areas will benefit from it.	**URBAN**

12. OA is close to the principle that defends the rights of nature			
RURAL	OA, like sustainable development, has similar positive impact on natural environment as that generated by the compliance with the principle that nature has rights, because it protects, to a certain extent, the cycles, the needs of nature. Consequences are felt both in rural an urban areas. According to concept of Rights of Nature,	In urban areas, the consequences derived from the respect of the rights of nature (to the extent accepted in the OA principles) are similar, in type, to those in rural areas (cleaner, more protected environment, improved human health etc), but their intensity may be higher due to a bigger contrast between the state before and after the implementation of	**URBAN**

	environment itself has rights superior to ownership. Rights of Nature is the recognition and honoring that Nature has rights; it is the recognition that our ecosystems – including trees, oceans, animals, mountains – have rights just as human beings have rights. Rather than treating nature as property under the law, rights of nature acknowledge that nature in all its life forms has the right to exist now and tomorrow, maintain and regenerate its vital cycles. "…. Ethics have expanded over time and some thinkers and activists now regard nature (or certain of its components) as deserving liberation from human domination… From the perspective of intellectual history, environmental ethics is revolutionary; it is arguably the most dramatic expansion of morality in the course of human thought… in recent years many people found compelling the notion that nonhuman life and nonliving matter have moral standing… historians are aware that the same incredulity met the first proposals for granting independence to American colonists, freeing the slaves, respecting Indian rights,	(the same) measures for the compliance with the rights of nature. In rural areas, certain rights of nature are respected (consciously or unconsciously) to a higher degree than in urban ones. Two consequences, at least, derive from here: the gap between the state without and the state with respect of rights of nature is lower in rural areas than in urban ones; the acceptance of measures dedicated to compliance with the rights of nature is more difficult to obtain in urban areas (because people are resistant to change and bigger the change, more reluctant they are and because their number is higher and their power and interests are more intense that those of rural inhabitants).	

	integrating schools, and adding an Equal Rights Amendment to the Constitution. As John Stuart Mill put it, every great movement must experience three stages: «ridicule, discussion, adoption».” (R. F. Nash, 1987, p. 6-8)		

13. OA contributes to create equity between generations			
RURAL	Just as sustainable development, OA contributes to ensuring equity between generations, because it offers future generations the chance to benefit from all advantages brought by OA: to have a clean environment, to have the opportunity to benefit from a rural environment, from the possibility to choose a rural and agricultural life style, to preserve a certain culture, to be able to consume natural, uncontaminated products that might disappear otherwise etc.	Just as sustainable development, OA contributes to ensure equity between generations, because it offers future generations the chance to benefit from all advantages brought by OA: to have a clean environment, to have the opportunity to benefit from a rural environment, from the possibility to choose a rural and agricultural life stile, to preserve a certain culture, to be able to consume natural, uncontaminated products that might disappear otherwise etc.	**URBAN**

14. OA contributes to create equity between territories			
RURAL	Rural areas are, in general, less favored areas compared to urban ones; OA offers jobs, income, interest for rural areas, contributing to more equal chances for the two types of habitat: rural and urban. At the same time, just	Rural areas are, in general, less favored areas compared to urban ones; OA offers jobs, income, interest for rural areas, contributing to more equal chances for the two types of habitat: rural and urban. At the same time, just	**URBAN**

	as pollution has no political or administrative frontiers, a clean environment spreads its positive influence beyond the land surface where it is located. So, improving environment through OA has positive impact beyond the geographical area where it is practiced.	as pollution has no political or administrative frontiers, a clean environment spreads its positive influence beyond the land surface where it is located. So, improving environment through OA has positive impact beyond the geographical area where it is practiced.	

15. OA has an educational role			
RURAL	Nature knows the best. Working in OA keeps the man close to nature and its laws; thus, nature teaches man about its laws, to respect them, to adapt to them.	Nature knows the best. Working in OA keeps the man close to nature and its laws; thus, nature teaches man about its laws, to respect them, to adapt to them. Urban inhabitants can also learn from the rural inhabitants' experience.	**URBAN**

16. OA stimulates ecological intelligence			
RURAL	Man is more involved, more present in organic farming than in the conventional one. He is more aware of the biological cycles, of the rhythm of nature, of its laws and carries out his work in accordance with them, learns to respect, appreciate and use them. Organic producers act cautiously and responsibly to protect the health and welfare of present and future generations and the environment.	Preference for bio products is usually associated with understanding of how they were produced and of nature-production-consumption relationship. Thus, the consumer becomes more aware of the laws of nature, more responsible, more cautious. Ecological intelligence of urban residents (main beneficiaries of organic products) is thus stimulated. In other words, their ability	**URBAN**

	Thus, OA stimulates environmental intelligence, which is the ability of an individual or group to adapt to an ecological niche, to understand organisms and their ecosystems, the capacity to learn from experience and deal effectively with his/its environment (Goleman D., 2009, p 40). Ecological intelligence has positive consequences on natural and social balance and economic efficiency in the long run.	(as an individual or as a group) to adapt to an ecological niche, their capacity to learn from the experience and to deal effectively with their environment increase (D. Goleman, 2009, p 40). Positive impact on the natural balance and social and economic efficiency in the long run is obtained. The chances of ecological intelligence to spread its effects in other fields where urban residents are involved increase – more sustainable management of urban areas, health protection policies, nature protection policies etc.	

17. OA brings the man to a superior level of its evolution			
RURAL	OA brings man to a new level on his evolution, where he acts in harmony with nature, not against it, where he respects the laws of nature and the rights of nature.	OA brings man to a new level on his evolution, where he acts in harmony with nature, not against it, where he respects the laws of nature and the rights of nature.	**URBAN**

18. OA is strengthened by the power of example			
RURAL	The power of example is higher than of explanations; thus, more numerous and more widely known organic farming activities are, more chances that they are initiated by others will be. As production increases, prices	The power of example is higher than of explanations; therefore, larger and more advertised the consumption of organic products is, more chances to be adopted by others are. The higher the interests of buyers and the	**URBAN**

	may decrease, and consumption expands.	demand are, more attractive to producers organic field is.	

19. Development potential of OA depends on available natural conditions and commitment to sustainable development			
RURAL	DP = NC (R) + PEF (U). Development potential of OA depends both on natural conditions – available land, climate factors, visible in rural areas and on political and economical factors, acting mostly in urban area and which condition the commitment to sustainable development. Physical factors sustaining the development of OA belong mostly to rural area, as here is where it takes place (weather conditions, soil, water etc). Rural areas, in most cases, are able to provide conditions for OA development and the need to have cleaned environment and healthier products exists and is increasing. However, these favoring factors are obstructed by the forces in favor of conventional agriculture – need for big quantities of food, higher economic efficiency, competition, political interests etc. The development potential of OA is proportional to the commitment to adopt and	DP = NC (R) + PEF (U). Development potential of OA depends both on natural conditions – available land, climate factors, visible in rural areas and on political and economical factors, acting mostly in urban area and which condition the commitment to sustainable development. Political variables (policies, strategies, development directions, education directions etc) are mostly decided by urban residents, sometimes are based mostly on their views, ignoring needs and perspectives of rural inhabitants. Decisions related to economic aspects (food demand, funding, etc) depend more on urban side than on rural one. Political and economical decisions have also influence on social level. Pollution affecting rural areas has main roots in urban space, too – policies establishing pollution levels, industry productions, population demand for contaminating products etc. The development potential of OA	**URBAN**

	extend a sustainable development pattern. During the last decades efforts were made towards this direction.	is proportional to the commitment to adopt and extend a sustainable development pattern. During the last decades efforts were made towards this direction. However, favoring forces are obstructed by the forces promoting conventional agriculture – need for big quantities of food, higher economic efficiency, competition, political interests etc. Currently, the restraining factor, the one that influences to a greater extent the development of OA, is the political-economical one.	

20. Expansion of OA has a synergic effect			
RURAL	Expansion of OA means larger cultivated areas, higher production, consumption, more producers, consumers, involved decision-makers etc. Together, these components produce a higher effect then separately. In rural areas, they increase all positive effects of OA. In addition, OA expansion enhances the power (resources, legitimacy, acceptance, etc.) of those who fight for sustainable development and, implicitly, extends its implementation.	Expansion of OA enhances all positive effects of OA in urban areas, too. In addition, OA expansion increases the power (resources, legitimacy, acceptance, etc.) of those who fight for sustainable development and, implicitly, extends its implementation.	**URBAN**

Figure 2. Model of the interactions among organic agriculture – rural space – urban space (IOARU)
Source: author's elaboration and Petrescu, D. C., 2011

4. Conclusions

Organic agriculture is able to fulfill the role of mediatior in dimishing the conflict between what people need and take and what nature has to offer them; at the same time, organic agriculture can mediate the tensions between urban and rural areas, born from the competition for physycal space, income, labor force, natural resources etc.

Agriculture (regardless of its type) generates direct mutual influences and extensive effects between rural and urban space – related to human health, food safety, food security, equity, employment and many others. Organic farming, in particular, is a solution for sustainable development, creating a strong link between rural and urban space and huge economic and social benefits to members of both habitats.

The paper aims to create a model that reflects the interactions between rural and urban space, through organic agriculture (and consumption of organic agricultural products) in the context of sustainable development. The purpose of this model is to systematize these influences, to facilitate their understanding and highlight the usefulness, necessity and importance of production and consumption of organic agricultural products and their role in shaping a healthier, more balanced, cleaner, more sustainable world.

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ORGANIC AGRICULTURE POLICY AND LEGISLATION

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Abstract. The organic sector is founded on the principles of social, environmental and economic fairness, thus the policy on organic production should be viewed in the context of the broader agro-ecology and other relevant policies. The purpose of the organic policy is to create a broad framework for the development of a prosperous organic sector that is globally competitive and capable of supporting government's commitments towards poverty alleviation, decent work creation, food security, improved health and nutrition and potentially genuinely sustainable economic development. Organic agriculture policy regulates the organic sector, protecting both producers and consumers, as well as promoting fair ecological and social practices.

Keywords: agriculture, organic, policy, legislation, sustainability.

1. General concepts in organic agriculture

The term "organic agriculture" refers to a process that uses methods respectful of the environment from the production stages through handling and processing. Organic production is not merely concerned with a product, but also with the whole system used to produce and deliver the product to the ultimate consumer (El-Hage Scialabba and Hattam 2002).

Two main sources of general principles and requirements apply to organic agriculture at the international level. One is the Codex Alimentarius Guidelines for the Production, Processing, Labeling and Marketing of Organically Produced Foods: According to Codex, "Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management

practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, cultural, biological and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system" (FAO and WHO 1999). The other is the International Federation of Organic Agriculture Movements (IFOAM), a private-sector international body. IFOAM defines and regularly reviews, in consultation with its members, the Basic Standards that shape the "organic" term. In September 2005 in Australia the General Assembly of IFOAM adopted the Principles of Organic Agriculture which are the fundamentals of Organic Agriculture: health, ecology, care and fairness. In March 2008, after years of consultations, INFOAM approved the following definition: "Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved" (INFOAM 2008).

2. Organic agriculture - a dynamic sector worldwide

Consumers worldwide are becoming concerned about the quality and safety of food that they eat. They are concerned about the effect of pesticides, fertilizers, livestock effluent and veterinary drugs on their health and livelihoods. Organic agriculture is considered to be a viable solution to most of these concerns.

Organic agriculture has grown tremendously over the last decades, both as a commercial production and as an environmentally friendly production method. It has been found to be the best model for emerging farmers. A number of countries around the world have seen considerable increase in their organically farmed areas (worldwide situation of the area dedicated to organic agriculture in table no.1). More than 10% of Switzerland's farmland is organic, Sweden reached 19% in the year 2005, and about 13% of Austria's farms are organic. A number of developing countries are showing significant rates of adoption.

Table 1. Worldwide situation of the area dedicated to organic agriculture

Region	Year	Area (1000 Ha) *	Type of item
Europe	2009	7094.24	Agricultural area organic, total
Africa	2009	1002.08	Agricultural area organic, total
Americas	2009	7403.58	Agricultural area organic, total
Asia	2009	2209.98	Agricultural area organic, total
Oceania	2009	12139.51	Agricultural area organic, total
Europe	2009	4917.47	Agricultural area certified organic
Africa	2009	105.31	Agricultural area certified organic
Americas	2009	6909.87	Agricultural area certified organic
Asia	2009	926.43	Agricultural area certified organic
Oceania	2009	9.66	Agricultural area certified organic
Europe	2009	1673.76	Agricultural area in conversion to organic
Africa	2009	450.55	Agricultural area in conversion to organic
Americas	2009	467.96	Agricultural area in conversion to organic
Asia	2009	448.96	Agricultural area in conversion to organic
Oceania	2009	0.05	Agricultural area in conversion to organic

** May include official, semi-official or estimated data*
Source: adapted after FAOSTAT, FAO Statistics Division 2012, 07 February 2012 (http://faostat.fao.org/site/377/DesktopDefault.aspx?PageID=377#ancor) (a)

3. Organic agriculture policy and legislation

The organic sector is founded on the principles of social, environmental and economic fairness, thus the policy on organic production should be viewed in the context of the broader agro-ecology and other relevant policies such as national framework of sustainable development and initiatives such as the implementation for National Rural Development Program and Action Plans. A policy process needs to be participatory and be

based on clear objectives. Action plans, programmes and projects should develop from the overall policy. There are many reasons as to why governments should develop and implement the policy on organic sector (UNCTAD & UNEP 2008; PMG 2011):

- *Environmental benefits:* Through its holistic nature, organic farming integrates wild biodiversity, agro-biodiversity and soil conservation. It takes low-intensity farming one step further by eliminating the use of chemical fertilizers, pesticides and genetically modified organisms.

- *Protection of consumers:* false labels on conventionally produced products and selling them as organic are common practices. Many consumers are falling into this trap and sometimes pay premium prices for wrong products. This state of affairs developed because of a lack of a policy framework and regulatory system for organically produced products.

- *Health benefits:* there are more than 500 additives in foodstuffs permitted for use, some of which have negative human health and natural effects. Pesticides have potential to cause undesirable side effects. These include adverse effects on farmers, consumers, community health and safety, groundwater and surface waters, and non-target wildlife organisms. In addition, pesticide use raises concerns about the persistence and accumulation of pesticides in food chains quite distant from the original point of use, and about the role of certain pesticides in causing reproductive failure and endocrine system abnormalities in both wildlife and humans

- *Climate change:* Organic sector has well established practices that simultaneously mitigate climate change, build resilient farming systems, reduce poverty and improve food security. Organic production emits much lower levels of greenhouse gases, and quickly, affordably and effectively sequestrates carbon in the soil.

- *Social justice:* consumers are free to decide about what type of food they would like to eat. Organic production is based on a holistic view of the integration of farming into nature. Its proponents maintain that this fountain promotes “social justice” issues by recognizing the essential role of farmer; improving labor conditions, work place health and safety; the contribution of farming to rural communities and engaging in “fair trade”.

The purpose of the organic policy is to create a broad framework for the development of a prosperous organic sector that is globally competitive and capable of supporting government's commitments towards poverty alleviation, decent work creation, food security, improved health and nutrition and potentially genuinely sustainable economic development. Organic agriculture policy regulates the organic sector, protecting both producers and consumers, as well as promoting fair ecological and social practices. The objectives of the policy are (PMG 2011):

- To support the wide-spread production of high quality and safe organic products for both community, local and export markets.
- To facilitate broad participation in the organic farming sector.
- To protect consumers against false, misleading and unfounded claims and create the obligation for all producers to indicate the levels of inputs used in their produce.
- To improve competitiveness and profitability of the organic sector both on community, local and export markets.
- To improve the health of our population and our environment.
- To improve access to better nutrition for all.
- To uphold organic standards and prevent non-compliance.
- To provide a regulatory protocol framework to govern the organic sector and align the conventional sector on the same principles of transparency, compliance, traceability and accountability.
- Level the playing field for organic food production, by either removing direct and indirect subsidies to chemical agriculture or subsidizing organic agriculture equally.
- Agricultural policy environment can be favorable or unfavorable to organic farming.

Through special policies and programs governments can support the development of organic agriculture by offering subsidies, more funding for research, and other incentive programs for organic conversion. There are two major ways in which organizations and governments can encourage more sustainable agricultural production systems. One way is to provide subsidies, grants, credit or low-interest loans to sustainable models such as organic agriculture. The other way governments and organizations can encourage sustainable agricultural systems is through the internalization of costs, i.e.

removal of subsidies and other interventions that currently work against sustainability. Either of these would have the effect of removing distortions and making the sustainable, low-input options more competitive, at least for domestic trade (INFOAM b). At EU level, for the period 2007-2013, Council Regulation (EC) 1698/2005 provides the basis for agri-environment measures (article 39). Payment ceilings are similar to those of the period 2000-2006. Agri-environment measures are part of the thematic Axis 2 "improving the environment and the countryside through support for land management" of the regulation. Agri-environment payments are conditional upon commitment by the farmers for five to seven years. Payments for organic commitments are annual and per ha and are meant to cover the additional costs incurred and the income forgone (e.g. due to lower yields) as a result of organic production methods. Additionally, where necessary transaction costs (costs associated with the administration of the measures) can be covered. Ceilings for agri-environment payments (total public support, i.e. EU part and national co-financing) are €600 / ha for annual crops, €900 / ha for permanent crops, €450 / ha for other uses of land. These ceilings can be exceeded in exceptional circumstances justified in the rural development programmes, particularly if the payments are related to the new challenges (e.g. climate change, biodiversity, etc.) as identified in the Health Check.

The organic sector worldwide would be developed and supported through the following policy instruments: education and training programmes about organic farming; awareness programmes (Information campaigns about the principles, the practices and the environmental and other benefits of organic farming should be established. They should target consumers as well as farmers, but also operators in the processing industry, retailers, large-scale kitchens as well as schools); coherent and accessible national inspection and certification programme; research and development programmes; support schemes for organic farmers; market development; technical support base; traceability (traceability is all about farming and keeping record of production system that occurred in the farm; it is important to implement traceability in organic farming for quality assurance issue and it is also important to give confidence to the consumer and also describe the originality of the product); regulatory

framework. The most conducive policy framework is obtained when organic agriculture is recognized and integrated in main policies of the country, e.g. the agriculture policy, food and health policies, environmental policies and poverty eradication policies. However, even when such integration is accomplished, there are merits to formulate one consistent organic policy, to ensure that all the needs of the sector are properly addressed. Documents that directly or indirectly underpin this policy are the following (exemplification): for Romania: Romanian Constitution (article 35), National Rural Development Programme 2007-2013 and National Strategic Rural Development Programme 2007-2013, Order no. 65/2010 approving the Rules on the organization of inspection and certification, inspection and approval of certification bodies and inspection bodies monitoring activities, Order no. 219/2007 approving the Regulations on registration of operators in organic farming, as supplemented and amended, Kyoto Protocol: Article 3 (a) iii promotion of sustainable forms of agriculture in light of climate change considerations, etc.

At EU level, in June 2007, Council Regulation (EC) no. 834/2007 on organic production and labeling of organic products was published and it came into force on January 1, 2009. It repeals the former Regulation (EEC) no. 2092/91 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs considerable protection for both consumers and producers has been achieved. This regulation has been implemented in all countries of the European Union since 1992. In August 1999, rules on production, labeling and inspection of the most relevant animal species were agreed (Council Regulation (EC) no 1804/99), covering issues as foodstuffs, disease prevention and veterinary treatments, animal welfare, husbandry practices and the management of manure. In March 2000 the European Commission introduced with Commission Regulation (EC) no. 331/2000 a logo bearing the words “Organic Farming - EC Control System”. This logo can be used on a voluntary basis by producers whose systems and products have been found to satisfy Council Regulation (EEC) no. 2092/91. In 2004, the European Commission published the European Action Plan for Organic Food and Farming. In December 2006 the European Commission reached a general approach on the revision of the regulation. On June 12, 2007, the

Agriculture Ministers of the European Union reached political agreement on a new regulation on organic production and labeling. The new regulation was published on July 20, 2007 and came into force on January 1, 2009 (Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labeling of organic products and repealing Regulation (EEC) no. 2092/92). On September 18, 2008 the implementing rules were published as Commission Regulation (EC) no.889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) no. 834/2007 on organic production and labeling of organic products with regard to organic production, labeling and control (http://www.organic-europe.net/europe_eu/eu-regulation-on-organic-farming.asp). On 1 January 2009 new EU regulations went into effect for the production, control and labeling of organic products. However, some of the new provisions on labeling did not take effect until 1 July 2010.

4. Standardization and certification in organic sector

Developing countries are important suppliers of organic commodities. They, however, need to establish that they conform to the standards and rules of the importing developed countries. Suppliers to multiple markets may need to carry several such certifications: standards accepted in Sweden may not be recognized in the United States or Japan, and vice-versa. International equivalence of various national organic standards will reduce the administrative overhead, improve public-sector relations with private certifiers and traders, and eliminate redundant certification. This bureaucracy and its attendant cost particularly burdens poor farmers in developing countries. Internationally recognized accreditation and equivalence will benefit exporting and importing countries alike because it ensures conformity with requirements of importers while recognizing the competence and compliance of the exporters. High certification costs act as barriers to new entrants in the sector, especially international standards and accreditation systems that small-holder farmers wishing to access retail or export markets, have to comply with.

On the other hand, especially within organic agriculture sector, consumers must rely on certification programmes that verify claims. The standards that specify the organic production process

appear quite precise, especially compared with claims made for other competing products. Consumers decide to purchase organic food in part because that choice reflects their values. For example, many consumers demand that organic food meet strict animal welfare standards. Others expect organic to mean fresh, local and minimally processed. The whole organic community requires that genetically modified organisms not be used to produce or process organic food. Social and economic issues, including producers receiving a fair price, are increasingly receiving attention (El-Hage Scialabba and Hattam 2002). Most industrialized countries have regulations that govern organic agriculture, including Australia and the European Union countries, Switzerland, Japan and the United States. Some developing countries have also established policies and regulations on organic agriculture. Organic certification systems were developed in the early 1970s and by the 1980s there were organic certification bodies in most OECD countries. Today, there are 70 countries that have a domestic certification organization, and a dozen internationally active organizations offer organic certification services in virtually all countries in the world (TOS 2005).

Differences with regards to the scope of regulations and variation in their implementation raise a number of concerns, namely (FAO 2002):

- Import discrimination whereby compliance is required with standards not always suitable to agro-ecological conditions of export countries;
- Multiple accreditation of certification bodies in order to access the three main organic agriculture markets (Europe, Japan and the United States);
- Difficulties to traders, due to different rules interpretation by certification bodies;
- Enormous workload (and delays) for authorities to negotiate bilateral equivalency;
- Limitation of bilateral agreements with regards to products with ingredients sourced from around the globe.

In the absence of official measures to address equivalence, the organic community has organized an international programme to accredit certification bodies. The IFOAM Accreditation Programme, established in 1992, developed international

procedures to evaluate organic certification programmes and assess compliance of organizations that claim to adhere to organic standards. Certification programmes involved with organic agriculture apply to the International Organic Accreditation Service (IOAS), an NGO established in 1997, in order to be accredited. IOAS evaluates their standards against the IFOAM Basic Standards and examines the competence of their programme against established criteria through field visits and audits. To date, IOAS has accredited about 20 certification bodies, operating in both developed and developing countries. This privately organized service has the potential to facilitate international trade in organic products, but this promise will be fully realized only when it is recognized by governments which have developed rules for organic agriculture.

From 1 July 2010, the EU introduces a new organic logo to ensure consumer protection and common standards.

5. Conclusions

A country wanting to develop its organic sector needs to perform an in-depth integrated assessment of its general agriculture policies, programmes and plans, to understand how they affect the competitiveness and the conditions of the organic sector. At EU level, the reasons why governments support organic vary, but the key objectives remain the protection of the environment and the promotion of rural development through organic farming. It is important to link the organic development to general objectives for agriculture in the country, as it is in Romania. These can be issues such as: increased income to the agriculture sector; protection of environment, e.g. water; protection of biodiversity; strengthening the competitiveness of small-holders; protection of human health; increased exports; promoting quality over quantity as a market strategy.

Given the existence of an European Action Plan for Organic Food and Farming (2004), in Romania an action plan for the organic sector should be developed based on analysis of the state of the sector, participatory consultations, a needs assessment and proper sequencing of actions. The action plan should state measurable targets for the organic sector to help agencies and stakeholders focus their efforts.

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LOCAL RABBIT BREEDS AND RESEARCH PROSPECTS TO DEVELOP AND INCREASE RABBIT MEAT PRODUCTION AND CONSUMPTION IN VIEW OF ROMANIAN RURAL SPACE SUSTAINABLE DEVELOPMENT

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Abstract. This paper addresses the challenging role of rabbit production, and especially the sustained efforts to create and homologate the first Romanian rabbit race for our rural development. The objective of the paper is to provide information on the new steps taken towards Transylvania Giant breed homologation and regarding the research prospects to develop and increase rabbit meat production and consumption. Advantages of the production and consumption of rabbit meat are highlighted and the global situation in this direction is also presented.

Keywords: rural development, Transylvanian Giant rabbit, production, consumption, sustainability.

1. Rabbit rearing: one answer to agriculture's needs

Rural development, broadly characterized as a process to enhance the quality of life of rural residents and the economic performance of rural areas, is predominantly supported at the EU level by the Common Agricultural Policy (CAP) (and in particular

by its second pillar). Initiatives to reform the CAP have always shown the need to attract new people and rejuvenate the farming and the whole rural economy, bearing in mind the EU's demographic challenge to ensure viability for future generations (Petrescu-Mag et al 2011a). The strengths and weaknesses of rural areas should be recognized, in particular (this situation is also characteristic for the rural areas of our country):

-The rural exodus occurring in many member states;

-The dependence on neighboring urban areas to achieve local development and the resulting need to reinforce urban-rural linkages.

Other aspects that require attention and improvement are: precarious infrastructure; deficient land management and technical endowment of the rural territory, localities and houses; strong disequilibria at all levels of agricultural activities; very slow economic growth and great dependency on the weather conditions throughout the year; technological and structural obsolescence of the capital stock; low investments that result in non-significant increase and modernization of fixed assets; low absorption of the European funds (Otiman 2008).

For these reasons and as we will explain below, rabbit rearing could represent one of the answers agriculture needs in the context of fragmented land, aging population, lack of financial resources for investments and the need to provide a source of meat protein quality. In the same time, the domestic rabbit is one of the animal species that could found a productive niche in the suburban agriculture of Romania. Economic efficiency of production of rabbit meat is high. Rabbit meat production for self-consumption or for sale is a solution both for the protein needs of families in rural and peri-urban areas, within a production for self-consumption, and for increasing their incomes. It is also a solution for providing large quantities of a healthier type of meat (compared to others now preponderantly consumed) by developing businesses for rabbit breeding and meat production, either in intensive or traditional system, or even organic. Animal production very often takes into account aspects such as conservation of national genetic resources, but also a better and better productivity. These two issues are the reasons for creating the first two rabbit breeds in Romania: Transylvanian Giant

Rabbit Breed and Cluj Rabbit Breed (Botha et al 2011). The two new breeds are still being statistically analyzed for homologation.

2. Rabbit production/consumption: advantages. Transylvanian Giant rabbit - first Romanian rabbit breed

In recent years there has been rising global awareness on the virtues of rabbit meat production in developing countries as an alternative means of alleviating world food shortages. Rabbits are easily incorporated into integrated farming systems as they convert plant materials, which often are of low nutritive value, to high quality meat, as well as providing faces whereby nutrients are returned to the soil (Samkol & Lukefahr 2008). Rabbits have small body size, short generation interval, high reproductive potential, rapid growth rate, genetic diversity, and the ability to utilize forages and by-products as major diet components that make the animal appropriate for small livestock keeping in developing countries (Cheeke 1986). For limited-resource, small-farm families, the procurement of a few breeding rabbits, largely supported by renewable on-farm resources, can potentially yield enormous and permanent benefits. The major goal of rearing rabbits is to offer protein sources to feed the breeder's family. According to the World Health Organization (WHO), the estimated number of cases of diabetes in developing countries is likely to increase more than two-fold in the next 30 years from 115 million in 2000 to 284 million in 2030 (WHO, 2003). Meat production in general is a complex issue, with diverse implications: economic, environmental, political, social– public health, public perception, ethics etc (Vesa et al 2009). A secondary goal is to generate family income through sales. A systematic evaluation of local genetic types will help to breed animals adapted to the local agro-climatic complex. A policy of cross-breeding to reinforce this adaptation to the environment and so upgrade productivity is necessary. It is one of the activities which, carried out intensively, contributes heavily to the emission of greenhouse gases and therefore has an important role in policies on climate change, which are so much discussed today. From this point of view, the first Romanian rabbit breed - „Transylvanian Giant”- fulfills these requirements (Petrescu-Mag et al 2011b).

Transylvanian Giant rabbit (Fig. 1) has been created as described in Petrescu-Mag et al (2009), using mostly the native Romanian population (extremely heterogenic, but rustic and hardy) and also: Californian breed (for body constitution and growth rate), Giant Papillon (for size and background black color) and Agouti German Giant (for body size). After a complex breeding program (see Petrescu-Mag et al 2009) resulted a relatively uniform population from almost all phenotypic points of view: Himalaya color pattern (white, pointed black pattern; red or pink eyed), black background color, medium sized and thick ears, average weight of 6 kg (at adult stage, 6-8 kits in a litter, good lactation, very good tolerance to pasteurellosis (due to artificial selection made for that trait). However, there were obtained also several individuals weighing less than 5.5 kg, value which was considered the inferior limit of weight of Transylvanian Giant at adult age. Thus, we considered appropriate a correction of body size and weight, and we appealed to the infusion with Giant White (during 2010-2011). This infusion with Giant White in Transylvanian Giant population diluted the pointed black trait in the next generation, resulting many agouti-Himalaya and agouti-Himalaya-like individuals (Petrescu-Mag et al 2011c).

Figure 1. Transylvanian Giant
Source: I. V. Petrescu-Mag personal album

3. Rabbit meat production and consumption in Romania and worldwide

Rabbit is not a customary item in the Romanian diet. With some exceptions Romanians are not acquainted with this meat and are often reluctant to try it. The reasons are due to various motivations: the absence of consumption habit, the organoleptic characteristics and others avoid eating it because of emotional and moral reasons. Another impediment is due to the fact that technical personnel trained in rabbit production are lacking (FAO). Even if the owner of a small unit can manage with labor that is not skilled, a certain minimum number of technical operations need to be mastered. They also need to be assisted to fight against the technical problems that can crop up periodically: health and reproduction problems and so on. Making good use of the advantages offered by the rabbit implies knowing more about the animal: its requirements vis-à-vis environment, rearing techniques and the products it supplies. Another prerequisite is the availability of motivated labor.

Lebas and Colin (1992) calculated that the world production of rabbit meat is of the order of 1.5 million tons. This would mean a per capita annual consumption of roughly 280 g of rabbit meat; however, most inhabitants in many countries do not consume rabbit meat as compared to the consumption of 2.5-3 kg/year in France and 4-4.5 kg/year per capita in Italy. Europe is indeed the centre of world rabbit production. The major world producers, which far surpass all other countries, include Italy, the Commonwealth of Independent States countries (particularly Russia and Ukraine), France, China and Spain, collectively account for 75% of total world production. China ranks second, which specifically involves the central Chinese provinces, such as Sichuan and Szechuan (see tables 1 and 2). Less major production areas are found in some regions of Africa, Central America, and Southeast Asia, particularly Indonesia. Colin and Lebas (1996) indicated that countries such as Indonesia, the Philippines, Thailand, and Vietnam account for 87% of the region's total doe population, and Brunei has the largest number of breeding does per 1,000 inhabitants. Vietnam led other countries in the total value of rabbit meat produced per 1,000 USD of the country's total gross national product. Rabbits are not reared in significant numbers in most countries of the Near East.

Table 1. Statistics on rabbit meat production in Europe

Rabbit meat production in 2010		Producing animals/slaughtered 2010
Country	**Tonnes**	**1000 Head**
Austria	420	250
Belgium-Luxembourg	No available data	No available data
Bulgaria	8300	5800
Cyprus	412	293
Czech Republic	37800	20000
Denmark	No available data	No available data
Estonia	10	8
Finland	No available data	No available data
France	51665	36777
Germany	37500	22000
Greece	7400	4200
Hungary	5404	3946
Ireland	No available data	No available data
Italy	**255400**	169700
Latvia	74	34
Lithuania	60	35
Malta	1800	1200
Netherlands	No available data	No available data
Poland	2900	1234
Portugal	No available data	No available data
Romania	**164**	**135**

Slovakia	3700	2500
Slovenia	No available data	No available data
Spain	66200	58800
Sweden	No available data	No available data
United Kingdom	No available data	No available data
Europe (total)	**508739**	326912

Source: adapted after FAOSTAT, FAO Statistics Division 2012, http://faostat.fao.org/site/569/DesktopDefault.aspx?PageID=569# ancor (the table may include official, semi-official or estimated data; as it is shown in the table, there are countries for which data are not available)

Table 2. **Statistics on world rabbit meat production**

Rabbit meat production in 2010		**Producing animals/ slaughtered 2010**
Country	**Tonnes**	**1000 Head**
China	669000	514600
Asia (total)	809071	621363
Africa (total)	97263	83335
Americas (total)	277889	149681

Source: adapted after: FAOSTAT, FAO Statistics Division 2012, http://faostat.fao.org/site/569/DesktopDefault.aspx?PageID=569# ancor (the table may include official, semi-official or estimated data)

4. Research prospects in the field

The first important step is the homologation in Romania of the two breeds: Transylvanian Giant Rabbit Breed and Cluj Rabbit Breed. The process towards this desideratum is evaluated and monitored by ANARZ (Bucharest). In this direction, several activities to promote the first breed took place in academia's environment (participation in sessions, scientific communication, writing scientific studies, exhibitions) and for general public (via media). After homologation, a tour of exhibitions abroad will follow in view to prepare the international homologation. Approval of a breed means not only working on genetic

improvement of a population but also a good management, economic studies and a wide legislation survey. In this regard, very useful are the funds that enable the financing of such research programs (we mention “Transylvanian Giant Breed homologation: Legal and economic implications for rural development of Romania as member state of the European Union”– a postphd research project etc.). The aims of the research activity are to find how to improve productivity and increase the meat production quantity, by using local breeds (Yamani 1990). Targets are small farmers in rural areas, but also some large scale production systems.

Institutions involved in the homologation of the under study breed are: “Ion Ionescu de la Brad” University of Agricultural Sciences and Veterinary Medicine Iași (coordinator and ANARZ submit documentation), Bioflux SRL, “Babes-Bolyai” University Cluj-Napoca and possible other institutions.

5. Conclusions

In Romania (with the help of popularizing activities, information, development of rabbit programs, development of the systems for collecting and commercializing the rural production, a production and a collection commercialization chain etc.) domestic rabbit has the potential to become one of the most exploited species for meat production. This is because of some factors, such as: the need to ensure high quality meat supply, the high fecundity, the ease of maintenance of the rabbit which makes it suitable for the conditions of family households (Petrescu-Mag et al 2011c). The rabbit has several points in its favor as a meat producer and it can be raised on a small scale by individual households. In our country, the rearing of rabbits is carried out, mostly, at family household level. The nowadays world situation is in favor of cuniculture, due to three fundamental aspects (Díaz Marante 2006): a) Lack of animal protein, either by increasing demand due to world population growth or decline in the breeding of those animals historically producers; b) High cost of concentrate feed; c) Great capacity of the rabbits to take advantage of materials with high fiber content.

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AGRI-ENVIRONEMNTAL INDICATORS

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Abstract. Links between the environment and agriculture practices are complex, agriculture continues to be the main user of the countryside, and an important factor of environmental quality. In recent years more attention was paid to the integration of environmental policy objectives in other community policies, including agricultural policy, environmental policy integration being considered as a key defining feature of sustainable development. The paper aims to analyze the main request for integration of environmental concern into CAP and presents the agri-environmental monitoring in Romania.

Key words: agriculture, environment protection, indicators, integration

1. Integration of environmental concern into the agricultural policy

The idea of integrating the concept of sustainable development concept into the sectoral policies has been promoted on June 1998, at the Cardiff European council, when a number of economic sectors have been proposed for integration. The strategic approaches of the 6th EAP include among others the integration of environment protection requirements in other Community policies and promotion of sustainable production and consumption patterns. Integration is also stipulated in other EU official documents being considered as a key defining feature of sustainable development.

EU Sustainable Development Strategy adopted in 2001 promotes environmental integration by introduction of a system of impact assessment for all major policy proposals. This approach provides information on the tradeoffs between the economic, social and environmental dimensions of sustainable development.

During the Gothenburg European Council, it was agreed that “economic performance must go in correlation with sustainable use of natural resources”, principle that has been also confirmed in the Lisbon strategy and Strategy 2020.

The links between the richness of the natural environment and farming practices are complex. Agricultural practices have an adverse impact on natural resources. Pollution of soil, water and air, fragmentation of habitats and loss of wildlife can be the result of inappropriate agricultural practices and land use. In recent years there has been increasing concern about the effects of intensive agricultural production methods on both human health and the environment.

Common Agricultural Policy emphasizes the risk of environmental degradation and encourages farmers in the maintenance of the environment by targeted rural development measures. Some measures to support agricultural policy, caused damages of natural capital through erosion, water pollution and biodiversity loss.

In an attempt to integrate the proposals at the international level, the OECD proposed in 1999 a set of agri-environmental indicators, establishing a series of attributes that must be met by the indicators: to be relevant to policies, to be made on sound scientifical basis and to be measurable.

At the meetings on Cardiff (June 1998), Vienna (December 1998) and Helsinki (December 1999), the European Council asked the Commission to report on the integration of environmental concerns into Community sectoral policies and asked for development of a set of indicators to monitor integration.

On January 2000 the European Commission published a policy document "Indicators for integrating environmental issues into the CAP", which identified a set of agri-environmental indicators to serve the following purposes:

- provide information on environmental conditions in agriculture,
- monitor the links between agricultural practices and their environmental effects,
- provide contextual information, particularly concerning the diversity of EI agro-ecosystems,

- assess the measures on which agricultural policies promote rural development and environmentally sustainable agriculture,
- inform on the overall assessment process of agricultural sustainability.

To improve and develop agro-environmental indicators system was launched in 2002 IRENA project (Indicator Reporting on the Integration of Environmental Concerns into Agricultural policy).

IRENA project results are the following:

- 40 indicators and sub-indicators and corresponding data sets,
- an indicator report, which reviews the agri-environment interaction on the basis of indicators and describes the development and progress on development of agro-environmental indicators;
-an indication on integrating environmental concerns into the CAP, which assesses the usefulness of indicators for policy evaluation system policy;
-an evaluation report, which examines the implementation of the IRENA operation, evaluates the indicators and data sources used, and identifies areas for future work.

In 2006, the European Commission adopted 28 indicators of environmental agriculture (AEIs) to assess the interaction between CAP and the environment. The indicators are identified under the DPSIR (Driving forces - Pressures and benefits - State/Impact - Responses) analytical framework:

Table 1. The set of agri-environmental indicators

Domain	Sub-domain	Title
Responses	Public policy	Agri-environmental commitments
		Agricultural areas under Natura 2000
	Technology and skills	Farmers' training level and use of environmental farm advisory services
	Market signals and attitudes	Area under organic farming
Driving forces	Input use	Mineral fertiliser consumption
		Consumption of pesticides

		Irrigation
		Energy use
	Land use	Land use change
		Cropping patterns
		Livestock patterns
	Farm management	Soil cover
		Tillage practices
		Manure storage
	Trends	Intensification/extensification
		Specialisation
		Risk of land abandonment
Pressures and benefits	Pollution	Gross nitrogen balance
		Risk of pollution by phosphorus
		Pesticide risk
		Ammonia emissions
		Greenhouse gas emissions
	Resource depletion	Water abstraction
		Soil erosion
		Genetic diversity
	Benefits	High Nature Value farmland
		Renewable energy production
State/Impact	Biodiversity and habitats	Population trends of farmland birds
	Natural resources	Soil quality
		Water quality - Nitrate pollution
		Water quality - Pesticide pollution
	Landscape	Landscape - state and diversity

Source: EC, 2010

2. Agri-environmental indicators in Romania

In Romania, according to National Institute of Statistics, are monitored the following agri-environmental indicators:

- Area under irrigation command and agricultural area irrigated

Irrigated area is the total works carried out to ensure the controlled water supply to the crops in order to increase the agricultural output and guarantee its independence from weather conditions.

Agricultural area irrigated - represents the area on which irrigations were carried out at least once in an agricultural year.

- Drainage area, open canals

Drained area represents the total hydro-technical works meant to remove the excess moisture and to consolidate the land of an agricultural or non-agricultural area through a network of drainage ducts which are underground ducts or open surface channels.

- Area reclaimed with soil erosion control works

Reclaimed area is the total hydro-technical works carried out to remove the excess water from low land surface for cultivation purposes or for plant health reasons.

Erosion proof area is the hydro-technical works carried out to reduce or to stop the soil surface degradation due to external geographical agents by removing its fertile layer and the performance of water-course regulation works to avoid rain water flowing from slopes to prevent damage caused by floods at the slope base.

- Quantity of chemicals and natural festilizers applied in agriculture

The chemical fertilizers are industrial products which can be separately nitrogenous, phosphatic and potassic fertilizers or combinated as complex fertilisers (active substance). The natural fertilizers - manure from all species of domestic animals and poultry (fresh or sour), also the compost in liquid form, measured in brutto weight.

- Area of the land where chemical and natural fertilizers were applied by ownership

The area on which fertilizers were used represents the actual area on which chemical and/or natural fertilizers were applied.

- Quantity of pesticides applied in agriculture

The pesticides are any substances or mixed substances, including the ingredients in their mixture, used in agriculture, sylviculture, in storage spaces, as well as in other activities in order to prevent, reduce, remove or kill the insects, pathogenic agents, weeds and other forms of animal or vegetal life, including viruses harmful to plants and animals, insects and rodents bearing man-transmissible diseases and products regulating plant growth and their defoliation and splitting; they are reported in active substance.

- Area of the land where pesticides were applied.

The area on which pesticides were used represents the actual area on which the pesticides were applied. Data about the area of the agricultural land where pesticides were used are presented by pesticide type: insecticides, fungicides, herbicides and by ownership form at cross-country level.

3. Conclusions

The desired relationship between agriculture and the environment can be captured by the term sustainable agriculture. This calls for management of natural resources in a way which ensures that their benefits are also available for the future.

In the European Union, the development of agro-environmental indicators is different; some are already operational and are well-defined. However, a series of indicators need substantial improvements in order to become fully operational, for example indicators related to benefits and landscape. In order to improve the set of indicators and their availability for analyses on the integration of environmental objectives is required a unitary monitoring of agri-environmental indicators at national level. The indicators monitored in Romania are not enough developed to reveal complete information on integation of environmental objectives in the CAP: already conceptualized EU indicators can be a starting point for the development of agri-environmental indicators in Romania.

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SUSTAINABLE DEVELOPMENT AND ITS IMPORTANCE IN THE AGRICULTURAL SECTOR

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Abstract. Nowadays people talk more about the concept of "sustainable development", adopted at the Conference in Rio de Janeiro of 1992. This concept is recognized and adopted by all states, but its realization is dependent on the ability of everyone to work towards achieving the strategic objective of this concept and the economic power of each state. For instance, in developed countries, there is a national strategy for sustainable development - there are laws in this respect, modern technologies are pursued, economic efficiency being appreciated in terms of achieving this objective.

Keywords: sustainable development, agriculture, economic development, sustainable agriculture

1. Introduction

Since 1972, the year when the Conference on the environment took place in Stockholm, and until now, over 60 interpretations of the concept of sustainable development have circulated. The most popular interpretation of the concept of "sustainable development" is that given by the Norwegian Prime Minister Gro Harlem Brundtland. She published, in 1987, the final report "Our Common Future", document also known as the Brundtland Report which defined sustainable development as: "development which meets present needs without compromising the ability of future generations to meet their own needs".

But few know that the eminent Professor Dr. N. O. Popovici Lupa, in his work "Agriculture; Knowledge of culture of the land and agricultural plant", published by the publishing house "Viata Romaneasca", in Bucharest, in 1922 (seventy years before the Rio Conference), used the concept of sustainability for the first time with the definition given by the farmer "the one who

deals with the agricultural profession is an entrepreneur and as such he pursues the greatest profit possible, namely to remove from a certain stretch of land, the largest and most expensive quantity of products, as sustainable as possible, with the lowest expenses and with the condition to maintain, if not to increase soil fertility" (Dona, 2009).

In order to meet the growing demands of the population in terms of meeting the various needs, people exploit their environment more intensively. These anthropogenic impacts can have quite dangerous consequences on natural resources and environmental health (Andreica, Calin, 2011).

The economic development practiced until now has been characterized by activities such as: the wood industry by deforestation with consequences that we are aware of (landslides, erosion, etc.), mineral extraction until the exhaust of stocks, exploitation of living sea resources, the change of certain courses of water, the emission of gaseous pollutants and genetic manipulations are well known at present.

2. Agriculture towards sustainable development

A system, in order to be sustainable and viable, must meet the following conditions: maintaining and improving the physical environment and resistance to external pressures or to strong perturbations (Bran, 2006); satisfying the food of the society; economic and social well-being of farmers.

One of the problems facing humanity more and more is the availability of natural resources and environmental quality for future generations. Many researchers wonder about the equitable placement strategy for sustainable development benefits, between people during the current period and also reporting to the needs of future generations (intra-generation benefits).

The existence and quality of natural resources generally ensure economic performance. Environment degradation leads to reduced agricultural productivity and thus lower incomes.

In order to answer to an ever-increasing demand of the population in terms of meeting the various needs, people exploit their environment more intensively.

While the development of human society, population growth, culture and technology progress have led to a great wealth of knowledge, to a complex of technical activities and to

the diversification of material goods, apparently encountering only benefits, on another level, this civilization determined the development and growth of many pollutants that act negatively on the ecological balance of nature, on life, deteriorating the vital factors of life, air and soil.

This situation is downright paradoxical, especially visible in recent decades, which show that man has become an important factor of environmental pollution.

More and more humanity faces several serious problems, their lack of settlement threatening the very existence of life on earth. Some of these problems are represented by the food crisis, natural environmental degradation, rapid population growth, consumption of energy and raw materials - these problems are related to agriculture. The need to address these issues requires the priority development of agriculture. The contribution of this sector in meeting social needs is expressed by the notion of food security.

This notion has emerged with the worsening of world food supply and the appearance of difficulties in providing agricultural raw materials.

Ensuring food security does not imply only ensuring quantitative consumption needs, but also refers to ensuring a certain quality and assortment structure.

Sustainable agriculture essentially refers to the harmonization of agricultural development and to the maintenance of ecological balance.

We should not forget that food has a special value and if, by eating it, the human being introduces directly destructive elements into the body, this can aggravate the sensitivity of the human body under different conditions, and can decrease the immune system, leaving the body defenseless against diseases.

We seldom encounter terms like sustainable development, sustainable agriculture and organic farming. The novelty consists in the increased attention to be given to new environmental technologies, eliminating chemicals of any kind, eliminating pollution in order to create products with superior biological quality.

Sustainable agriculture is considering the development of cultivation systems to meet human needs both quantitatively and qualitatively, considering environmental protection. Switching to

a new type of agriculture must be made gradually in order not to compromise its durability and in order to maintain the integrated and ecological aspect. Hence the need for an agriculture managed by ecological principles.

Pollution from agricultural activities is largely due to unreasonable application of intensive culture technologies, which besides dynamic mechanization, uses excessive amounts of chemical fertilizers and pesticides, so that agriculture is not only a victim but also a cause of pollution.

Using mechanization and industrial technologies, replacing the human and animal energy by fossil fuels energy and increasing production capacity of soil and crop yield by using chemical fertilizers and pesticides, the agriculture nowadays has reached a high short-term profitability, but with serious results on the environment.

This shows that the technical progress promoted by science not only brings benefits, but can also cause environmental damage, with irreversible consequences in the present and future, maintaining and deepening serious ecological imbalances.

Sustainable agriculture aims at economic growth (Bran, Rojanschi, 2004), the market and the environment. In order to practice sustainable agriculture, we must identify: the potential of known technologies and practices, but also new ones, in order to provide agricultural products without degrading the environment and without reducing long-term economic viability or compromising the interests of future generations; economic, institutional and cultural instruments for the development and adoption of technologies and practices for sustainable agriculture.

The rapid development of organic farming was done amid increasing consumer awareness on human health vis-à-vis the products consumed, due to concerns about food production methods and about the environmental ones.

2.1. Particularities of agriculture as a branch of material production

Agriculture is an industry that relies on ever renewing resources, unlike other industries that use natural resources (oil, coal, ores, etc.) that is depleted on exploitation.

In the specialty literature, agriculture is considered a branch of material production in which, through living organisms

and through the control action of man, takes place the transformation of the solar kinetic energy into potential energy, as the only form available to the human body - organic substance.

The physical process of transforming the solar kinetic energy in potential energy belongs exclusively to the living organisms of green plants. Thus, the participation of living organisms, green plants, is the first feature of agriculture regarded as a branch of material production.

The processes of creating organic matter occur in a natural way, but we cannot yet speak of agriculture only when the activity of living organisms takes place under the action directed by man. The development of living organisms under human control is the second feature of agriculture as a branch of material production (Dona, 2009).

The importance of agriculture in comparison with other branches of national economy derives from the following facts: the first and most important subject matter is that this sector is able to gain energy naturally, while other sectors are energy consuming. Secondly, agriculture was the primary industry of material production from which other branches emerged; from the most simple and obvious reasons agriculture is the sole provider of vital means of subsistence for that part of society occupied by other branches of material production. Thirdly, the action favorable for biological factors makes that, at any level of capitalization, the share of goods and services consumed in agriculture is lower than in other branches of national economy. And fourthly, food products are safe on the world market, providing high efficiency in agricultural exports.

2.2. The role of agriculture in economic development

Recently, ecological conception starts to make way more and more, combined with the economic conception (economic-ecological conception) to address the issues in agriculture, focusing on maintaining and increasing the production capacity of agro-ecosystems, on preventing pollution in its various forms, on the realization, in such circumstances, of profits.

Agriculture represents an overall national economy branch of great importance, contributing, to a great extent, to the economic growth recovery of a country.

The importance of the role of agriculture in economic development is addressed in most literature works, but few admit that behind it stands agriculture development. These two facts are far from being independent. Agricultural development is in close connection with other economic sectors, especially industry. In some works it is stated that agriculture does not play an important role in economic development, it is said that it is a subordinate sector, driven by industry. This is totally untrue; it is the sector that sustains the proper functioning of other sectors, the motor of other activities.

The main function of agriculture is providing food for the domestic consumption of the population, or simply to ensure the food of the population.

According to some experts, agricultural goods are wage goods and where there is an abundant agricultural supply, consequently agricultural prices are low, which allows the practice of low wages resulting in high profits.

This function of agriculture is the basis of our country's efforts to provide consumption close to that in certain countries in Western Europe.

At the same time,agriculture participates in meeting the needs of the population for commodities by the supply of agricultural raw materials from processing industries (food and light industries). This is a second function of agriculture.

Between agriculture and industry there is a relationship of conditioning and mutual influence. The development level and the diversity of processing industries depend on the volume and range of raw materials supplied by agriculture.

Therefore the state of agricultural production growth, as well as the quantity reduction and assortment of products lately acted as a brake on production growth and development in the industries processing agricultural raw materials.

In terms of emphasis of environmental pollution trends, agriculture fulfills an important ecological function, contributing to the restoration and maintenance of the environment.

Agriculture enjoys today a great attention in all countries, regardless of their economic development. In general, most economically developed countries are also the largest producer and exporter of agricultural products.

3. Addressing the concept of sustainable development in agriculture in Romania

Romania, the beneficiary of a temperate climate and an enviable relief, is trying today to integrate in a global economy increasingly based on a tough economy. This determines us to enhance and capitalize millennial experience in mainly agricultural activities.

Briefly analyzing the possibilities of economic development of our country, it shows that the domains in which we can register successes, therefore profits, are agriculture and tourism, both areas being related to environmental compliance.

The food situation in Romania is currently characterized by the instability of agricultural supply, by a poor quality structure of food consumption, especially in terms of animal products. In recent years the difficulty of providing other products has emphasized (sugar, oil, potatoes, cereals).

The food security of the country was affected by the unsatisfactory level of agricultural production and mutations in the economy, which have a negative impact on all economic branches.

According to the current state of Romanian agriculture we observe that there are factors that threat the development of this sector, such as: crumbed agricultural property, subsistence-level farming, and slow legal system and often incoherent. In Romania only 3.7 million ha of soils meet the conditions for sustainable agriculture. The other 12 million ha, of the 16 million ha, soils are subject to anthropogenic factors. Therefore almost 7 million ha of land are vulnerable to surface and deep erosion and landslides. On about 3.5 million ha of this surface, erosion is strong, reaching in Buzau and Vrancea counties 20 to 25 tons / ha per year against the regenerative capacity of the soil of 2 to 3 tons / ha per year.

In order to eliminate gaps existing today in our agriculture and that practiced in the European countries or other developed countries, it is necessary a transition to the practice of an intensive agriculture based on mechanization, which will increase labor productivity as an important factor in sustainable development. Other important factors that can lead to sustainable development in agriculture are: unification under different legal forms of agricultural land, the application of environmental technologies, choice of varieties adapted to the soil and climate, severe

selection of planting material, integrated anti-parasitic protection by activating natural antagonists of pests, thus leading to reduced pesticide use, knowledge of plant-environment relationship in order to increase the productivity of ecosystems,etc.

As representative area of Romanian agriculture, Baragan Plain, once considered the granary of Europe and beyond, today is an agricultural area that is experiencing economic problems: lack of funds or insufficient funds, lack of labor force due to the aging of population in rural areas, financial and economic crisis by reducing investment, climate issues: floods, storms, heavy winters, hot temperatures; environmental problems: deforestation, extinction of species as the Great Bustard for which reintroduction we use money and effort.

4. Conclusions

Agriculture enjoys much attention in all countries, regardless of economic development. In the contemporary world, most developed countries are the largest producers and exporters of agricultural products. As the branch of our national economy, agriculture is a very complex and complicate activity.

Conventional agriculture, as practiced today, with all substantial contributions to social progress, is still far from what sustainable development means, not only a state of harmony with nature, but rather a development dynamic process, in accordance to the principles of modern ecology, by which the use of resources, direction of investment, technology development orientation and institutional change are made taking into account current and future requirements of the technical progress.

Sustainable agriculture is the one that can operate with profit from an economical point of view, but compatible with ecological constraints. Knowing more closely the mechanisms of sustainable agriculture, perfectly integrated into the general harmony of nature, may constitute a negligible advantage in the struggle for the food security of the population.

Between the economic growth and environmental quality there is a bi-univocal relationship. On the one hand long-term economic growth is restricted by the need for conservation and environment development, and on the other hand the improvement of environmental quality cannot be done without resources, which requires sustainable economic growth.

Rational and simultaneous fulfillment of agricultural functions requires ensuring a balanced growth of the two sectors, agriculture and industry.

Agricultural activity involves consciously changing an ecosystem in order to increase production, by exploiting the physical substance of life, physical and chemical factors, the environment and biological community, the essence of agricultural activity is ultimately the conscious directing of balance in the ecosystem, in order to achieve desired goals.

The harmonization of agricultural development with environmental protection requires measures aimed at raising the positive contribution of agriculture to the environment, pollution reduction caused by environmental agriculture, the adoption of an agricultural policy that takes into account the environment.

The conservation of natural resources compels you not to generalize industrialized agricultures, intensive consumers of energy, of humus, water, and, on the contrary, to find ways of reconciling profitability and environment friendly farming, as way to ensure sustainability.

In the national economy, agriculture has several functions, determined by its contribution to national economy; agriculture provides food products for the domestic consumption of the population, provides agricultural raw materials to processing industries, provides labor supply, has an important ecological function, participates in the creation and development of state reserves of agricultural products for unforeseen situations.

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REDUCING URBAN - RURAL ECONOMIC GAPS. CASE STUDY: ROMANIA

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Abstract. Variety is one of the important features of the enlarged European Union. With the vision of additional enlargement in front, disparity such as those in living environment, quality of life and cultural background are likely to be more relevant than ever. Although the development of cultural variety lies at the heart of the European model, encouragement greater structure is also a central priority. The paper underlines that both the incentive and the concrete design of strategies/procedures are powerfully triggered by the environment of the program meant to reduce the gaps, i.e. the individual restricted rural structure circumstances. The transferability of "good practice" is given to a partial extent only. However, this paper provides a fine indication of "what can be done" and, in spite of the heterogeneity of European rural areas and the recognized types of social capital initiatives, the comparative study of the various approaches allows for the elaboration of some general recommendations to be followed when appealing in rural progress policy design based on social capital. The concept of "rural" is notoriously difficult to define. Despite critiques, rural and urban continue to be portrayed, if not as polar opposites, then at least as distinctly different entities. A dominant discourse is the notion of rural society as epitomizing "the good life" and representing the antithesis of change, a category defined in opposition to modernity.

Key words: Europe 2020 Strategy, urban and rural areas, labor market, economic gaps, rural policy.

1. Introduction

In an effort to recognize possible similarities and variations between these regions, this paper searches key aspects of quality of life from an urban–rural point of view, specifically – income and deficiency; accommodation; employment and education; work – life balance; access to work, school, family, friends and services; and individual well-being indexes. The study not only reveals motivating answers about quality of life from an urban–rural angle but also raises significant issues for policymakers, mainly relative to some of the poorer European countries.

So, as to increase competitiveness and raise participation levels, mainly for the low skilled, and in line with economic policy guideline, Member States must review tax and benefit systems and the capacity of public services to give the necessary sustain. Member States must increase labor force participation throughout policies to encourage active ageing, gender equality and equal pay and labor market integration of young people, disabled, legal migrants and other vulnerable groups. Member States must also get rid of barriers to labor market entry for newcomers, sustain self-employment and job creation in areas including green employment and care and promote social innovation both in rural and urban areas.

2. Quality of life indicators and urban–rural discrepancy

The implication of the EQLS data alongside the array of aim, usually nationally derived, statistical data available for analyzing social issues in the EU and for informing the development of policy, has been argued in some of the earlier analytical reports started from the EQLS.

However, there are some precise latent advantages that should be mentioned in relation with the study of urban–rural discrepancies.

The EQLS data are also able to search other questions relevant to quality of life, but not fully captured in purposes statistical data. Such subjects include those connecting to the strength of the family and social networks (e.g. frequency and type of contacts), sense of community, and social identification

with, experience of and attitudes to civic commitment. Once more, these topics are pertinent not only to the quality of life and welfare of individuals and families, but also to social solidity.

This paper involves the difference among urban and rural areas. It searches two spatial magnitudes: urban–rural disparities and how these vary involving countries and groups of countries.

The study based on this geographic framework reveals that in western and northern Europe, there is little proof of important urban–rural disparities. As an alternative, it is in the poorer states of eastern and southern Europe that urban–rural differences are most marked; in relation to most of the indicators, this disparity involves a lower level of perceived welfare and quality of life in rural areas. So, policy considerations concerning urban–rural differences will be most pertinent in these countries.

In relation to the units of study used in this paper, two points should be kept in mind. To begin with, while the social policy dimension concerned with variations and differences among individuals and households within geographical units is not clearly an element of this analysis, it is a central implicit part; this is because the reference point for subjective evaluation of relative lack and related issues will normally be comparisons with other individuals and households within the country or area.

Secondly, while the characterization of countries as a geographical unit refers to fixed, managerially defined limits, the geographic categories of rural and urban used in this paper are based on an exact data source and convention which are at variance with the definitions used in other datasets.

One key advantage that the EQLS data might get to an analysis of urban–rural discrepancies is the possibility for the quality of life approach to look at certain extensively held views: first, that the basic, non-material character of rural life recompense for what may be the material reward of urban life; and second, that in contrast with urban areas, quality of life and subjective well-being will be higher in rural areas than might be projected based purely on the proof of objective indicators of material welfare.

There is certainly some proof of factors that may make up for rural inconvenience. For example, lower monetary profits in rural areas of poorer country groups may be equalize by the self-provision of food, which is a factor not typically recorded in other

data. However, there is little proof that general levels of life fulfillment are higher in rural areas.

Lately EU policy has lacked compassion to urban–rural relations and gaps.

On the other hand, the interdependencies among these two regions now have a new political salience and are likely to turn into even more vital with the emergence of territorialized growth policy (Bengs and Schmidt-Thomé, 2005), so underlining the weight of policies such as InterReg for addressing the interdependencies of urban–rural associations.

2. Implications for EU rural policies

A main result of the EQLS data analyzed is that the perceived quality of life in many domains seems to be worse in rural areas than in urban areas in the poorer Member States (EU6 Low), and mainly in the acceding and candidate countries (ACC3) of southern and eastern Europe. In distinction, there are few variations between rural and urban areas in the more rich EU Member States of northern and western Europe. This ruling uncovers a major dispute for the EU's rural and agricultural policies in devising ways to improve these shortcomings in rural areas of the poorer Member States.

A double challenge emerges from these findings. One dimension of this challenge involves finding ways to support stronger rural economies and quality of life in rural areas of the poorer countries, because the CAP investments are directed towards agriculture rather than rural development. So, the question is whether it is possible to reduce these disparities within poorer countries mainly through agricultural policy measures only. The second, territorial dimension of the challenge concerns the fact that current support under the CAP goes principally to the wealthier regions of the richer countries of northern and western Europe, with the least sustain going to those very areas identified as having a lower perceived quality of life (Shucksmith et al, 2005).

One more cause of regional and national differences relates to the rough allocation of RDR funds (based on historical spend) in the EU, together with the co-financing necessities for Pillar 2 spending. Under the Agenda 2000 agreement, the RDR allocated only modest funds for the period 2000–2006 and this will remain

the case for 2007–2013. In the meantime, countries with questionably the greatest environmental and rural development needs stay underfunded (Baldock et al, 2002; Dwyer et al, 2002).

The EU Commission has maintained that its reforms of the CAP since 2003 have required making it well-matched with the EU's cohesion objectives and its regional policies. But, when Shucksmith et al (2005) modeled the impacts of these suggestions, they completed that the latest reforms will do nothing to take away the inconsistency between the CAP and cohesion policy, if not they are not accompanied by exact national priorities aimed at specific local program accomplishment.

So, rural areas of the poorest countries have the lowest perceived quality of life in Europe. Yet, it appears from current research that events under the CAP lend very little support to these areas, as an alternative focusing on rural areas in the wealthy core of Europe.

Some suggestions could be offered on how the CAP might add more effectively to the economic and social development of these rural areas in the poorest countries of southern and eastern Europe. Such efforts would require greater funds expenditure to be constant to broader rural development activities targeting the poorer rural areas of Europe, and less to be spent on market hold up in ways that at present favor the wealthy rural regions with larger farms and supported products.

It is vital that these territorial measures contain support for rural society development, working with and building the capacity of individuals and groups within their communities. Local improvement agencies should give priority to collective action that is comprehensive when offering grants and other support, and should smooth the progress of new arenas for contact and collective learning.

Stability with cohesion objectives could also be improved through allocating the RDR budget to Member States according to their relative needs for rural development and environmental management, as proposed in the *Mid-term review of the CAP* (European Commission, 2002). A paper by Mantino (2003) illustrated a diversity of ways in which this might be achieved at regional level, using subjective criteria suggested by the Commission in the first draft of the MTR proposal (agricultural area, agricultural employment and GDP per capita) and

previously used for SAPARD allocations in the then candidate countries, as well as different environmental criteria.

In conclusion, bigger spending under the CAP on a LEADER-type approach is suggested, if territorial cohesion is to be pursued in rural areas of the poorest countries in Europe. The EU initiative LEADER was introduced in 1991 as a pilot project, to stimulate innovative approaches to rural development at local level, particularly in the most underdeveloped rural areas.

Of all the measures under the CAP, Shucksmith et al (2006) concluded that the LEADER program was the most triumphant in supporting the poorest, declining rural regions of Europe and thus holds the most possible for promoting territorial cohesion.

The gradualist proposals of the EU Commission for the period 2007–2013 will allow the LEADER model to be applied on a wider scale by Member States that wish to do so. However, even if the Commission argues that 'for the EU as a whole, persistence and consolidation of the LEADER approach will be safeguarded' (European Commission, 2004), the reduction in the overall funding of Pillar 2 threatens the continuation of the LEADER program in many countries. This program offers a real chance to build capacity and well-being in the poorest rural areas of Europe.

3. Implications for EU urban policies

Relatively less notice is given here to discuss the implications of urban–rural differences, uncovered in the EQLS, for EU policies dealing with urban areas. This is mainly for the reason that the results lift fewer questions for urban areas. In most of the domains quality of life indicators in urban areas were equal to or better than those in rural areas. In the urban environment, the quality of life was perceived as lower because of the unemployment and non-material inconvenience.

On top, it is clear that there is appreciation in EU policy of the vital importance of cities to economic development within a knowledge-based economy (European Commission, 2005c). Certainly, this does not mean that urban troubles do not exist, but rather that they typically involve inequalities within urban areas and, in particular, the presence of urban deprivation and social exclusion within neighborhoods. It is central to accentuate that

these differences are masked in the cumulative data for urban areas used in this analysis. The fact that the analysis does not expose urban troubles in relation to quality of life indicators does not mean that they do not exist at neighborhood level.

The EU has known the significance of addressing inequality and exclusion within cities. As the URBAN program did not continue beyond 2006, the kinds of action funded under the URBAN and EQUAL initiatives were included in the operational programs of the Cohesion Funds.

There has, however, been an ancient worry that the refocusing of funds on the NMS could be to the detriment of de-industrializing cities and urban regions. Once more the mixture of convergence and economic competitiveness may work beside some urban areas of this kind. Even as some declining urban areas in the wealthier countries may succeed in reinventing themselves economically, others may not and could reflect the rural areas in the poorer countries, losing out in the developing model of EU subsidy.

4. Types and examples of precise actions that can reduce urban-rural differences

The idea of social capital is quite new, complex and vague. Particular social capital initiatives for development of job creation in rural areas are hardly ever implemented or introduced at the planned policy level, but somewhat are realized in the form of tangible projects or procedures at local stage.

The social capital initiatives recognized can be grouped into the subsequent types, a number of which are characterized by cross-regional or cross-national collaboration:

■ Partnerships among authorities (government, social partners, NGOs) of diverse administrative levels for combined policy growth;

■ Public-private collaborations for joint policy growth[1];

■ Public-private collaborations for empowering rural ventures;

■ Creation and/or support of traditional business clusters, mainly in rural areas where companies abstain from collaboration;

[1]When referring to public-private partnerships, it needs to be acknowledged that the meaning of ‘private’ is ambiguous since many ‘private actors’ (particularly NGOs) are funded by public money.

■ Creation and/or sustain of business systems for the joint allocation of rural goods;
■ Creation and/or sustain of business systems focusing on local sole selling propositions[2], i.e. building on local production/service ethnicity;
■ Creation and/or sustain of business systems for growing the local tourism sector, i.e. building on natural and/or cultural resources;
■ Creation and/or sustain of business systems encouraging employment in the region, mainly with a precise focus on individual target groups;
■ Creation and/or sustain of systems aiming the labor market incorporation of the local inhabitants, mainly with a specific focus on individual target groups.

What all these diverse types of proposals have in common is the setting up or use of social networks as an instrument to carry out joint actions for the advantage of the individual local community. This takes into account the information that social capital merely exists when it is shared by diverse citizens and, then, can contribute to a more competent use of other types of assets.

5. Developing a skilled workforce answering to labor market requirements, encouraging job quality and lifelong learning in order to reduce urban-rural gaps

Member States ought to encourage productivity and employability through a sufficient supply of knowledge and skills to equal current and future demand in the labor market. Education and attractive vocational training have to be complemented with real incentives for lifelong learning, second-chance opportunities, guaranteeing every adult the chance to move one step up in his/her qualification by targeted migration and integration policies. Member States should build up systems to recognize acquired competencies, eliminate barriers to occupational and geographical mobility of workers, promote the acquisition of transversal competences and creativity, and center their efforts particularly on sustaining those with low skills and rising the employability of older workers, as at the same time improving the

[2]Unique Selling Proposition (USP) refers to an inimitable competitive advantage (e.g. best quality, lowest price).

training, abilities and experience of highly capable workers, as well as researchers.

Member States' hard work to reduce poverty must be intended for promoting full contribution in society and economy and extending employment opportunities, making full use of the European Social Fund. Hard work must also focus on ensuring equal opportunities, counting through access to reasonable, sustainable and high quality services and public services and particularly health care.

Member States must take efficient anti-discrimination actions. Just as, to fight social exclusion, give power to the people and encourage labor market participation, social protection systems, lifelong learning and active inclusion policies must be enhanced to create opportunities at various stages of people's lives and protect them from the risk of elimination.

Social security and pension systems have to be reorganized to guarantee that they can be fully deployed to ensure sufficient income support and access to healthcare – consequently providing social cohesion – as at the same time remaining financially sustainable. Benefit systems have centered their attention on ensuring income security during transitions and reducing poverty, especially between groups most at risk from social segregation, such as one-parent families, minorities, people with disabilities, children and young people, elderly women and men, legal migrants and the homeless. Member States have to actively support the social economy and social innovation in sustaining of the most vulnerable.

6. Inclusive growth – a high-employment economy bringing economic, social and territorial cohesion

Inclusive growth equals to empowering people through high levels of employment, investing in skills, struggling with poverty and modernizing labor markets, training and social protection systems subsequently to help people expect and manage change, and build a cohesive society. It is as well necessary that the benefits of economic growth extend to all parts of the Union, counting its furthest regions, therefore increasing territorial cohesion. It is about ensuring access and opportunities for all throughout the lifecycle. Europe needs to make full use of its labor potential to face up to an ageing population and rising

global competition. Policies to encourage gender equality will be required to boost labor force participation consequently adding to growth and social cohesion.

Europe should act:

– Employment: Due to demographic change, our workforce is about to shrink. Only two-thirds of our working age population is currently employed, compared to over 70% in the US and Japan. The employment rate of women and older workers are particularly low. Young people have been severely hit by the crisis, with an unemployment rate over 21%. There is a strong risk that people away or poorly attached to the world of work lose ground from the labor market.

– Skills: About 80 million people have low or basic skills, but lifelong learning benefits mostly the more educated. By 2020, 16 million more jobs will require high qualifications, while the demand for low skills will drop by 12 million jobs. Achieving longer working lives will also require the possibility to acquire and develop new skills throughout the lifetime.

– Fighting poverty: 80 million people were at risk of poverty prior to the crisis. 19 million of them are children. 8 per cent of people in work do not earn enough to make it above the poverty threshold. Unemployed people are particularly exposed.

Action under this priority will require modernizing, strengthening our employment education and training policies and social protection systems by increasing labor participation and reducing structural unemployment, as well as raising corporate social responsibility among the business community. Access to childcare facilities and care for other dependents will be important in this respect. Implementing flexicurity[3] principles and enabling people to acquire new skills to adapt to new conditions and potential career shifts will be key. A major effort will be needed to combat poverty and social exclusion and reduce health inequalities to ensure that everybody can benefit from growth. Equally important will be our ability to meet the challenge of promoting a healthy and active ageing population to allow for social cohesion and higher productivity.

[3] is a welfare state model with a pro-active labour market policy

7. Case Study: Romania

After 2005, we can notice that the urban unemployment reduces and starting with the year 2009 it can be observed a boost due to the economic crisis and its impact on the Romanian economy.

The Romanian job market has lost over two million people in the past few years due to emigration. Large Diaspora communities have formed in Spain and Italy, while EU jobs in Brussels also attract young Romanians. In the spring, Labor Minister stated that while the EU's target employment rate is 75%, Romania is nearer 50%. Women, young people and the over-45s are particularly struggling to find jobs.

However, one area of work that is not counted in the country's employment figure is subsistence farming. 30% of Romanians work in agriculture and this includes those who focus mainly on growing enough food to feed their families.

Table 1. Unemployment rate in urban and rural Romania (gender and area)

Year/ Gender	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
M	6.5	7.4	7.7	7.1	8.9	7.5	7.7	7.7	8.2	7.2	6.7	7.7
F	6.1	6.2	6.4	5.9	7.7	6.4	6.9	6.4	6.1	5.4	4.7	5.8
Area												
Urban	9.2	10.3	11.2	10.4	11.2	9.5	9.5	8.8	8.6	7.7	6.8	8.1
Rural	3.5	3.5	3.1	2.8	5.4	4.3	6.2	5.2	5.6	4.9	4.6	5.4

Source: Bulletins of the National Institute of Statistics, various issues, period 1998-2009.

Inter-regional factor mobility is recognized to be an important route to encourage economic growth and efficiency gains. EU enlargement with Romania and Bulgaria forces both countries to develop their regional policies and to stimulate their economic development. One of the central issues of economic development is an efficient interregional migration that contributes to the decrease of regional income disparities by reallocation of labor from low productivity to high productivity regions. It can be achieved by improving the employment

opportunities, real wages and economic and social circumstances of diverse regions. At the moment, it seems that the efficiency and welfare (as measured by output) gains from inter-regional labor mobility in Romania have been quite restricted.

Unemployment effects are missing and that wage effects are principally the influence of low wages in donor regions. To reduce these counter-intuitive results, I think that the inter-regional migration decisions are in part the results of the de-collectivization of Romanian agriculture. It has provided rural economic opportunities, while high rates of urban unemployment have reduced urban economic opportunities. As a result, it was some major return migration from urban to rural areas, which may have incidentally implicated interregional relocation.

This means that, while controlling for differences in each direction of migration and each year, the depicted pattern of migration becomes characterized by pull effect rather than push effect, based on rational income decisions. This repercussion is very important, as it stresses the fact that as the massive reform of the Romanian economy gets under way, the effects of many other socio-economic factors such as housing, health amenities and human capital turn out to be significant areas of future inter-regional migration research.

More recent and relevant data of internal migration in Romania would be a good way forward to model an extension of the standard economic models that include significant socio-economic conditions which could influence migration decisions.

8. Conclusions and recommendations

• Encouragement of the role of youth in rural areas requires more attention and funding to territorial RD within the RDR.

• Young people entering farming will also experience individualization, so will need leadership and support, perhaps through RDR and a broadened New Entrants Scheme.

• Partnerships have become an essential factor in RD, and much more could be done to engage young people. CEC should fund research to learn lessons of LEADER and fund the piloting of ground-breaking ways of involving rural youth.

• Evaluations of youth policies must reveal their impact on youth unemployment in rural areas.

• In preparing young people for uncertain non-linear youth transitions, flexible and creative support structures are needed which can address each young person's individual and various needs. This should include employment, welfare, education, training, careers and guidance services.

Cohesion policy is being refocused on the NMS, but there is a predisposition to direct funds to cities as areas of greatest potential. This risks is neglecting the rural areas where living standards are lower. Such strategies will encourage the out-migration of rural youth.

• The challenge is to build up a coordinated policy in relation to young people which encourages balanced territorial development of rural and urban areas of the NMS.

• Centralization of services deteriorates issues of remoteness, accessibility and migration for young people in rural EU.

As the European Union slowly begins to emerge from the economic crisis, member-state governments now face the tough task of reviving their job markets and getting people back into work in the coming years, against a backdrop of an EU employment target of 75% for the year 2020.

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COMMON AGRICULTURAL POLICY AND ITS OBJECTIVES FOR SUSTAINABLE MANAGEMENT OF NATURAL RESOURCES AND MEASURES IN FAVOR OF THE CLIMATE

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Abstract. The first part of this article is a history of the greening of the Common Agricultural Policy (CAP). The second part focuses on parameters and methodologies to take into account in order to evaluate the costs and the benefits of the future CAP. Finally, the last part of this paper is a discussion about the objectives of the greening and the instruments used to achieve them.

Keywords: sustainability, natural resources, agriculture, policy.

1. Introduction

In the forthcoming decades, agriculture in the European Union (EU) and the rest of the world will face the consequences of climate change. The majority of EU lands are managed by farmers (47 % of the EU territory). The CAP, with a budget of € 281.8 billion for Pillar I and € 89.9 billion for rural development for the 2014-2020 period, has a crucial role helping farmers to adapt their products from these changes, but also enhancing the provision of environmental goods and services resulting from good agricultural practices (European Commission, 2009a, 2009b, 2011a, 2011b). The first part of this article is a history of the greening of the CAP. The second part focuses on parameters and

methodologies to take into account in order to evaluate the costs and the benefits of the future CAP. Finally, the last part of this paper is a discussion about the objectives of the greening and the instruments used to achieve them.

2. Evolution of the CAP: from the supply of agricultural goods to the provision of public goods

For over twenty years, the CAP has been reformed to gradually adopt measures to develop a European agriculture more environmentally friendly. The aim of all these reforms is to change from an agriculture providing only agricultural goods into an agriculture combining production of agricultural goods and environmental goods. In 1992, with the introduction of agri-environmental measures and the creation of Natura 2000 sites (which recover around now 17.6% of the land area in the EU27), the CAP understood the key role played by the agriculture in order to resolve current environmental problems (Comité Européen de Droit Rural, 2011; European Commission, 2010). In 1999, The Agenda 2000 package for agriculture has been supplemented by a Regulation on rural development, the second pillar of the CAP. One of the aims of this pillar is to promote and enhance agro-environmental measures introduced in 1992. With this reform, the environment issues became an essential element of the CAP (Comité Européen de Droit Rural 2011). Moreover, this reform introduced the possibility for each Member State to impose the cross-compliance which is a mechanism that links direct payments to compliance by farmers with basic standards concerning the environment, food safety, animal and plant health and animal welfare, as well as the requirement of maintaining land in good agricultural and environmental condition (Comité Européen de Droit Rural 2011; European Commission 2009c). The Mid-Term Review of 2003 makes the cross-compliance not optional but mandatory for direct aids. Moreover, it strengths the second pillar of the CAP establishing the concept of modulation (monetary transfer from the first pillar to the second pillar). However, in 2008, the report of the European Court of Auditors concerning the effectiveness of the crosscompliance, concludes that the environmental impact of cross-compliance is limited. Even if it helps to reduce the negative environmental externalities generated by agricultural production, it does not produce positive

environmental externalities from agriculture (European Court of Auditors, 2008; Balny et al 2009). In 2008, the Health Check of the CAP continues to promote an agriculture that respects the environment, but it also enhances agricultural practices to mitigate and adapt to climate change (Comité Européen de Droit Rural 2011). Moreover, during the period 2007-2013, nearly 20 billion euros, or 22% of the total funds allocated to rural development have been planned for the agrienvironmental measures. Unfortunately, the calculation method of this aid is based on a notion of "cost offsets" and not a concept of "payment for a service". Therefore, the agri-environmental measures are not financial incentives for farmers (European Commission, 2011c; Gassiat et al 2010). In 2014, the CAP must be reformed. This new reform is commonly called the CAP after 2013 or CAP 2020 and one of his three major objectives is to develop a sustainable management of natural resources by promoting good environmental farming practices ensuring the provision of environmental public goods. The CAP has always been adapted to try to respond to new challenges of its time and now the new major challenge of this policy is the greening (European Commission, 2010).

3. The CAP post-2013

As Dacian Cioloş, Commissioner-designate for Agriculture and Rural Development, said: *"Agriculture is not only a food producer but also a provider of public goods, which are important to the European citizen – environmental protection, optimal use of natural resources, preventive measures for climate change, animal welfare"*. Public goods provided by agriculture are either of environmental type such as agricultural landscapes, the biodiversity of agricultural areas, the water quality, water availability, soil functions, stabilizing the climate, the air quality, resilience to floods and fires or either of societal type such as the vitality of rural areas, the welfare of farm animals and food safety (Cooper et al 2009). Unfortunately, public goods are by definition "non-excludable" (if the good is available to one person, others cannot be excluded from the benefits it confers) and non-rival (if the good is consumed by one person it does not reduce the amount available to others). The environmental goods and services provided by the farmers, by their nature, cannot be

secured through the “conventional” markets. This non-payment from the market encourages farmers to over-exploit the potential of their land to the detriment of public goods. Therefore, in opposition to other production sectors, agriculture needs regulatory and policy interventions to ensure that it supplies environmental public goods. Moreover, public goods provided by agriculture are highly appreciated by society especially those with high environmental value. Attitudinal surveys indicate a willingness on the part of the European public to pay for environmental goods and services. Indeed, a collective value is attributed by society to sustainable management of natural resources. That is why the CAP must take into account in its objectives the environmental expectations of European citizens (Cooper et al 2009). The reform proposals suggest the creation of a “green” payment in the first pillar of the CAP to enhance the efforts of farmers to respect the environment and provide public goods. For the 20142020 period, 30% of the budget of pillar I would be spent for the improved use of natural resources. In fact, to beneficiate from the green payment but also of the basic payment, farmers are required to observe on their eligible hectares three agricultural practices beneficial for the climate and the environment:

- to maintain existing permanent grassland on their holding;
- to have an ecological focus area on their agricultural area on at least 7 % of their arable land;
- to have at least three different crops on their arable land when the arable land of the farmer covers more than three hectares.

Organic farmers and farmers who will choice the “Small farmers” scheme are exempted from these specific requirements (European Commission 2011d).

The Figure 1 presents an estimation of the greening amount per hectare of potentially eligible area in each Member State. These estimates are obtained for each Member State dividing 30 % of their amount allocated to the first pillar in 2020 by their number of potentially eligible hectares in 2009.

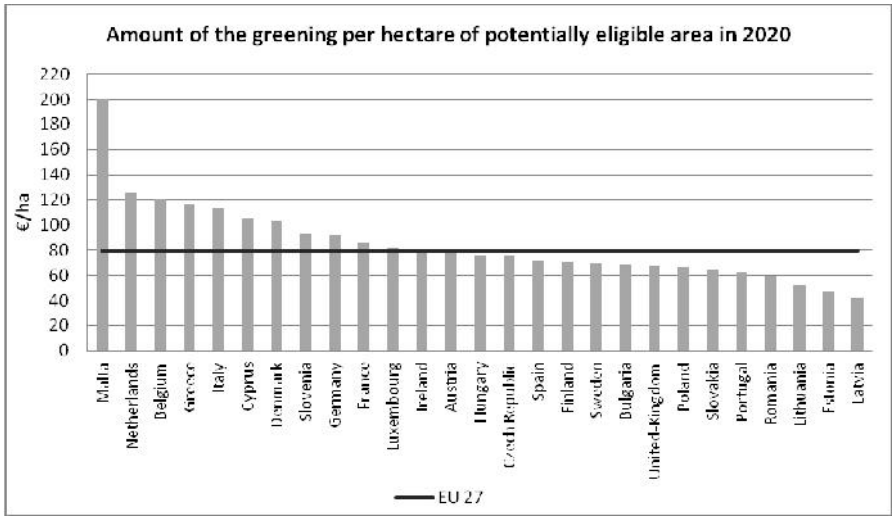

Figure 1. Amount of greening per hectare of potentielly eligible area in 2020
Source: 2009 IACS statistics and European Commission, 2011d.

For 2020, the average amount of the greening in EU would be around 80 € per hectare of potentially eligible area. However, the distribution of the greening aids per hectare is not equitable between Members States. For example, the lowest average greening payment per hectare would be 42 € for Latvia, in contrast, average greening amounts of Netherlands, Belgium and France would be respectively equal to 126 €, 120 € and 86 € per hectare. The difference of aid per hectare between Latvia and the Netherlands is as high as 84 € per hectare. Indeed, this distribution of the greening budget reflects historic spending of the pillar I rather than the agri-environmental objective assessment.

Costs and benefits of greening parameters: The costs and the benefits of greening parameters for all the EU's 27 Member States are difficult to estimate because a lot of data, but also a lot of information, are unavailable. This paragraph describes and makes a critical study of parameters and methods to be taken into account to evaluate the costs and the benefits of the greening.

4. Permanent grasslands

Permanent grasslands have a lot of potential for mitigating the effect of climate change, notably, thanks to their capacity to sequester and store carbon in soils, prevent against flood and preserve the pasture biodiversity (Dumont et al 2007; FAO 2009; European Commission 2011b). During the period 2014-2020, according to the calculation model of the effect of a number of greening measures from Van Zeijts et al (2011), grassland areas in EU would decrease less under a scenario with greening measures (by 2,5 %) than a scenario without (by 3,1 %) (Van Zeijts et al 2011). But, currently, a measure concerning the permanent grasslands exists: each Member State is obliged to ensure that the proportion of agricultural land that is classified as permanent pasture in a base year (2003 for the EU15 Member States, 2004 and 2007 for the new Member States) does not decline by more than 10 % (European Commission, 2009c). The future CAP reform strengthens this measure because it is not more a national or a regional measure but an individual measure (each farmer has to maintain existing permanent grassland on his holding). The measure used to estimate the cost of the biodiversity is the opportunity cost. On farmland, the opportunity cost of the supply of environmental goods is the income foregone in the alternative agricultural use of land (Sinden, 2004). In the case of grassland, the non-conversion into arable land is the highest opportunity cost (European Commission 2011b). Unfortunately, the evaluation of the opportunity cost is difficult because it depends on the soil quality. The better is the soil quality (like in Belgium and Netherlands), the higher is the opportunity cost (European Commission 2011b). Unfortunately, one of the problems is that the base year of "freezing" of the permanent pasture is 2014. Thus, farmers could try to convert a part of this permanent grassland in arable land before January 1st 2014. Moreover, there are no rules about the mowing. So, to take the maximum

advantage of public goods provided by the pastures, rules regarding the date of the first mowing and the frequency of the mowing should be implemented.

5. Crop diversification

The legislative proposal obliges farmers with more than 3 hectares of arable land to have at least three different crops on this area and none of these crops covers less than 5 % and the main crop no more than 70 % of the arable land. According to the Commission, 92 % of the farmers respect these rules. The farmers who do not satisfy the measure are either those who have too few crops (like farms specialized in dairy and beef production with a lot of permanent pasture and with few hectares of corn) or those who do not respect the required percentages. We can imagine that some farmers could convert a part of their grassland before 2014 in order to have more hectares of corn so that will be easier for them to respect the crop diversification measure. Actually, this measure could be a counterproductive one from the environmental point of view. To evaluate the cost of the crop diversification measure, the Commission proposes to consider that this opportunity cost is equal to the difference between the farm individual gross margin of arable land and the average regional gross margin of field crop for farms in compliance with this measure. According to the Flemish experts' assessment, this measure will contribute the least to environmental and climate objectives. Moreover, its contribution depends on the definition of the term "crop". Are spring wheat and winter wheat the same "crop"? The definition of the concept "crop" will be crucial. (European Commission 2011b; Danckaert et al 2012).

6. Ecological focus area

According to the legislative proposal, at farm level, at least 7 % of arable land and permanent crop have to be in ecological focus area. This measure could be made a significant contribution to the environmental and climate objectives, especially where there are degradations of structure quality, soil erosion and eutrophisation, and also in favor of water quality, fauna and flora, and landscape. Moreover, this ecological areas help to reduce the greenhouse gas emissions, mainly reducing the use of fertilizers (Danckaert et al 2012; PBL 2012). According to

a study of PBL researchers (2012), the budget for agri-environmental measures and greening payments for permanent grassland and ecological set-aside of an assumed 5% of the arable land could increase by 3% farmland species richness in 2020. Impacts would be more important in intensive farmed regions where the biodiversity level is low (Figure 2). But this measures appear not enough effective in extensively farmed regions and regions dominated by grassland. Moreover, according to the PBL analysis, this agri-environmental measures cause negative impacts on species richness in Scotland and Bulgaria (PBL 2012).

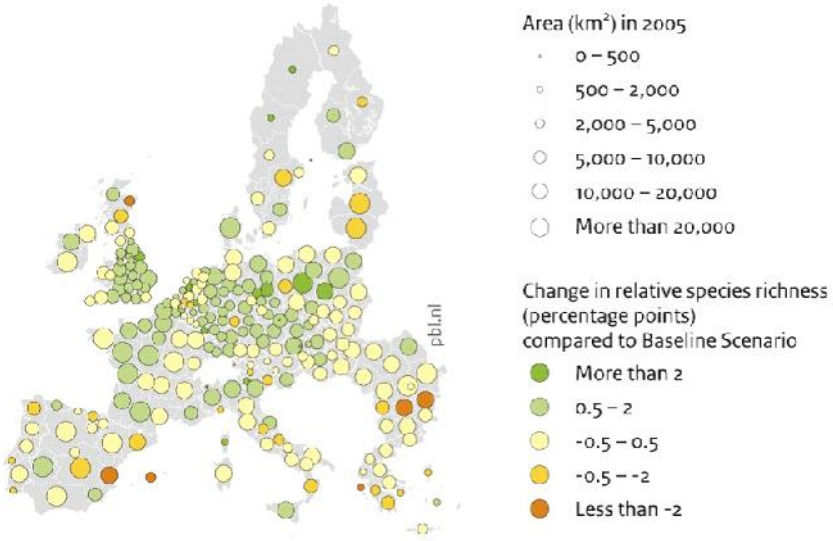

Figure 2. Effet of greening measures
Source: PBL (2012) adaptation of PBL from the Greening scenario 'minus' moderate shift measures from Van Zeijts et al (2011). Changes are mainly caused by net 5 % ecological set-aside of arable land.

Unfortunately, this measure is unclear and the lack of information about the definition of ecological focus area is the limiting factor. Indeed, the areas of ecological interests are different in each country of the EU. Therefore, it should be

allowed for each Member State to choose some agri-environmental measures relevant for each agricultural region. Moreover, there are no rules regarding the duration of implantation of ecological zones. A farmer can change each year the ecological site. Moreover, some farmers could rent marginal lands to meet the standards of this measure. The large degree of freedom in the implementation of ecological zones risks to make this measure ineffective (PBL 2012). Furthermore, some divergences exist between the objective of this measure and the methodology used (Le Roi et al 2011). What is the most interesting, 7 % of arable lands with ecological focus area or 100 % of the agricultural land under the influence of ecological focus? The first proposition doesn't take into account the interaction between all the ecological focus areas. Moreover, the reference surface of this measure is the farm and not the plot. Thus, a farmer with, for example, 500 hectares of crop, could put all his 7 % of ecological focus area in the same plot and of course the ecological benefit is not relevant. In conclusion, the second proposition is more interesting because it takes into account the importance of the continuity between all the ecological focus areas of all the lands (arable lands and pastures). The consequence of this measure is that some farmers will have to inactivate a part of their production in order to have enough hectares of ecological focus area. This is incoherent with another important role of the future CAP: global food security (Danckaert et al., 2012). Indeed, biodiversity gains thanks to these measures would involve a loss of 2 % for grass to 4% for cereal production (PBL 2012; Van Zeijts et al 2011).

7. Discussion and conclusion

The consideration by the CAP of the efforts of farmers to respect the environment and provide public goods is the first step toward a more sustainable agriculture but also mainly a revaluation of the farmers work. Unfortunately, the policy of greening of the CAP seems to be a political façade. Indeed, for agronomic reasons the crop diversification is used and the measures concerning the permanent grasslands exists yet. Furthermore, new benefits measures like green cover don't appear in the last reform proposals. That is why the greening seems to be a recycling of existing measures. Moreover, there is a lack of

economic quantification of the environmental benefits of these measures. That is the reason why the 30 % of the pillar I budget devoted to the greening payment seem a stratagem to justify the current payments granted to the farmers. Moreover, in the regions where the greening is necessary, the farmers will have to support the greening of the CAP. In these regions where the greening adds more costly burdens onto farmers, a phasing-in of the greening and specific aids should be necessary to avoid a decrease of their economic viability. Unfortunately, it seems that there are sometimes incoherencies between the objectives and the tools used to achieve them. In fact, it would perhaps be more interesting to strengthen the second pillar of the CAP rather than to try to justify the greening of the aids of the pillar I devoted to the income support for farmers? To increase the funds for research and innovation on sustainable agriculture and for rural development, in particular, those devoted to the environmental measures, would be a more favorable policy to respond to the environmental challenges of our times.

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