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Sustainable development in agriculture: a socio-ecological approach

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ABSTRACT
In this paper is presented a perspective on sustainability in agriculture - which derives from a notion of development tied to the idea of growth - supported by technological advances aimed at ensuring sustainable management of natural resources. In this sense, we consider here a socio-ecological approach in order to bring together the individual and their environment, showing that this relationship is fundamental for a process of co-evolution, where nature and human being together can define the organization society.
Keywords: Sustainability; Natural resources; Water resource; Food production.

I. INTRODUCTION

Sustainability is a diffuse term, and several authors have already tried to define what exactly involves the use of this word applied to goods, services or conditions. The definition given to sustainable development by the Brundtland report [1], "development that meets the needs of the present without compromising the ability of future generations to meet their own needs", provides scarce direction for actions in addition to the suggestion of maintaining the permanent stability of all conditions and actors over time, inhibiting from now on increases in demands.

Besides the discussion among researchers of one same country, there is also what was called by R. Abramovay as "New and Old World schools"[2], indicating an even greater divergence when the issue is dealt in different countries or continents. This basically occurs due to two conditions: a) it is a derived biological term to describe human activities and their effects on areas of direct and indirect influence; b) different environments tend to respond differently, impairing or even preventing involved humans from giving the desired sense to the term etymology.

When applied directly to agricultural issues, sustainability may be considered a philosophical, ecological (a term that makes its interpretation even more difficult since it must involve human ecology as well), economic or strategic issue which, depending on the choice, justifies the use of a certain method and serves to condemn it. The importance of this definition lies in the establishment of subsequent standards and rules which can thus be followed, monitored, audited or traced in order to provide the system under analysis the condition of sustainable or not. When this condition is not possible, how to define the needed or comprehensible parameters to set rights and duties related to the production or consumption of resources, renewable or not, needed for production?

The term Sustainable Development (SD) was first used in the United Nations Conference on Environment and Development held in the city of Stockholm in 1972. The final report, entitled "Limits to Growth" (Meadows report), produced a derivation, presented in 1987 as "Our Common Future"; the Norwegian prime minister at that time, Dr. Gro H. Brundtland, was the referee and the document was named "Brundtland Report"[1], which had its definitions. "Sustainable development" and consequently its derivations for the several areas of human activities have allowed a heated debate about its meaning, since its concept given in that report is: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Similarly to every concept created to answer a macro-level question, it allows several interpretations; however, one thought line is clear since the beginning: the idea that the fulfilling of current needs will not differ in the future, especially in environments that have reached or are reaching their limit [3]. On the other hand, this "stability" is not viable since several factors (natural or not) may occur to make the conditions of a certain environment closer to a limit or even post-limit situation, causing unsustainability. An example is the agricultural community, which maintains its productive resources controlled and starts to face drought (or flood) resulting from a cyclic recurrence event of 500 years or over. How can a population be prepared for something like that? Even under biological condition, where entire species, especially endemic ones, can emerge and disappear over such a long period.

Apart from the issue of lack of stability, sustainable development (or sustainability) is a term applied to human achievements or changes. This term was taken from the biological sciences, which use it to define a balanced environment without great impacts on its trophic systems. Thus, the debate about the concept of sustainable development, sustainability or sustainable agriculture (as the paper will focus its analysis on this area) becomes even more confusing, since the initial subjectivity is highly used to justify thought or action lines. In 1996, citing several authors, J.W.Hansen suggests that only in the United States there are concepts or uses for sustainable agriculture such as philosophy, ideology, strategy or ability to meet a group of objectives [4]. This seems to prove the difficulty in standardizing the concept for its *lato* understanding. Conversely, R. Abramovay already evidenced such differences, further increasing the difficulties while exposing greater differences even within the above-mentioned lines between the European and the North-American thought [2]. For that author, the American thought, even ideologically, showed an anthropocentric, productivist form of results, whereas the European though was directed to the ecocentric issue.

Either way, the problem is not necessarily which concept will be the main one but the need of this standardization to generate clear categories such as rules and parameters to allow the use of sustainability besides the concept form. This need is evident when the scarcest natural resource reaches its availability limit, with the need of planning or relocation to allow its rational use (it can be cited as following Liebig's law). Although there are a number of possibilities, this paper is focused on the issue of water resource, since until recently it was considered an unlimited renewable natural resource without the clear idea that human actions could ever exhaust it. Thus, the access to water in Brazil is considered an inalienable right but deserves debate as to restrictions to be applied close to its limit.

As this sustainability is based on the ecological issue, since it depends on the biogeochemical cycle properly named "cycle of water" [5], human actions may at most influence its consumption and consequently increase its scarcity. Analyzing the degree of such influence, the current difference in though between the human and the natural planning becomes clearer since the water resource sustainability originates at least from an order of magnitude that is different from that used in agricultural sustainability. An example is the water resource minimal planning given by the watershed (or micro-watershed) sedimented in the form of natural water divisors (mountain peaks and river thalwegs), whereas in the crop process the freedom of choice of the farmer (or human actor involved in the physical environment exploration) allows a limited planning to the legal limits of the farm. This is an example that impairs the perfect combination among the several sustainability types (or concepts), since it involves the issue of sustainability affected by private and public (group) demands, not always moving in a coherent manner.

Verifying a historical aspect already known over time, environmental impact and population have always shown a well-defined causal link [6]. A still current example is the phenomenon of human concentration surrounding civilization poles, where the water resource is understood as a direct source of water supply for a population. However, around these human agglomerations there is traditionally the formation of a "greenbelt" for the production of highly perishable foods (fruits and vegetables), which demand high quantities of water for their production and are located there for logistic and economic purposes (high added-value products). As the city and the population expand, the demand for water supply increases and restrictions may appear as to the water resource use for other activities, especially agriculture (not only quantity, but also quality). How to solve such an impasse since the distance from productive poles implies the reformulation of areas previously directed to other crop activities (and frequently distant from the water resource needed for this type of production), sometimes requiring large civil building to allow this type of "development", changing the local or regional economies, previously defined social strata. Does not it change the crop sustainability baseline of the involved regions? Does not it contradict the original concept of sustainable development?

II. THE DESTABILIZING ROLE OF ECONOMY

The economy applied to the issue of development (or sustainable agriculture) is also a factor of variation of pressure on sustainability, which does not necessarily depends on the control of local wishes. After occurrences involving catastrophes (excess or scarcity included), it is the motor force of most human actions in market-free systems. Examples of this influence can be seen where, although there is local balance of production-consumption (offer-demand) which would keep the prices and the producers' gains at a "sustainable" level, similar products imported from different regions of the planet reach the local market with lower or less competitive prices relative to the local prices. This generates at least an increase in offer, rapidly destabilizing the system which has been sustainable so far. From this point, several actions may take place so that the generated responses will be reflexes of human decisions, local or not, directed to the several proportional sustainability levels. Considering some scenarios as examples: a) the local

production may be summarily ended and rural exodus may occur due to the low or absent payment to producers, forcing b) the change in the productive system, either by products that require larger areas to yield the same salary per individual (increased population exclusion process) or by products of differentiated added-value, forcing c) different contribution of inputs, d) increasing the production cost and the price of the final product to the consumer, or e) generating an unsustainable ecologically situation such as d) overuse of water resources or f) need of introducing exotic species, forcing the agroecosystem change. On the other hand, this scenario could be completely inverted (characterized as negative), and the local production would start to search for higher efficiency in its productive system, better managing the resources and decreasing the costs, changing the baseline of competitiveness in its favor or allowing the entrance of new actors into the productive system.

Considering both extremes, there is a change in the previous stability, requiring a rearrangement of ecological, economic and social positions of the local crop zone until there is a new relative and apparently "sustainable" accommodation. This new balance, generated by the economy, not always (or almost never) can be related to the ecological balance. This is due to the great differentiation between the economic objectives (in market systems that appreciate free competition), the efficiency maximization and profit generation, and the ecological objectives, the maintenance of the local biotic community in balance with the abiotic environment. This may favor, similarly to the introduction of the so-called "economic species" into new regions, the complete environmental imbalance, with the need of acquiring and applying auxiliary inputs (such as agrochemicals, organic fertilization, population control). Even for activities involving some of the so-called "organic agricultures", in which the major part of the involved issue is philosophic and the farmer accepts a certain economic differential (losses) relative to the remaining crop production systems, reaching the rupture point, at which the farmer either works with some points in common with conventional systems (such as homogeneity of populations per area, contribution of external resources) or fatally risks abandoning the activity.

As regards the issue of water resource, we can cite small farmers who live and develop their activities in areas of up to one rural module in a valley cut by only one watercourse. Evaluating such a situation, which would be the decision as to the authorized use of this resource in watersheds with established committee, watershed agency and bestowal? According to the Brazilian Legislation for Water Resources [7], these families would not be bound to bestowal registration and water fees. However, as previously cited, these farmers are vegetable producers and therefore would be subjected to fluctuations in the market price (local or not), which could also interfere in the demand for water resource. Thus, an isolated small farmer who use the water resource from the watershed, according to the legal permission, does not represent a great impact relative to other uses; however, if almost all producers unlimitedly use the water in critical moments (drought periods, for example), the watercourse may suffer from the same problems that occur in situations of large projects, with the difference that in the latter there is a minimal planning of the resource management, including bestowal transfer, whereas for small farmers there is a problem as to the water resource sustainability, including the sustainability of the crop itself. In some watersheds, such as that of Sinos River, Rio Grande do Sul State, Brazil, another problem may arise as to the water resource sustainability due to the location of large areas of irrigated crops, especially rice, in the upper part of the river. This leads to an increased demand of water in this region and also to the use of pesticides that release residues into the water body, with severe reflexes of water quantity and quality in the medium and lower courses of the river, especially during drought periods, resulting in difficult public supply to downstream cities. According to the current Brazilian legislation, public and water supply have primacy of use, followed by the demands of industry and finally agriculture. In watersheds with a committee established, considering the legal hierarchy, how is the priority of access decided? In general, the committee itself assumes this decision. How and on which basis is it decided? Considering the practice observed in most watersheds, there is not a defined parameter as to this "sustainable use", but a debate in which users with greater pressure power (especially economic and a certain degree in the social area) receive the greatest advantages.

III. OTHER PRESSURE FORMS

Several other alteration forms could be cited such as the choice of the local society for the role of the rural space as a "therapeutic" environment or "guardian" of natural resources, the multiple use of water resources [2,8], demonstrating that it hides a rediscussion of the usefulness of the rural space solely and exclusively for food production. In addition, the development of peoples should also be analyzed when there are apparent signs that countries called developed are thus due to the use of natural resources beyond their limits, whereas developing people are coerced to conserve the same resources in favor of humankind (the greatest good?). All these questions indicate that sustainability be discussed in

an accelerated form so that its applications are not delayed [9,10].

IV. CONCLUSIONS

After the presentation of the previous cases, we come to the main question: is it convenient to accept the term sustainability or sustainable agriculture to define the momentary status of a crop system?

As to food production, the term seems not to be applicable anymore as the economy becomes globalized and worldwide events directly affect local systems. Furthermore, the evolution of modern societies and their systems of values have affected the parameters to evaluate what is or is not important anymore at a speed extremely higher than that the local ecological features can support. Thus, the application of the term sustainability in a *Latu Sensu* form is not recommended, especially when involving issues such as the building of social, economic or environmental politics since the sectorized objectives of each one of them are conflicting.

Concerning water resources, a clear example would be the issue of bestowal application. In a watershed with constituted committee and agency, or in which the State controls the water bestowal to be used by enterprises under drought condition, how could this use be redistributed to allow the maintenance or distribution (if it is the case) of losses at sustainable equanimity? Which parameters will be fulfilled? Currently, restricting to the rural environment, the only clear parameter is that of subsistence based on water supply but it is far from meaning sustainability. Thus, it is recommended that the term sustainable keep in use, preferably as a guiding idea of concept than as an objective in politics, techniques or systems since what is sustainable for one person or group will not be the same for another person or group and in both cases the demands for natural resources for the maintenance of a human population with freedom of expansion will hardly be it, considering the ecological support of the environment, from where the term was adapted.

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