XX IASP WORLD CONFERENCE ON SCIENCE AND TECHNOLOGY PARKS
June 1-4, 2003 - Lisboa, Portugal

# ROLES AND ACTORS IN THE SUSTAINABLE DEVELOPMENT: THE FARMER, THE SCIENTIST, THE POLITICIAN, THE ENTREPRENEUR

LUCY WOELLNER DOS SANTOS [*]
Agronomic Institute of Paraná - IAPAR, Rod. Celso Garcia Cid km. 375, C.P. 481
CEP 86001-970 - Londrina, PR, Brazil
Tel.: 55 43 3376-2444 • Fax: 55 43 3376-2101
E-mail: lucyws@iapar.pr.gov.br

ELISA YOSHIE ICHIKAWA [¤]
Paraná State University of Maringá - UEM, Avenida Colombo 5790
CEP 87020-900 - Maringá, PR, Brazil
Tel.: 55 44 261-4306 • Fax: 55 44 263-6500
E-mail: elisa@wnet.com.br

**ABSTRACT:** This paper aims at discussing the possibilities of a sustainable development having as a starting point the relationship between University-Industry-Government. In doing so, it analyses a partnership between a public institute, private firms, coops, NGO's, and many others community's actors involved in the implementation of the Program *New Frontier Sandstone*. This paper starts discussing the concepts of sustainable development and the most studied models on the relationship University-Industry-Government. After that, the above mentioned development program is related and, finally, the importance of society involvement in the building of sustainable development in order to have a long-term development process is showed.

---

[*] C&T Analyst of Agronomic Institute of Paraná – IAPAR/PR, Brazil. Coordinator of the Group of Studies on Technological Innovation in Agriculture – GEITA.

[¤] Teacher and researcher of the Department of Administration of Paraná State University of Maringá – UEM/PR, Brazil. Member of the Group of Studies on Technological Innovation in Agriculture – GEITA.

## INTRODUCTION

The present work aims at discussing the possibilities of achieving sustainable development based on the State-Research Institute-Productive Sector relationship. For such, it reports partnerships carried out among public organizations, companies, cooperative societies, non-governmental organizations, and several other actors of civil society in the realization of the Program *New Frontier Sandstone*.

To meet the goals mentioned above, there is an initial discussion about the concept of sustainable development and the need for the participation of society as a whole so that such development may happen effectively. Then, models most often used to analyze University-Industry-Government relationships are presented. On that topic, it is verified that, in current approaches, the participation of the several segments of organized society is a primary condition for a fruitful University-Industry-Government relation to occur. After that, there is the presentation of the Program *New Frontier Sandstone*: what it is, how it was originated, how it developed, and the dynamics with which it is being carried out by the entities in the partnership. Finally, final considerations of this work are presented, showing the importance of the participation of all segments of society in the carrying out of a sustainable development which may help improve economic, social, environmental, and human conditions in the country.

## WHAT DOES SUSTAINABLE DEVELOPMENT MEAN?

In this paper, Barbieri and Lage (2001, p. 1)'s concept is used, according to which the term "development" is employed to indicate the "process to promote qualitative improvement of life conditions in a society." According to the authors, the term "development" is strongly associated with the idea of transformation of productive structures to make them more efficient and adequate in the generation of riches. Hence, the strong linking of the term "development" to economic growth, industrialization, modernization, and other correlative expressions.

In many cases, such expressions have been used as if they were synonyms. That is greatly due to the experiences concerning development shared in several countries, such as Brazil, where economic growth and the incorporation of technical progress have become the main reason in the existence of governmental plans which are practiced even to the detriment of other important issues, such as eradication of poverty and regional unbalances (Barbieri and Lage, 2001).

Besides, it may be observed that the plans for development implemented in recent past in peripheral countries reveal an instrumental view of environment, considering it only in regard to what is convenient to their economic goals. To the instrumental view of nature, the belief in market power as a regulator of economic agents' actions as well as the optimism in the capacity to solve problems resulting from the exploitation of resources through permanent amplification of scientific and technological knowledge may be added.

Such optimism is based on the belief that any problem regarding scarcity in the present will be solved in the future, since there will always be the possibility to substitute raw materials and productive processes. As market visualizes the possibility of exhaustion of a certain natural resource, its price in the market would be raised and that would stimulate research activities and scientific and technological development to better profit from that scarce resource and eventually find alternatives to substitute it (Banerjee, 1999; Barbieri and Lage, 2001).

According to that view, called *cornucopian*, alluding to the mythological figure which symbolizes eternal fortune and abundance, the problems involving development are reduced to the increase in national production, while social and regional inequalities would end up being eliminated by the effects of continued growth in face of the overflowing benefits concentrated on the top of the social pyramid for the remaining segments of society (Barbieri and Lage, 2001).

According to Barbieri and Lage (2001), the 1972 United Nations Conference about Human Environment, carried out is Stockholm, had major contributions to a new understanding of the development process and its relation with environment. The authors argue that the most

meaningful contribution was to have had such relation as an issue to be discussed. From then on, it is impossible to speak earnestly about development without considering the environment and vice-versa.

The 1992 United Nations Conference about Development and Environment, carried out in Rio de Janeiro, and other meetings that followed, advocated the premise that environment and development cannot be dealt with separately. From the linking between development and environment, the latter taken in its broadest meaning, comprising physical, biological, and social nature, and not that reductionistic view that used to consider it only as a source of productive raw materials, springs a new concept of development, called "sustainable development" (Barbieri and Lage, 2001).

The indiscriminate use of the expression "sustainable development", however, has contributed to make its understanding more difficult. The definition given in *Our Common Future* (Comissão Mundial sobre..., 1991) may be a starting point to the understanding of what this new way of thinking about development really is. According to World Committee on Environment and Development, "sustainable development is that which meets the present needs without compromising the possibility of future generations to have their own needs met" (Comissão Mundial sobre..., 1991, p. 46). Still according to the Committee, the main policy goals derived from such concept are the following: to resume growth as an essential condition in the eradication of poverty; to change the quality of growth to make it more just, equitable, and less intensive concerning raw materials and energy; to satisfy primary human needs of employment, food, energy, water, and sanitation; to keep the population at a sustainable level; to conserve and improve resource basis; to re-orient technology and to administer risks; and to include environment and economy in the decision-making process.

According to Barbieri and Lage (2001), such definition and goals for the sustainable development show a large distance from the *cornucopian* attitudes, which orient most development plans carried out in Brazil and other countries. There is an explicit mention to an inter-generation pact when they manifest concern regarding resource management and preservation so that future generations may have their own needs met.

**The dimensions of the sustainable development concept**

As mentioned before, the concept of sustainable development has generated a lot of doubts and controversies mostly due to the fact that the concrete experiences regarding development were wasteful in regard to natural resources and generated so many social-environmental problems that it was difficult to visualize any concrete proposals to solve them.

A troublesome point of the concept refers to the understanding of the term "sustainable" (Banerjee, 1999; Barbieri and Lage, 2001). A great advancement in that aspect was the overcoming of a unilateral view of sustainability, common to the conventional approaches to development. It is worthwhile clarifying that the absence of environmental concerns in those conventional approaches resulted from a policy that was deliberately turned to a whatever-it-may-cost economic growth and not from the absence of economic concepts and instruments to deal with environmental issues.

That way, Sachs (1993) advocates a concept of sustainable development based on five dimensions, namely, social, economical, ecological, spatial, and cultural dimensions. The social dimension refers to social equity, the pact among generations; the economical dimension refers not only to the need to maintain regular investment fluxes, but also to the efficient management of productive resources. Besides, the benefits of economic growth must remain in the region to strengthen the endogenous saving and investment sources. The ecological dimension refers to the actions in the prevention from environmental damages. The spatial dimension concerns the search for a balanced rural-urban configuration and a better solution for human settlements. The cultural dimension refers to the respect to the different cultures in the construction of models that are adequate to the specificities of each ecosystem, each culture, each place.

To the five dimensions mentioned by Sachs (1993), Barbieri and Lage (2001) add the political sustainability, understood as the strengthening of democratic institutions and the

promotion of citizenship, since a project of sustainable development should take into account the demands of the different segments that form society. For such, it is necessary to promote the human being's fundamental rights and guaranties, amongst which are freedom of expression, of association, of locomotion, of access to information, and others indispensable to personal and collective development. It should be emphasized that a project of sustainable development should not be just a governmental project, but one that involves society as a whole, hence the need to make sure all of its segments will be granted effective participation.

One requisite that may be inferred from the concept of sustainable development is the need to amplify popular participation in decision-making processes. That means to consider the effective participation of a multiplicity of actors who build a certain society in decision-making processes. Such effective participation is not limited to the right to vote. One of the most effective ways to participate may be through the organized civil society, to defend rights, promote humanitarian help, diffuse information, etc.

The 21st Agenda (Conferência das Nações Unidas..., 1997) dedicates several of their chapters to the strengthening of the role of main social groups, such as women, youth, indigenous populations, NGOs, syndicates, companies, etc, and recommends the creation of new forms of partnership among them as well as the amplification of the access to the information which State authorities have about issues that are relevant to the developmental process. In the next topic, we shall discuss how one of those forms of partnership (University-Industry-Government) may come to contribute to the regional sustainable development.

## THE UNIVERSITY-INDUSTRY-GOVERNMENT INTERACTION FOR THE SUSTAINABLE DEVELOPMENT

During many years, the model used to analyze the relationship among segments of society aiming at technological innovation and development was the one conceived in 1968 by Jorge Sábato and Natalio Botana (Sábato and Botana, 1968), and presented at the World Order Models Conference, carried out in Italy in that same year. Sábato and Botana (1968) advocated that Latin America could participate in the scientific-technological development, and recommended the insertion of science and technology in the very scheme of the developmental process as a strategy for such participation. That would result from the multiple and coordinated action of three fundamental elements in the development of contemporary societies: government, productive structure, and scientific-technological infra-structure.

Such configuration, called "Sabato's Triangle", was graphically described by means of a triangle "supported" by a base: the government occupies the upper vertex while the two other elements, university and industry, occupy the base vertexes.

Almost 30 years after the presentation of the Sabato's Triangle Model, and aiming at linking science, technology, and economic development, Leydesdorff and Etzkowitz (1996) proposed the Triple Helix model. The term had its origin in an analogy with the Double Helix, used in molecular biology to describe the DNA molecule structure. In the DNA molecule, the interaction of different pairs of chemical base expresses different genetic characteristics. In the University-Industry-Government relation, the different arrangements of three elements result in different forms of cooperation (Leydesdorff and Etzkowitz, 1996).

Triple Helix overcame the University-Industry-Government interaction model in which the flux would occur in one direction only, from basic research to innovation. The Triple Helix starts with the perception that changes in the depth and meaning of the role of government, industry, and university are happening, and there is a need for the three to interact and use science and technology to produce riches (Leydesdorff and Etzkowitz, 1996).

Both Sabato's Triangle and the Triple Helix point out the need to incorporate science and technology to the development process of the countries as a basic condition for development and, for such, multiple and coordinate actions of the three basic elements, university, industry, and government, are required. It is possible to conclude, therefore, that, instead of being a different concept, the Triple Helix, while being a spiral model of innovation, which understands the University-Industry-Government relations as a dynamics of multiple

relations in different stages of knowledge capitalization, holds the concepts of Sabato's Triangle, this being a particular case of the Triple Helix. In other words, the Triple Helix is a model of general applicability, of which Sabato's Triangle is a particular situation of a society with a determined institutional definition.

Both models, however, still carry in their dynamics the *cornucopian* view of development. That is, the existing supposition is that the University-Industry-Government relation brings about economic dividends and that the other segments of society will benefit from the overflowing of benefits concentrated on the top of the social pyramid. For such view, development is still unilateral.

According to Schwartzman (2001), however, the research activity and search for knowledge is never purely technical, and the demands and consequences of scientific activity, even though they benefit some productive sectors, may end up harming other segments of society. Thus, a healthy University-Industry-Government relation requires a permanent "mingling" of different interests which has an influence on the distribution of endowments, the identification of fundamental research themes, local issues, and so on.

Today, after the end of the cold war and the rise of a new economy, the great "purchasers" of science results are not the military and governments, but the business sector, which manages more reduced resources and obeys stricter cost-benefit logic. One of the consequences of this new situation is that the separation which existed between the more academic extremes and the more applied extremes of the scientific and technological complex has become difficult to be sustained and kept, leading to a whole set of new experiences on inter-relationship among the several forms of scientific activity, which Gibbons et al. (apud Schwartzman, 2001) called "mode 2" of knowledge construction (see Table 1). That way, the "linear model" of knowledge construction, or "mode 1", which has never really corresponded to reality, becomes even more questionable.

**Table 1: Modes of scientific knowledge production**

| Mode 1 (linear) | Mode 2 (non-linear) |
|---|---|
| Basic knowledge is produced before and regardless of applications. | Knowledge is produced in the context of applications. |
| Research organization in a disciplinary way. | Trans-disciplinarity |
| Homogeneous research organizations. | Heterogeneity and organizational diversity. |
| Strict commitment to knowledge: researchers do not feel responsible for possible practical implications of their work. | Accountability and reflexivity: researchers are concerned with and responsible for the non-scientific implications of their work. |

**Source:** M. Gibbons, C. Limoges, H. Nowotny, S. Schwartzman, P. Scott, M. Trow, *The new production of knowledge - the dynamics of science and research in contemporary societies*, Sage Publications, 1994 apud Schwartzman, 2001.

Finally, those are the models (Sabato's Triangle, Triple Helix, and Mode 2) which are usually taken into account in the analysis of the relation among the elements considered "basic" in the process of technological innovation and in the development of societies. According to the perspective of the first two, the linking of science, technology, and economic development presupposes the involvement of three fundamental elements: University, Industry, and Government. Even though they present variations with each other, they are traditional models of scientific and technological development, according to which, despite the participation of the

productive structure in its dynamics, society is not considered an important actor. Model 2, however, presupposes the participation of segments which have increasingly gained importance in the decisions on public policies and their implementation: NGOs, interest groups, pressure groups, and the civil society as a whole.

An analysis of such scenario allows the conclusion that knowledge is not a privilege of universities, since other social segments may also hold culture and creative energy and, by means of the democratic process, they may contribute to the identification of technological and social needs as well the to the solution of the main challenges society has to face.

Moved by these arguments, some entities related to the science world (Mori, 2000; The Wellcome Trust, s.d.; United Kingdom Parliament, 2001; River Path Associates, 2000; Ciencia Hoy, 1998; MCT, 2002) have promoted conferences and surveys of various natures trying to grasp, both from the public in general and from communities of specialists, which emphases, demands, expectations, and uncertainties are to be the object and focus of research policies and directives in the reaching of societies' development.

Among the numerable results and recommendations presented in those surveys, it is possible to conclude that a recent cultural change is going on in the scientists' attitude regarding the public, motivated by a "confidence crisis" of the society towards science. Ways to improve dialogue are pointed out, through an open policy of information to the public, both of what is known and of what is unknown in science, as well as the debate about the risks and uncertainties regarding technological applications. Besides, the results of those studies point out that the decision to carry out research of great social impact, of important ethic and scientific dimensions, cannot belong solely to researchers, evaluators, and financiers. They strengthen the importance of using democratic procedures and criteria in the decision making about technological policies and argue in favor of a wider participation of all citizens.

That way, it may be observed that the University-Industry-Government relationship took up a new dynamics. Today, it is impossible to speak of sustainable development without including a fourth important, but usually forgotten, component: society itself. With the strengthening of democratic institutions, the various segments of society have felt the right to demand local projects of sustainable development. And it is such demands that must be part of the agenda of the institutions which promote technological development.

## SUSTAINABLE DEVELOPMENT FOR THE CAIUÁ SANDSTONE REGION

From this section on, a project developed by IAPAR, Agronomic Institute of Paraná, carried out based on a partnership with several segments of the Paranaense society, is succinctly presented. The project motivated the creation of a governmental program called *New Frontier Sandstone* and shows that it is possible to launch a process of sustainable development based on the partnership of several social actors.

### The Northwestern Region of the State of Paraná

Paraná is a State localized in southern Brazil. Northwestern Paraná comprises an area of 3.2 million hectares, comprising 16% of the whole State. Despite the potential that area might have concerning agricultural production, 72% of its total is formed of pastures. On theses pastures there is a bovine herd of about 3.5 million animals, representing almost 40% of the State stock (Oliveira et al., 2000).

90% of the pasture soil, however, characterized by the high susceptibility to erosion, has low capacity to hold the cattle - less than 1.5 AU[1] per hectare. Originated from Caiuá Sandstone, the soil presents medium to sandy texture. The sand proportion reaches 85 to 90% presenting critical levels of phosphor, potassium, calcium, magnesium, and quite often, low levels of organic matter (about 1%), which may cause macro and micro-nutrient deficiency in the cultures. As a consequence, the region presents low indexes of animal and vegetable

[1] AU = Animal Unit = equals 450 kg of live stock weight.

productivity, causing the small and medium-sized farms to lack their sustainability possibility and resulting in rural exodus. As for the larger farms, they run the risk to be classified as non-productive properties, increasing the focus of agrarian conflicts (Oliveira, 1997).

In the past, that region was covered by a dense tropical forest and was colonized in agricultural lots accompanying the soil declivity, in between the roads built at the slope tops until the lowlands adjacent to the drainage nets. During that time, there was a progressive transformation in the soil use, through the eradication of coffee plantations and the formation of pastures. However, the bad management of the regional soils and pastures caused serious problems, leading to a low capacity to hold the cattle and a drop in the production of beef and dairy.

Today, the regional cattle profile is represented by medium to large-sized animals, with low technological use. It is an extensive and extractive cattle breeding system which, after three decades of exploitation, led to a process of degradation of mineral riches originally present in the soil. As a consequence, there is low productivity in pastures and animals as well. In that scenario, what may be found is a de-capitalized farmer with remote chances to overcome the situation.

There is, however, a positive factor to be considered in that type of soil: sandstone is toxic aluminum-free, which favors the "rotation" of cultures and pastures, so that each planting may return to the soil what had been taken from it during the previous harvest. Such rotation also allows the soil to "rest" and to recover for nest planting. Without such procedures, the soil is impoverished, the productivity is reduced and the rural producer's support is threatened (Governo do Paraná, s.d.).

**The New Frontier Sandstone Project**

IAPAR, a governmental institution responsible for agricultural and cattle breeding research in the State, had already been actuating in the Northwestern Region since the 1970 decade, searching for alternatives for the soil recuperation, for the preservation of natural resources, and for the increase of local productive activity. Nevertheless, until recent times, research was not focused on the integration between farming and cattle breeding.

In 1997, the project "Studies on the recuperation of pasture areas in the northwestern region of Paraná" was established aiming at evaluating, validating, and disseminating production systems that were sustainable regarding their agronomic and economic aspects, using no tillage rotation annual crops, meeting the needs of integration between farming and cattle breeding (Oliveira et al., 2000).

An important element in the understanding of the project's developmental context was the role played by the city government of Umuarama which, for the implementation of its Program of Land Rental, started to demand the participation of IAPAR in the generation of technological knowledge which could back up the program implementation.

In 1998, IAPAR presented a proposal to the Ministry of Science and Technology aiming at financial support for the realization of the project. Unfortunately, the proposal was not approved. In that same year, negotiating with Zeneca Brasil Ltd. (currently Syngenta Proteção de Cultivos Ltd.), an English company in the chemical field, IAPAR was granted a partial loan for the conduction of the project. The project also got the participation of the Maringá Cooperative Society of Coffee Planters and Farmers LTD - COCAMAR, which organized field days, lectures, supported publications, donated agricultural supplies and equipment, granted the area for the research activities, and designated funds to IAPAR. Finally, the project also had the support from IMASA - Fuchs Industry of Agricultural Machines S.A., in lending the necessary machinery for no tillage planting.

The project aimed at establishing farming cycles for the production of grains and forage alternating with cycles of semi-perennial pastures of high quality and productivity, benefiting animal production and soil use. During the project's first years, preliminary results were obtained referring to the use of culture rotation according to the no tillage system and the farming-cattle breeding integration, which were published by IAPAR (Oliveira et al., 2000), in order to make information available to professionals, producers, leaders, financing agents, rural

sector authorities, etc., as fast as possible. Such information were related to a survey of the regional characteristics; proposals to the recuperation of degraded pastures through culture rotation; recommendation for soy cultivars, etc. Research proves that Caiuá Sandstone is proper to the cultivation of soy, wheat, oat, and other cultures typical of red latossol.

Based on these results and considering, on the one side, the history of commitments IAPAR has had to the carrying out of projects leading to the optimization of soil use and the preservation of natural resources and, on the other side, that the rational use of the soil is a basic condition to development, especially to an agricultural State like Paraná, the State Government launched the *New Frontier Sandstone Program* in September 2001. The program aims at taking new technology to producers in that region so that there is an integration between agricultural and cattle production (Governo do Paraná, s.d.).

Having the research generated by IAPAR as a starting point and a technological base, the *New Frontier Sandstone* program intends to create a kind of task-force uniting the State Government, regional city governments, and entities representing agriculture and cattle breeding, in search for soil recuperation, productivity increase, final product standardization, and environmental respect.

By means of actions like the spreading of technological alternatives in the region, public and private technical assistance improvement, farmers' professionalization, amplification of partnerships among institutions that actuate in the area, and the articulation with other on-going projects in the region, the governmental program intends to change the current picture, permitting the exploitation of production systems which harmonize rentability, employment creation, soil recuperation, and other natural resources.

With that in mind, the goals are for the Program to change the region profile and to produce the following advancements until 2006 (Governo do Paraná, s.d.): the inclusion of 20% of the regional pasture areas to the system of integration; the increase of average pasture capacity from 1 to 3.5 animals per hectare; the dynamization of regional economy with an increase in agricultural and cattle production and productivity; the creation of rural and urban employment due to the increment of regional agribusiness; the reduction of agrarian conflicts; the consolidation of technical and economical information on the farming/cattle breeding system.

To reach such goals, action towards the producer's professionalization are planned, as well as the development of new income sources and the implantation of a productive system of integration between farming and cattle breeding, the latter already developed as a result of research carried out by IAPAR.

According to the Governmental Program's perspective, the *New Frontier Sandstone* program is a proposal that includes partnerships with public and private entities as well as those in the third sector. It aims at the integrated action of the State Government through the State Secretary of Agriculture, the Federal Government, cooperative societies, city governments, universities, private companies, commercial associations, federations, syndicates, and non-governmental organizations.

**Project Results**

IAPAR has been working actively in the search for technological alternatives which may make it possible for the sustainable development of Caiuá Sandstone Region. As a result of the work that has been done, IAPAR issued a publication (Oliveira et al., 2001) with instructions on land rental aiming at the recuperation of degraded pasture areas.

According to Dalberto (2001, p. 3), that issue, regarding the economic and financial aspects, in analyzing different alternatives of land rental systems aiming at the recuperation of degraded pasture areas, "tries to go further in the definition of technological innovations for Caiuá Sandstone, offering guidelines that minimize the risks taken by the producers who were willing to get engaged in the process of sustainable development of the northwestern region."

The conclusions drawn are that the Caiuá Sandstone region has got climate and soil conditions which, used according to the no tillage planting system and culture rotation, allows for the establishment of systems of integrated farming and cattle breeding that are sustainable

regarding the agribusiness and economy aspects. The research data generated on the technology of vegetable and animal production, as well as those concerning the recuperation of degraded pasture areas, allied to the appearing of new genetic materials, validated in rural properties, are invaluable contributions to the regional development. A synthesis of the results obtained show that the farmer may get a rentability related to soy and corn worth US$ 370 per hectare in five years, considering only one harvest a year (Oliveira et al., 2001). Another result refers to the area farmed with soy, which has increased over 2,000% in the last years in the region.

As for the rental/partnership system proposed, the study reveals that, besides not demanding large sums of investiments from the cattle breeder, the system is an opportunity for the management of the property according to a more intensive technological process and for the recovery the zootechnical indexes based on the recuperation of degraded pasture areas, which may make the production system much more competitive and financially worthwhile (Oliveira et al., 2001).

The results obtained by the project up till the present and the goals established indicate that the process of integration between farming and cattle breeding in northwestern Paraná will provide the development of modern cattle breeding, with early slaughter of animals producing dairy and beef production based on pastures. All this, together with the production of cassava, densified coffee, fruits, silk worm, cotton, heart of palm, coconut, citric fruits, and poultry, will provide a better insertion of the region in the State economy (Oliveira et al., 2001). With those results in mind, IAPAR currently develops 27 projects and 53 experiments in the region, aiming at making the soil more adequate to farming.

## CONCLUSION

The issue of sustainability permeates all activities developed by the man, considering that it is related to his being adequately inserted in the environment around him. However, despite being a compulsory issue in all levels of discussion, the practice of sustainability is far from satisfactory, mostly when there is a search for a more holistic view of it.

With that vision, a program of sustainable development demands, indeed, an interdisciplinary vision, necessary for a broader panorama of the relations between man and nature. It is not only a matter of preserving the human species and their surroundings, but of promoting a development based on the five sustainability dimensions, namely, social, economic, ecological, spatial, and cultural dimensions (Sachs, 1993), besides guaranteeing political sustainability, that is, the demands coming from the different segments of society must be taken into account by means of democratic decision-making processes (Barbieri and Lage, 2001).

When the focus is on agriculture, sustainable development demands the involvement of producers, scientists, politicians, entrepreneurs, coming through all the productive chain and reaching the consumers, its final link.

Within that context, the *New Frontier Sandstone* Program is a case in agribusiness sustainable development which had, from its very conception, the concern with economic, ecological, spatial, and social sustainability of northwestern Paraná. With an increasing involvement of the several social actors, its focus was broadened and incorporated also cultural and political sustainability.

The reaching of long-term goals, with the creation of rural and urban employment, the reduction of rural exodus and poverty, and the consequent reduction of agrarian conflicts, the preservation of nature by means of a fairer growth, and others aspects, are challenges the Program is willing to face. For such, an ample participation and commitment of the several segments involved in the search for a sustainable development in the region is of utter need. On the other hand, a *sine qua non* condition in the consolidation of the effort carried out up till the present is the support from the State, through the definition of public policies which give priority and incentive to the generation of knowledge, since that is what grants technological support in the realization of the goals idealized by the Program *New Frontier Sandstone*.

**REFERENCES**


BARBIERI, J. C.; LAGE, A. C. 2001. "Conceitos, problemas e pontos de partidas para políticas de desenvolvimento sustentável". Paper presented at ENANPAD – Encontro Anual dos Cursos de Pós-Graduação em Administração, Campinas, Brazil, September 16-19.

BANERJEE, S. B. 1999. "Sustainable development and the reinvention of nature". Paper presented at Critical Management Studies Conference. Manchester, UK, July 14-16.

CIENCIA HOY. 1998. Nota Especial. Encuesta de opinión: ¿Qué piensan de la ciencia los argentinos? *Revista de Divulgación Científica e Tecnológica de la Asociación Ciencia Hoy*, volumen 8, nº 48, septiembre/octubre 1998. 9p.

COMISSÃO MUNDIAL SOBRE meio ambiente e desenvolvimento. 1991. *Nosso Futuro Comum*. Rio de Janeiro: Fundação Getúlio Vargas.

CONFERÊNCIA DAS NAÇÕES UNIDAS sobre meio ambiente e desenvolvimento – CNUMAD. 1997. *Agenda 21*. São Paulo: Secretaria do Estado do Meio Ambiente (Série Documentos Ambientais).

DALBERTO, F. 2001. Apresentação. In: Oliveira, E. de et al. *Arenito Nova Fronteira* - sistemas de arrendamento de terra para recuperação de áreas de pastagens degradadas. Londrina: IAPAR. 30 p. (Circular 115).

GOVERNO DO PARANÁ – Secretaria da Agricultura e Abastecimento. s.d. *Arenito Nova Fronteira* – Programa de Incentivo ao Sistema Integração Agricultura-Pecuária no Noroeste do Paraná. S. local, s. data, n. paginado (folder).

LEYDESDORFF, L.; ETZKOWITZ, H. 1996. The future location of research: a Triple Helix of University-Industry-Government Relations II. *Easst Review*, v. 15, n.º 4, p.20-25.

MCT – Ministério da Ciência e Tecnologia. 2002. *Livro Branco*: Ciência, Tecnologia e Inovação. Brasília: MCT. 80 p.

MORI – Market & Opinion Research International. 2000. *The role of scientists in public debate* – Full Report. U.K: The Wellcome Trust. 71 p.

OLIVEIRA, E. de. 1997. *Estudos de recuperação de áreas de pastagens na região Noroeste do Estado do Paraná – 1ª. Fase: 1997-2000* – 3.2.05.13. Londrina, IAPAR.

OLIVEIRA, E. de et al. 2000. *Recuperação de pastagens no Noroeste do Paraná*: bases para o plantio direto e integração lavoura e pecuária. Londrina: IAPAR. 96 p. (Informe de Pesquisa, 134).

OLIVEIRA, E. de et al. 2001. *Arenito Nova Fronteira* - sistemas de arrendamento de terra para recuperação de áreas de pastagens degradadas. Londrina: IAPAR. 30 p. (Circular 115)

RIVER PATH ASSOCIATES. 2000. *Towards a Democratic Science* – an e-conference for The British Council. Wimborne, Dorset, UK: River Path Associates. 2 vol.

SÁBATO, J.; BOTANA, N. 1968. "La ciencia y la tecnología en el desarrollo futuro de América Latina". Paper presented at The World Order Models Conference, Bellagio, Italy, September 25-30.

SACHS, I. 1993. *Estratégias de transição para o século XXI*: desenvolvimento e meio ambiente. São Paulo: Studio Nobel.

SCHWARTZMAN, S. 2001. *Ciência, tecnologia e interesse público*: a efetividade da pesquisa científica no Brasil (marco de referência para um projeto de pesquisa, 2000/2001). http://www.10minutos.com.br/simon/c_eficaz.htm

THE WELLCOME TRUST. s. d. Research International. *Science and the Public: Mapping Science Communication Activities.* Research carried out by Research International with funding from The Wellcome Trust. http://www.wellcome.ac.uk/en/images/mapping_3395.pdf

UNITED KINGDOM PARLIAMENT. 2001. *Open Channels: public dialogue in science and technology*. UK: Parliament Office of Science and Technology, Report n.º 153. 41 p.