SUSTAINABLE DEVELOPMENT OF AGRO-ECOSYSTEMS IN TERRITORIAL PROFILE. CASE STUDY: BRĂILA COUNTY

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Abstract: *Understanding the complexity of the interactions between the natural and human systems is essential both for welfare of mankind and the sustainability of natural resources. An important component of this system is represented by agro-ecosystems which cover, at global level, a large part of the total area and comprise an important part of the ecosystems, being associated with different services (provisioning, regulating, supporting, cultural services). The present paper aims to identify the main types of agro-ecosystems from areas characterized by a high aridity tendency, in territorial profile and it is based on several studies undertaken in Braila County within a rural area composed of four communities representative for the dominant agricultural model. The dominant agro-ecosystem identified at the level of the investigated area is one with a strong agricultural character, being oriented towards obtaining high average yields, based on a relatively small number of crops, chosen mainly due to economic, profitability reasons. The study turns to quantitative analysis of statistical data and data obtained through questionnaires applied to agricultural producers from the investigated rural area, selected during several study tours, data that was processed using designated software for this purpose.*

Key words*:* natural and human systems, agro-ecosystem, agro-ecosystem's services

INTRODUCTION

The complex relationship between the natural system and the human system represented as follows by the concept of agro-ecosystem was, right from the start of the agricultural activity, a tensioned one, manifesting itself through the continuous testing of the resilience of the natural factors by the anthropic activity represented by agriculture. The natural communities were step by step replaced by others, productive, supported artificially. The goals of the agricultural activities were, in general, the production maximization, the operation in conditions of high profitability, the minimization of the productions instability and prevention, on long term, of the degradation of the productive capacity of the agricultural systems (Watt, 1973). In the present context marked by the demographical evolution at world level and implicitly of the demand for agri-food products, increasing from year to year, the main goal of the activity developed at the agro-ecosystems level has become the productions maximization, the other types of services of the agro-ecosystems (services of regularization, support services, cultural services) remaining in the second plan. This can lead, in time, to the deepening of the lacks of equilibrium manifesting in the relationship between the natural capital and the human capital within the agro-ecosystems.
The assessment of the agro-ecosystems present at the level of the area studied has followed the identification of the main characteristics linked to the: soil quality classes, crops diversification, productions obtained, agricultural technologies, and the utilization of the irrigation water. The main hypothesis of the present study is the following: the dominant agro-ecosystem type present at the level of the investigated area has a strong agricultural character (intensive agro-ecosystem), being oriented to the obtaining of some high average productions, on basis of a relatively reduced number of crops , chosen mainly from economic reasons, of profitability, benefiting from the advantage of cultivation on soils from the first quality classes and being dependant on the supplementary water supply through the irrigation system.

MATERIALS AND METHODS

For the study of the agricultural activities developed and the identification of the agro-ecosystem types present at the level of the area investigated it was appealed to the quantitative analysis assisted by the informatics program SPSS. Instruments utilized in the present paper were:

Statistical documents, studies and scientific literature referring to the typology of the agro-ecosystems and the sustainable development of the relationship between the human and natural capital;

Statistical data referring to the agricultural activity practiced in the investigated area;

Regional and local strategies referring to the investigated space;

Data obtained following the field studies developed in the zone investigated, processed by help of some informatics specialized programs – Questionnaires applied to the agricultural producers in the rural space of Braila for catching the types of agriculture practiced at their level. Questionnaires were subsequently introduced in a data base and processed by help of the informatics program SPSS, a program dedicated to the quantitative analysis.

RESEARCH RESULTS

The understanding of the complexity of interactions within the relationship natural system-human system is very important for the people welfare, and for the natural resources sustainability. Agriculture represents an important economic sector, especially for the developing countries, where the incomes per inhabitant are reduced, ensuring an important part of the GDP as well as numerous jobs for the population. Within this context, the analysis of the relationship between agriculture and ecosystem represents a natural approach having in view that, in essence, agriculture represents an ecosystem dominated by the anthropic activity and that between the two components there are relations of reciprocal interconditionality.

Important components of this system is represented by agro-ecosystems, covering a substantial part of the total area, at world level and comprise an important part of the ecosystems, being associated to different services:

- Of production– foods, water, pharmaceutical products, biochemical, industrial, , energy, genetical resources etc;
- Regularization – absorption of carbon and climate regularization, wastes decomposition, water and air purification, crops pollination, control of diseases and pests, flood and drought limitation ;
- support - soil formation, dispersion and circuit of the nutrients, primary production etc;
- generation and maintaining of biodiversity;
- Cultural – cultural, intellectual inspiration, recreation space, space for scientific researches.

The services of agro-ecosystem comprise services of the ecosystem ensured/supplied by the agro ecosystems. These are usually, defined as spatial units, functional and coherent of the agricultural activity including the live and inert components and their interactions (Shiferaw, 2005). This includes, implicitly, as an essential component, the agricultural activities of the nature of plant cropping, husbandry and management of natural resources.

The agro-ecosystems represent a simplified copy of the natural ecosystems and are created and managed by the Man through a supplementary energy input. These have a much simplified structure with a low internal diversity, with ecological niches not

saturated and a distribution of the substance and energy through a reduced number of large channels (sometimes only one). From this point of view, agro-ecosystems can be compared with the natural, simplified young ecosystems (Puia, Soran, 1987).

As regards the agro-ecosystems typology, one of the scientific approaches which get a large adhesion is that having at its basis the criterion of agricultural systems classification in function of the supplementary quantity of energy introduced by the anthropic activity. According to it, the more simplified an agro-ecosystem is characterized through the trophic level, the bigger the quantity of energy necessary to its maintaining is.

Starting from this idea and relying on a series of specialty studies, Puia and Soran proposed the following classification of the agro-ecosystems: extensive, intensives and industrialized. The main characteristics of these three types of agro-ecosystems are:

- Extensive agro-ecosystems– high energetic ratio out/in, low productivity, reduced pest control, rudimentary agricultural techniques, the sorts utilized have small yields; these agro-systems are assimilated to the systems of traditional agriculture, where the products quality can be traced;
- Intensive agro-ecosystems– approximately unitary energetically input (1/1); high average productivity determined by the utilization of some new, productive sorts, and of land improvements (especially irrigations); these are assimilated to the strongly mechanized systems that use chemical products like production of cereals and other crop plants, intensive orchards and vineyards, mixed production systems, cows for milk raise, fishery in the interior waters;
- Industrialized agro-ecosystems – sub unitary energetic input; focused on obtaining the products from one single species under control conditions; they are assimilated to the zoo-productive industrialized systems (complexes for poultry raise, swines, bovines), aquaculture systems, but also hothouses for vegetable production along the whole year.

The present paper proposes itself the identification of the types of agro-ecosystems from the areas characterized by a high tendency to aridity, in territorial profile and has at its basis a series of studies made at the level of county Brăila, in a rural area made of four representative communities for the agricultural dominant pattern, which is strongly characterized by the climatic factors and dependent on the supplementary water input through the irrigation system.

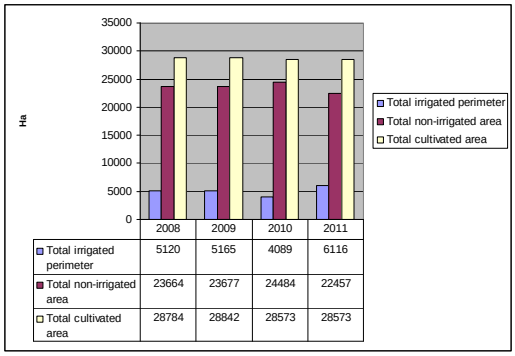
The rural space in county Brăila, which represented the investigating zone of the present study, is made of four rural communities in county Brăila that are: Cazasu, Tudor Vladimirescu, Siliştea and Vădeni (named as pilot zone Cazasu). The four communes are located near the county capital, municipality Brăila, very near to Danube River and is benefiting from the major advantage of being situated near the important road routes for transport represented by national and regional important roads as well as the River port infrastructure. Agriculture represents an important economic activity for the pilot zone, being practiced by small size, medium size and big agricultural farms.

The irrigation system in the pilot zone Cazasu was built many decades ago, in the communist period and was initially projected for the big size farms. After the year 1990, a great part of the infrastructure for irrigations deteriorated as a consequence of the political and economic deep changes which took place at national and regional level. This process was, at a certain extent, reduced after 1999, when there were founded the Irrigation Water Users' Organizations (OUAI), and the tertiary infrastructure for irrigations was transferred into ownership of these farmers associations– who became responsible for the maintenance and repair of the irrigation infrastructure owned by OUAI-s.

In the last years, the total irrigated area of the pilot zone Cazasu has registered important variations from the area point of view, from 5120 ha in 2008 to 6116 ha in the year 2011 (the minimum was registered in the year 2010 – 4089 ha), although the total area cultivated remained relatively constant within this interval (Figure 1).

The strong decrease of the total irrigated area registered in the year 2010 was, mainly, caused by the elimination of the subsidies which the farmers got for irrigations – subsidies for the electric power necessary for the system operation. At the level of the year 2011, we can assist to an important coming back of the total irrigated area of the pilot zone in comparison to the preceding years, this representing now 21,4% of the total cultivated area.

The pilot zone Cazasu offers conditions proper for the cultivation of cereals, technical plants and of other crops. The main crops at the level of the agricultural perimeter of the pilot zone are wheat, maize, sunflower and rapeseed. Taken together, the areas cultivated of the main crops represented over 59% of the total area cultivated at the level of the year 2008, the values being even higher in the following years – 68, 81% in2009, 64, 46% in 2010 and 68, 32% in 2011.



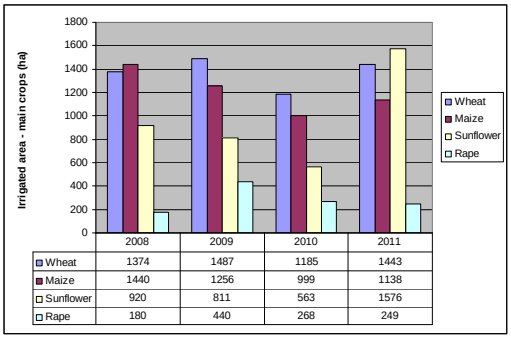
	2008	2009	2010	2011
Total irrigated perimeter	5120	5165	4089	6116
Total non-irrigated area	23664	23677	24484	22457
Total cultivated area	28784	28842	28573	28573

Figure 1. Total irrigated area, non-irrigated area and the cultivated area

In the production structure of the pilot zone there are present other crops also, as barley, two row barley, soybeans, potatoes and vegetables, but the areas cultivated are much smaller in comparison to those of the main four crops. The utilization of a relatively reduced number of crops in the production structure is supported by the farmers interviewed, the main reason being represented by the higher profitability and by the insurance for at least a part of the production that it will be sold at the end of the season. Many of the farms investigated are concentrated upon the seed production (mainly maize and wheat seed)), on a contract basis with one or more international companies specialized in this domain. This can be explained if we consider the fact that county Brăila produces appreciatively 70% of the maize for seed at national level and the trend from the last decade of the specialized companies was that of producing near the selling markets. This relationship between the farmers and the specialized companies is reciprocally advantageous: companies found in the investigated zone partners who benefit from a vast experience in the agricultural domain, modern techniques and rather big areas, ensuring very good conditions for the cultivation of these plants, and the farmers a way to ensure of some profitable results, able to offer technical-financial conditions necessary for the continuation of the activity. Profitability of these crops results, besides the ensuring of the production sale also from a series of advantages linked to the production process : the specialized companies support the expenses with the field preparation and crop initiation, a part of the specific necessary technical works, one or more waterings, harvesting and the transport to the own deposits .

From the four main crops taken together, wheat and maize represent the greatest part of the irrigated the area in the interval 2008-2011. As regards the years 2008 and 2009, there were insignificant differences at the level of the areas cultivated of the main crops, except the rapeseed crop, where the area cultivated increased from 180 ha to 440 ha in this interval (Figure 2).

The agricultural season 2010 has marked the decline of the irrigated area of the main crops, as result of the elimination of the subsidies which the farmers were receiving for the irrigations, the areas of the main crops registering the smallest values of the four seasons analyzed. Those affected, mainly, of these changes in the mechanism of the subsidies, were the small farms which were forced to give up irrigations because of the costs increase which they should have covered for the utilization of irrigation water. This situation has determined important changes at the level of the irrigated areas structure in function of the farm size, where the big farms (over 100 ha), disposing of financial resources sufficient to cope with these changes, represented the biggest part of the total irrigated area of the crops at the level of the pilot zone. In the agricultural season 2011, we assist to a strong comeback of the area irrigated of the main crops, in comparison to the previous one, based, first, on the activity developed by the big farms in the pilot zone, the area irrigated (main crops) registering the highest value in the four years. Also, the main crops structure has suffered some changes, the biggest area irrigated being now the case of the sunflower crop, while the areas cultivated with wheat and maize increased slightly in comparison to the year 2010, but situated, as follows, under the values registered in the season 2009.



	2008	2009	2010	2011
Wheat	1374	1487	1185	1443
Maize	1440	1256	999	1138
Sunflower	920	811	563	1576
Rape	180	440	268	249

Figure 2. Irrigatted areas of the main crops–pilot zone Cazasu

Also at the level of the investigated farms the problem of the irrigation water utilization is an important one, having in view the changes intervened at the level of the subsidizing mechanism and of the evolution of the electric power price. Taken together, the cost of water and energy necessary for the system operation, represent an important part of the total cost per crop, varying in function of the necessary specific of the crop: maize grain– 16, 7%, sunflower– 26, 66%, wheat for seed– 37,66% and maize for seed– 66,66%. Under these conditions, the economic profitability of the irrigation water represents a very important element for the farmers, who wish to obtain an economic advantage through its utilization. Elimination of subsidies for the electric power necessary for the irrigation system operation and evolution of its price (following to increase successively until the year 2018) make the farmers consider the present irrigation water price already high for their payment capacity. Moreover, together with the system reorganization, the tertiary irrigation infrastructure was passed into ownership of the

Irrigation Water Users Organizations, the members of which (farmers), must support the costs necessary for the maintenance and system operation.

The total production of the main crops in the pilot zone registered in the interval 2008-2011, a series of fluctuations generated both by the evolution of the areas cultivated and by the conditions specific to crops in the agricultural season. In the season 2008-2009, the total production of the main crops increased in case of maize crops, sunflower and rape seed, although the determinative factor was different: in the maize case, this was represented by the yield (total production increased from 10664 tones to 18061 tones, while the area decreased from 5229 ha to 4162 ha), and in case of the rapeseed and sunflower, the determinative factor was the increase of the area cultivated. The only crop in the case of which it was registered a decrease of the total production was the wheat, from 21657 tones to 19700 tones, although the area cultivated increased in this interval, , from 6368 ha in 2008 to 7960 ha in 2009; in this case, the determinative factor was represented by the conditions specific for crop, which were, especially, unfavorable for the crop of wheat during the season 2009. The total production of the main crops under irrigated system followed, in the period 2008-2011, greatly, the same evolution of total production, being influenced both by the changes from the level of the areas cultivated and that of productivity. Taking into consideration the total production and the productivity level at main crops, we could state that, among the four agricultural seasons analyzed, per total, the best results were obtained during the season 2011, both under irrigated and not irrigated system.

The results of the pilot zone as regards the total production are closely linked to the agricultural activity of the farms activating in this area, that is to the areas cultivated and the productivity level, which are, at their turn, influenced by the economic, financial and legislative environment specific in which they are developing their activity. The profound changes which take place at this level are strongly influencing the agricultural activity, and as a consequence, the potential results also. Having in view the fact that the agricultural production under irrigated system represents a bigger and bigger part of the total agricultural production of the pilot zone, the improvement of the irrigation water management represents not only an opportunity, but also a real necessity in view of improving the level of crops productivity and the economic performances of the agricultural farms.

CONCLUSIONS

The rural perimeter investigated within this study, made of four communes, is one representative from the point of view of the agricultural activities for the county Brăila, where agriculture is very important for the region's economy, the contribution of the primary sector to the creation of GVA being 3 times higher than at national level and double as to the Development Region South-East where the county Brăila is located.

Benefiting from an important pedological advantage, represented by the high share of soils from the category I and II for agriculture pretability and from the recent evolutions from the level of the size categories of the agricultural farms, which permitted the concentration of the lands and of the farms activity in big size farms , of over 100 ha, the main agricultural activity is represented by the field crops, mainly of maize, wheat, sunflower, rapeseed, both for consumption and for seeds obtaining (maize and wheat), but also from the cultivation of vegetables and other plants. The agricultural farms in the perimeter investigated have the necessary agricultural experience, being run, generally, by persons with high specialty education and a rich practical experience, they also own modern farm techniques represented by machines and devices of big capacity, which is

renewed periodically, both from own funds and attracted ones, of access to the irrigation system and qualified staff for its operation. Many of these are appealing to modern forms of ensuring the sale of te production, working on contract basis, especially for the production of seeds (maize and wheat) for the international specialized companies, but also others informal (verbal agreements) mainly for sale of the vegetables production .

Having in view the main characteristics of the agricultural activities developed at the level of the rural perimeter investigated, we can state that, the dominant model of agro-ecosystem is one of intensive type, being characterized by the following specific elements:

- Cultivation of a relatively reduced number of plants, mainly cereals under field crops system in big size farms, of over 100 ha;
- High productivity due to the utilization of selected sorts and to the land improvement works of the irrigations nature, and also the use of chemicals in the production process (fertilizers, herbicides, pesticides);
- The intensive utilization, in all phases of the production process, of the modern agricultural techniques (mechanization), ensuring, this way, the proper preparation of the agricultural land and the reduction of the specific costs per area unit;
- A strong commercial character of the farm activity developed, appealing to modern forms of the production sale (both formal and informal), the main goal being the insurance of the technical-financial resources necessary to the continuation and development of the activity.

The obtaining of agri-food products through such agro-ecosystems is recommended as long as there are resources for technological energy, accessible and relatively cheap. Any modification intervened at the level of the resources costs (for example the oil price, the electric power price) will determine, though, the price increase of the products obtained through such intensive agro-ecosystems. Moreover, the specialization of the producers by narrow branches, as well as the artificial separation between the cultivated land area and the natural landscapes determine that the natural recycling be substituted by chemical fertilizers which is translated in fact by a supplementary energy consumption. The non realization of the natural circuit has important implications upon the organic matter in the soil, reducing much quantitatively and resulting in the progressive decrease of the organic easy soluble substances, with a special importance in the soil fertility.

The main goal of the sustainable agriculture is not that of obtaining the maximum productivity but the insurance of the stability on long term. The development of some agro-ecosystems, self-sufficient, diversified, viable from economic point of view is based on genuine patterns of systems of crops and/or animal husbandry managed through technologies adapted to the local environment, at the hand of the farmers (Loucks, 1977). The preservation of resources and energy, the natural factors quality, the population health and the socioeconomic equitable development represent factors which should taken into account within the decision process regarding the species of plants cultivated, the agricultural techniques, crops rotation, fertilization, pests and diseases control and harvesting.

In this context, it is very clear that the requirements for a sustainable agro-ecosystem are not only of technical nature, but also biological, social, economic, political, illustrating in fact the requirements for a sustainable society Altieri and col., 1983). The ecological changes at agriculture level cannot be promoted without comparable changes in other associated zones of the society. As consequence, the final requirement for a sustainable agriculture, ecological one, is a natural attitude in favor for the coexistence and not of exploitation.

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