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**Limits and challenges of the institutional framework in the
production of cooperative forms of knowledge: the case of
the Brazilian Amazon**

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ABSTRACT

Transdisciplinary approaches implies in a conflictual relationship between research proposals and social priorities. Society does not recognise the knowledge produced as useful and science does not understand that promises to help and support public policies towards sustainable use of natural resources, specially in the Amazon, creates an expectation difficult to fulfill. The institutional framework has an important role, in the sense of integration between different sciences and to discuss these issues with society. Normally it is understood that no preliminary institutional design is needed. Decisions concerning research founding are taken by scientists leaving society out. In order to discuss these conflicts this paper will analyse an international global environmental change research program: The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) that has a strong transdisciplinary appeal. This analysis will focus on the limits and challenges of institutional framework of interdisciplinary and international research programs in incorporating and doing transdisciplinary research.

PALAVRAS-CHAVE:

Pesquisa transdisciplinar
Arcabouço institucional
Amazônia
LBA

**RESUMO – LIMITES E DESAFIOS DO ARCABOUÇO
INSTITUCIONAL NA PRODUÇÃO DE FORMAS COOPERATIVAS DE**

CONHECIMENTO: O CASO DA AMAZÔNIA BRASILEIRA. A transdisciplinaridade implica em relações conflituosas entre as propostas de pesquisa e prioridades sociais. A sociedade não reconhece o conhecimento produzido como útil e a ciência não entende que a promessa de ajudar e subsidiar políticas públicas para o uso sustentável dos recursos naturais, especialmente na Amazônia, cria expectativas difíceis de realizar. O arcabouço institucional tem um papel importante, no sentido de integrar as diferentes ciências e discutir estes temas com a sociedade. Normalmente é entendido que nenhum desenho institucional preliminar é necessário. Decisões relativas ao financiamento são tomadas por cientistas deixando a sociedade de fora. Para discutir estes conflitos este artigo analisará um programa de pesquisa internacional sobre mudanças globais: O Experimento de Grande Escala de Interação Biosfera-Atmosfera na Amazônia (LBA) que tem um forte apelo transdisciplinar. Esta análise focará nos limites e desafios do arcabouço institucional de programa de pesquisa interdisciplinar e internacional em incorporar a transdisciplinaridade.

RESUMEN:

La investigación transdisciplinaria
marco institucional
Amazonas
LBA

RESUMEN – LÍMITES Y MARCO INSTITUCIONAL DE RETOS EN LA PRODUCCIÓN DE CONOCIMIENTO FORMAS DE COOPERACIÓN: EL CASO DE LA AMAZONIA BRASILEÑA. La transdisciplinariedad implica relaciones conflictivas entre las propuestas de las prioridades de investigación y sociales. La sociedad no reconoce la utilidad de los conocimientos producidos y la ciencia no entiende que la promesa de ayudar y apoyar a las políticas públicas para el uso sostenible de los recursos naturales, especialmente en la Amazonia, crea expectativas difícil de lograr. El marco institucional juega un papel importante a fin de integrar las diferentes ciencias y discutir estos temas con la sociedad. Normalmente se entiende que ningún diseño institucional preliminar es necesario. Las decisiones de financiación son tomadas por los científicos que salen a la empresa. Para discutir este artículo examinará estos conflictos un programa internacional de investigación sobre cambio global: La Escala de la Biosfera de Gran atmósfera Interacciones en la Amazonia (LBA), que tiene un atractivo interdisciplinario fuerte. Este análisis se centrará en los límites y los retos de la institucionalidad para el programa de investigación interdisciplinaria y de incorporar la transdisciplinariedad internacional.

“A Yanomami xamã dreamt that the smoke produced by civilization would make a hole in the sky through which the sky would fall down. He tried to tell the people, but no one would hear him. (...) many years later science discovered the hole of the ozone layer (...) when will science and xamã dreams be able to talk?”
music written by a local artist, Eliakin Rufino, Roraima - Brazil

1. Introduction

The history of modern science since Galileu (Mariconda 2001; Stengers 2002) has increasingly specialised in a large scope of scientific disciplines that are separated from each other and distant from social life. Specialisation helped to develop science and technology but became insufficient when complex systems¹ became privileged scientific objects. Many complex systems (Legay 1996; Costanza 1996), such as the human genome and global environmental change, need specialised scientists working as a multidisciplinary team in different nations. These complex systems are not only multidisciplinary, aggregating different scientific areas, but also become transdisciplinary due to the necessity (in most cases related to the international research agendas) to integrate society with its different demands and perspectives (Schor 2007a).

Scientific institutions have been created in order to organise and promote research concerned with complex systems. Specifically, with respect to Global Environmental Change many international and multidisciplinary research programs have been created worldwide. Society demands quick and large scope scientific answers for global change and counts on science to diminish risk and vulnerability to these changes. Multidisciplinary research programs that deal with environmental problems, such as those organised to do research in global environmental change, have, at least theoretically, a strong transdisciplinary appeal (Schor 2007b; Schor 2008).

The transdisciplinary appeal becomes even stronger when international research programs are located in developing countries. It is understood that science produced in highly specialised research programs that have developing countries as scenario should have mechanisms that makes viable the integration of the knowledge produced in the region where the research is being done. There is a strong appeal to incorporate society not only in educational and training components but also in the evaluation of the results obtained and an active participation in the formulation of public policies.

Transdisciplinary approaches, usually understood as the incorporation of different aspects of society in science, often invoke the integration of the local/regional population into the research project since the beginning and not only at the end (as contexts of application). This paper will analyse an international global environmental change research program: The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) that has a strong transdisciplinary appeal. This analysis will focus on the limits and challenges of the institutional framework of interdisciplinary and international research programs in incorporating and doing transdisciplinary research.

2. LBA and its transdisciplinary approach

LBA is an international research initiative lead by Brazil that has a strong transdisciplinary appeal. The program initiated in 1996 with a wide range of

¹ “Complex systems are characterized by: (1) strong (usually nonlinear) interactions among the parts; (2) complex feedbacks loops has made it difficult to distinguish cause from effect; (3) significant time and space lags; discontinuities, thresholds and limits; all resulting in (4) the inability to simply ‘add up’ or aggregate small-scale behavior to arrive at large-scale results.” (Costanza 1996:981).

interdisciplinary and inter-institutional debates oriented to design a complex experiment in the Amazon Region. LBA was launched in 2001 with the first major atmospheric mesoscale campaign in the wet season in Rondonia – Brazil with Tropical Rainfall Measuring Mission (TRMM) validation campaign known as TRMM-LBA and since then two other major campaigns have happened (dry season and a dry to wet season). These mega-experiments are only a part of an even larger experiment program with a considerable number of projects: 118 in mid-2003 and more than 100 in 2004 (Mid-term Report 2003). The main objective of LBA experiments is to study the interaction of the biosphere (the Amazonian forest/basin) and the atmosphere in this sense LBA is “designed to address major issues raised by the Climate Convention” (Avisar and Nobre 2002:1). LBA is an International Geosphere-Biosphere Program (IGBP) program and is also filiated to World Climate Research Program (WCRP), Global Energy and Water Cycle Experiment (GEWEX), International Satellite Land Surface Climatology Project (ISLSCP). Basically LBA contributes with these international programs trying to understand the role played by tropical forest in climate regulation.

LBA is a “highly international experiment, but unusual in that the leadership and much of the intellectual impetus comes from the host nation, Brazil, with support from a wide range of Brazilian and developed-nation science agencies.” (Schimel 2004:S1). In order to accomplish such objectives LBA research program has a significant financial support not only from Brazilian agencies but also from the international partners. The main partners are the United States National Aeronautics Space Administration (NASA), The European Community and Max Planck. This financial and technological support made possible the implementation of a sophisticated infrastructure (lodgings, towers, cars, forest labs, highly specialised experimental devices)² located mainly in “primary forests” in distant sites in the Amazon basin and manages to bring into Brazil highly qualified scientists from all over the world: “the LBA study is pioneering science, methodology and new modes of international collaboration” (Schimel 2004:S1). LBA is the largest – in size and founding – and most important research program done in global environmental change in all of South America.

Most of LBA’s research is done in the natural sciences such as climate physics, meteorology, and hydrology having a strong instrumental approach to science. The experiments are done using satellite images, aeroplanes, towers and different experimental devices located in areas considered of ‘primary forest’. There is also a ‘human dimension’ and land use cover change (LUCC) component focusing on the discussion of the causes and effects of land use change on the forest and consequent climate change. It is understood that this experiment “helps provide the basis for sustainable land use in Amazonia by using data and analysis to define the present state of the system and its response to observed perturbations, complemented by modelling to provide insights into possible changes in the future.”(Avisar and Nobre 2002;1, Schor 2008)

² LBA has 10 offices in different cities in all of the Amazon Region. Manaus with 28 personnel, São Gabriel da Cachoeira – Amazonas – with 4; São Paulo with 7; Rondonia with one; Mato Grosso with 2; Tocantins with 3; Santarem (Pará) with 23; Belém (Pará) with 2; Acre with 1 and in Brasília 1. LBA has a total of 14 flux measurements towers located in all of these areas.

As leading institution LBA plays an important role not only in producing scientific knowledge but also in interacting with the local, regional, national and international communities. Answers to questions such as those formulated by LBA: How does Amazonia currently function as a regional entity? How will changes in land use and climate affect the biological, chemical and physical functions of Amazonia, including the sustainability of development in the region and the influence of Amazonia on global climate? (LBA, 1996); are not only of local interest but are of international concern. LBA results are understood by the public opinion especially the policy makers as not only scientific but fundamentally political. The discussion concerning the land use-cover change in the Amazon Region is very sensitive due to the fact that this region is seen as the last economic and political frontier. Interests diverse such as national security, agriculture, environment, economic (the promises of bioprospection) and socio-cultural (traditional knowledge understood as human and social capital) find themselves in an entangled scenario. Governmental economic development plans for the Amazon Region and military preoccupations with sovereignty and security enter in conflict with the conservation perspective sustained by the environmental segment of the Brazilian and international society that sees LBA's results as a strong ally (Becker 2004; Bitencourt 2002; Schor 2008).

LBA's transdisciplinary approach can be identified in three aspects of its research proposal (LBA, 1996). Firstly, in its fifth and last objective: provide qualitative and quantitative information that can support sustainable development policies and protection of the ecosystems of the Amazon. It is understood that the sustainable use of the Amazonian forest should be based in a solid scientific knowledge of the environment and that a strong and solid understanding of the functioning of the natural system is a pre-requisite for the definition of optimum development strategies. It is said, in the research proposal, that LBA is planned to generate new knowledge that will strengthen local and regional research networks that will function as a long term support for national and regional policies.

In this sense, the second aspect of transdisciplinary approach in LBA is the construction and solidification of human resources in the region. In order to do so an Education and Training component was established aiming to generate local and regional knowledge of the natural functioning of the Amazonian integrated system. It is considered that "the enhancement of research capacities and networks within and between the Amazon countries associated with LBA helps advance education and applied research into sustainable development and assists in the process of formulation policies for the sustainable development" (Avissar and Nobre, 2002:2).

The third aspect of transdisciplinary approach that can be identified in LBA's research program is related to the data policy. Having a strong preoccupation with the access to the data produced in an international research program LBA organised an informational system that centralises not only published data but also meta-data that are stored simultaneously in two different places in Brazil (São Paulo and Manaus) and in the USA, so that they can be made available for the longest period possible permitting differentiated access and uses. The access

to published data produced through LBA's projects and experiments can be reached in LBA's website.

These three aspects are described normatively in LBA's research proposal. In order to better understand how transdisciplinary in fact happened or, in some cases, not, in LBA's past five years it is necessary to contextualise some important aspects of research done in the Amazon basin.

Contextualizing Research in the Amazon Region

Since international research programs have to deal not only with scientists from different nationalities but also with national boundaries and laws, a unique institutional framework has to be created to meet these needs (Schor 2005, Schor 2008). These scientific institutional frameworks not only have to deal with local and national demands, but also with research in a multidisciplinary environment. This complex environment assumes that there are institutions capable of dealing with the complexity of the scientific research as well as dealing with the local community. The scientific community and the science policy-makers deal with the development of these scientific research programs in various ways, mostly concerning themselves with making the research happen than in creating institutions beforehand that would integrate the diverse research components and society. Even though, in most cases there is an explicit transdisciplinary component in the research proposal, such as those encountered in LBA's Concise Experimental Plan, the institutional design does not incorporate viable mechanisms that could in fact make transdisciplinarity possible.

Due to this fact most research programs established in this manner encounter many difficulties, especially with the transdisciplinary relationship between the research proposals and social priorities. In most cases, the integration between the science produced and the demands of knowledge of the local/regional communities and policy makers becomes unviable. Society does not recognise the knowledge produced as useful for their immediate needs and science does not understand that the promise to help and support public policies towards a sustainable use of the natural resources creates a very strong expectation that can not be fulfilled. An enormous abyss is opened between the science produced and the expectation of the knowledge that society understands that should have been produced. The lack of a common repertoire makes the dialogue between science and society very difficult (Schor and Demajorovic 2002, Schor 2007a).

The institutional framework has an important role, not only in the sense of the integration between different sciences, but also when the inevitable need to discuss these issues with society arises. The integration of scientific research with society is a weak point in scientific research programs and usually not identified as a research theme when the research program is developed. In most cases, the interaction with society is seen as an output deriving of the scientific results. As such it is understood that no preliminary institutional design that makes possible the incorporation of society since the beginning of the research program or even in building research agendas is needed. This is the case, at least for Brazil, with respect to the decision of which research project should be financed. Decisions concerning research founding are taken only by scientists leaving society out of the process. An interesting example of how civil society can be incorporated in

decisions concerning research funding can be seen in the USA's National Institutes of Health (NIH). The assessments of the projects proposed for funding in NIH is done not only by peer review but also by mixed counsels that incorporate not only scientists but also community leaders, medical and patient associations. This scheme functions in an interesting manner which motivates basic research inspired by social demand (Strokes 1997:139).

Environmental issues are centre of attention not only in Brazil but also about Brazil. The question concerning the future of the Amazon and its importance for biodiversity and planetary climate regulation is central in the Brazilian as well as in the international environmental, economical and political agendas. It appears to exist a consensus among many specialists that the future of the Amazon basin depends not only upon the results obtained by specialised scientist and/or public policy makers, but specially upon the effective insertion of the local population in the decision making process specially when the deforestation rates increases such as those observed in 2004-2005. Most processes of public participation are established to include the civil society organised institutionally as Non-Governmental Organisations (NGO's). Scientists and governmental decision makers tend to interact with NGO's that have the positive approach with "sustainability" of the environment as a clear premise. The NGO's have, in fact, an import role in the discussion of the future of the Amazon but are not necessarily always the main, neither the most prepared, actors in the Amazonian debate.

Illegal timber extraction and farming, and illicit activities such as wild-cat mining and drug traffic are chief activities contributing for the degradation of the Amazonian socio-ecological system (Harvey 1996). On one hand these controversial actors are strong actors in the Amazon region, their decisions have important consequences in the sustainability of the amazonian socio-ecological system. On the other hand, these controversial actors from a moral and ethical perspective might be important *stakeholders* in the Amazonian socio-ecological debate but they are not included in the debate. Illegality is understood as police affair, but in fact, the future of the Amazonian system as a whole depends very much on how they will interact with the different sectors of the decision making processes. Furthermore, these stakeholders are normally not incorporated in the public participatory debate what, in essence, empirically invalidates or at least makes most of the decision taken in these discussions, less legitimate.

The incorporation of these controversial stakeholders in public participatory arenas is a complex matter. To legitimate their participation might be considered as a legitimation of their actions in face of society. As these stakeholders in many cases have juridical problems, for them to accept to participate would mean probable police problems. Many of these stakeholders, specially the timber and coca-cocaine sector, have legal and illegal activities functioning together and will not obviously assume illicit activities (Machado 2003). In most cases these stakeholders end up participating in the debates through secondary agencies (called in Brazil 'Oranges').

Not only this morally condemned stakeholders do not have an explicit voice in the debate but a more fragile sector is left out. The *caboclo* population which are not socially organized and do not have and NGO's "protecting" their diffuse

interest are not considered in any type of transdisciplinary arena. The *caboclos* are probably those which have a more feasible voice in the debate for they are not valuable for any of their “natural” attributes, they are simply poor Brazilians living dispersed in the vast Amazonian region.

Since the Amazonian region is understood by several segments of the Brazilian Government and military sectors as a place of fragile sovereignty (Becker 2004; Gama 2004; Andrade 2003; Espach 2002; Mello 2002; Schor and Moraes, 2011), important decisions regarding scientific research are taken out of the public participatory processes. Most scientists agree to this procedure, once science is still seen as a neutral and anti-political process of sociability. Science and scientists are still understood as non-members of the public arena, as the philosopher in Plato’s cave myth, whom brings the truth from the real world (the natural system) to the social world (Latour 1999), and in this case a socially moral world.

In order to discuss transdisciplinarity and possible forms of “cooperative production of knowledge” in the fragile Amazonian socio-ecological system it is necessary to break through the Plato cave myth and put the “enemies” to talk. Is it possible to incorporate in the public debate immoral and unethical stakeholders? Will scientists be willing to leave behind the cave myth? Can these two faithful enemies – for they have always been present in the Amazonian socio-environmental medium – be able to dialogue humbly about our common future? Can an analysis of the institutional framework make possible a more cooperative form of knowledge production in terms of building of research agendas and research program design? Is the national government willing to understand the role of science in terms of sovereignty in a differentiated manner? Are the project proposals that consider themselves as strongly transdisciplinary working in the institutional design beforehand in order to incorporate the different segments of society in the production of knowledge? Can science hear thin voices? These are some of the questions that oriented the empirical analysis of the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) focussing on how transdisciplinarity was conceived in the initial proposal and the limits encountered to incorporate society in the decisions of a research program.

3. Limits and challenges of the institutional framework: the LBA case

To study science in action (Latour 1993) requires a specific methodological procedure due to the fact that most of the information required to understand and analyse subtle relations such as transdisciplinarity are not disposed in an organized or published form. In order to understand LBA the research methodology took different routes during the period of August 2000 until May 2005 (Schor 2005).

During these four and a half years different methodological approaches were done. All of these approaches made possible an interesting comprehension of the interdisciplinary, inter-institutional and transdisciplinary relationships built during the act of research in the different research projects of LBA. These approaches did not necessarily happen separated chronologically, in most cases more than one methodological alternative was used. In order to understand the analysis of transdisciplinarity in LBA it is necessary to describe the main

methodological approaches. One approach, the institutional framework approach, is related to the institutional and organizational arrangements made by LBA's leader scientists so that the scientists involved in different projects from different scientific disciplines could meet and discuss the procedures of the research program and projects. This approach is essential in order to understand the institutional dynamics in LBA which provides some clues on how society is incorporated in the scientific program.

An important institutional arrangement in LBA is a bi-annual meeting of the Science Steering Committee. This committee is organized to function as an important meeting point of the component coordinators with the objective to discuss epistemological and methodological approaches, problems and solutions. During these meetings a scientific up-to-date of the experiments held, of the data collected, of the results obtained and of the epistemological and methodological difficulties were presented. All members would participate in the discussion and an interesting multidisciplinary epistemological discussion took place. Not only the participation in the scientific committee was essential to understand LBA but also other more irregular workshops and conferences where a central location for the research proposal. During these events the question of how to deal with "social demands" and public policies were frequently put into question and different alternatives were tested usually related with the diffusion of LBA's results in the mass media and to the congressmen in Brasilia.

In order to understand the institutional history, the scientific themes and the comprehension of how the scientists understood "social demands" interviews happened throughout this period not only with the leading scientists but also with students, technicians, policy makers, stakeholders and scientists not part of the program. During this period, a stay of six months in LBA's the main office in Manaus permitted following up research groups into the forest areas. This period helped in the understanding of the behind the scenes not only scientific but also organizational and to understand the functioning of the main instruments such as the towers and hydrology models which generate the data.

The stay in the main office permitted the access to internal documentation and participation in daily discussion involving the problematics that are of interest in the study of transdisciplinarity. These internal documents added to the period of stay in the office helped the understanding of how science functions inside specific organizational and institutional arrangements. In order to register all of these aspects different forms of registration were used. Many interviews were tape recorded and filmed in a digital camera. Most of the instruments and how to use them including different aspects of the research done in the forest are recorded in more than 10 hours of film (digital). All of the work is registered in field books, in the total of seven, following the methodological procedures of the classical geographers and anthropologists. All of this material permits a detailed, long term analysis of the LBA program.

Understanding LBA as a circulatory entity, such as proposed by the actor-network theory (Law and Hassard 1999) makes it possible to comprehend the relationship between the initial proposals of interaction with society and what in fact happened and how these results are related to the lack of incorporating

transdisciplinarity in the initial programmatic design. LBA's transdisciplinarity appeal, as discussed above, is related mainly to the use of the results of the scientific research. The use of the scientific results is understood as a possible support of public policies, formation of human resources and strengthening of research networks in the region and data policy.

4. LBA's transdisciplinarity perspectives

Transdisciplinarity possibility in LBA is understood by its scientists and incorporated in the institutional arrangements in three different perspectives: as support of policy making, formation of human resources and strengthening of the regional research network and, thirdly, data-policy. With respect to the capacity building of human resources in terms of an increase in scientific qualification LBA's numbers are impressive: 856 students in the period of 1998-2004. Of these 318 undergraduates, 259 masters and 252 doctorate students completed their thesis and dissertations in LBA's research projects, out of which 732 are Brazilians (LBA in numbers, obtained in the Main Office). Due to this fact the research network in the region has been strengthened: a masters degree course in climate physics has been established in the Federal University of Mato Grosso and telecommunication and logistical infrastructures has been updated in many locations in the Amazon region specially those that had very few equipments. There is also a project being done inside LBA related to the production of material, with emphasis in written texts, to be used in primary, secondary and undergraduate courses in LBA's themes.

These results, even though they are important, are very controversial not only in the regional society but also inside LBA. The Science Steering Committee (SSC) of LBA has had some very interesting discussions about the problem of the formation of ultra-specialised human resources that will encounter difficulties in inserting themselves in the region and in Brazil. There are very few university places or research institutions to incorporate such a big number of specialised scientists. The regional scientific community argues that most of the masters and doctorates produced in LBA's programs do not establish themselves in the region usually staying in the big universities in the southeast of Brazil or even migrating to international research centers. There has been some discussion in the SSC that there was no explicit policy of human resource formation that took into account these aspects, and that for future programs with fact should be taken into account.

In fact the discussion concerning the capacity building of human resources has limited itself at the university level and little attention has been given to other spheres of civil society. It is frequently understood that human resource formation in scientific research programs is related to student formation. In one sense it has been important in Brazil the growing capacity of the national research community, mainly being trained in research projects, but this is not the only sphere that lacks educational investment. Surely the enforcement of knowledge of the local population and the stakeholders that deal with deforestation – one of the biggest problems in climate change – should be considered as part of a more ambitious human resource program. What can be seen is that what the scientists involved in the institutional design of environmental research programs understand as capacity building of human resources is restricted to their

university world. Even though this is usually the case, there is an interesting experience being done by a group of scientists in Acre in some of LBA's projects. They have tried out and incorporated alternatives for capacity building perspectives which surpasses the elaboration of thesis and dissertations. Focussing in the small land owners, debates and written material on how to manage fire, different crop perspectives and discussion concerning gender and violence have been common themes. This interesting initiative has restricted itself to this location and has not had an active role in the discussion of the capacity building program as a whole. Why this has not happened is still to be understood, but the fact is that a very traditional university perspective has prevailed in LBA and is the case for most of the research programs in the Amazonian region.

It is not expected that the scientist alone should manage to cope with aspects of transdisciplinarity with respect to the capacity building of human resources, but it should be expected that in the programmatic design of the research program this thematic should be emphasized and different participants should be considered during the elaboration of the research plan. Usually, and this is the case of LBA, the components of education and training are treated secondarily for it is understood that as most researchers – at least in Brazil – are also teachers and due to this fact understand about education and training, being capable of coordinating a component that has as main objective capacity building of human resources. In LBA all seven components have as coordinators highly qualified researchers in the specific areas but in the education and training committee the coordinator is a researcher with no specific formation in this complicated thematic.

There is a difference between the importance attributed to capacity building in human resources in the Amazon and what is in fact done. It can be read and heard in most of the scientific plans and meetings that the capacity building of human resources in the region is a very important aspect of the research program but in fact the committee due to deal with this thematic has very few financial resources when compared to the other scientific components. Not only the financial resources are less but the training and educational component does not have specialized guidance for the creation of innovative perspectives that could increase the scope of the understanding of what human resource capacity building means and can be done in a region such as the Amazon. In this sense, the alternatives proposed and done in the education and training committee in LBA are less innovative and ambitious when compared to the other scientific components in the same program. The hard science done in LBA has opened new perspectives of research in climate change whereas in terms of training and education the traditional university perspective has predominated which weakens any possibility of incorporating a large portion of the population that has no access to university, specially when the numbers of universities in the Amazon region is counted. In the Amazon State for example there is only one Federal University established in Manaus that now has initiated an expansion to other cities.

It is also recognised in the SSC the importance of the production of didactic material to be used in schools. The lack of knowledge about the functioning of the forest for climate regulation, the causes and consequences of climate change and the consequent global environmental change is seen by part of the scientists and policy makers as an aggravation of the environmental problem in the region. The lack of alternative materials to be used in local and national schools and university is a dramatic reality. Most of the text books used in the university courses are translated versions of North-American and/or European text books which deal with examples of distant ecosystems. The scientific community preoccupied with the conservation of the Brazilian forests recognize the necessity of a new perspective of “environmental education” in which the knowledge of the nearby ecosystems should be enhanced. The production of these textbooks is seen, in LBA, as an important contribution. Even though this is the case, the financial support for these projects is derisive when compared to the other projects. Due to this fact not much has been produced.

Education and training of human resources is recognized as an important aspect of transdisciplinarity in environmental research programs, specially in those related to global environmental change, such as LBA. It is understood that society has to be “educated” in order to participate in the debate and to promote conservation of endangered ecosystems. In fact the lack of organized knowledge of the functioning and importance of these ecosystems is a reality in Brazilian society, specially in the non-specialized sphere of society. Even though this problem is recognized and debated it still has a secondary place in the institutional design of scientific research program with a restricted view of how the debate concerning the environment can be spread throughout society. If it is difficult to introduce this discussion in the research arenas to talk about popular participation in decision-making concerning research programs is a dramatic tabu. Scientists and science policy-makers still view science as a autonomous sphere separated and that should be protected from society. Projects and plans about the development of science and technology in the Amazon region are discussed inside the offices in Brasilia and the actors chosen to participate do not necessarily represent society. What can be observed, specially in the official documents produced about science and technology development for the Amazon region in the past 50 years (since at least from the SUDAM proposal made by Celso Furtado in the early 1960’s) is that strategic plans and projects are continuously being written and discussed in closed arenas most of which undertaken the same principles – the necessity to develop local human resources – but no innovative alternative in terms of institutional design is incorporated perpetuating plans and projects that do not have effective interaction with society. These plans and policies are kept out of public debate with the argument that the Amazon region is feeble in terms of national sovereignty and security, which implies in a view that the people are incapable of acting freely in order to secure the territorial frontiers or even are seen as possible enemies.

It is also understood that science has to cooperate with the discussion of public policies for the Amazon region. In LBA the case was the same. With respect to the support of public policies for the Amazon it is necessary to understand that LBA is programmed in two phases. The first phase (1998-2004) had a strong emphasis in

data collection and experimental procedures. During this phase the preoccupation mainly was on how the data produced by the specific projects would be organized and how the access to this data would be made possible. In order to keep the data stored in Brazil a system of data collection, organization and disposal was constructed, which is called *Beija-flor* (Humming-bird). As LBA has many projects one of the main preoccupations of the component coordinators was to make sure that the data collected was stored in LBA's system even before the results were published. These "meta-data" are considered an important LBA product that has to be kept in Brazil, respecting the accessibility to meta-data before results could be published in order to maintain the ineditism of the research.

The data produced in this first phase and the results obtained have still to be worked on, so a second phase is programmed for synthesis work which includes actions that could support public policies for the Amazon. The difficulties now encountered are that the data collected are so specific that they are hard to be digested for public policies. Direct answers to question such as what is the minimum size that is need of forest to maintain climate regulation is a difficult question for science to answer but is the question that public policy makers want from science. This abyss exemplified in this type of question is typical of research programs that want to participate in the public debate about the future of the environment but that do not understand or incorporate social and political demands since the initial part of the scientific program research. To talk about the possible use of scientific results for the formulation of policies for the sustainable use of the Amazon is necessary to delineate since the beginning of the structuring of the research projects aspects and methodological perspectives that can make transdisciplinarity possible.

It is necessary to recognise that doing transdisciplinarity in specialised scientific research programs is very difficult. LBA has "good will" to incorporate "social demands" with respect to the use of its scientific results, but due to the fact that it has not delineated since the initial program design a specific institutional framework that could make transdisciplinary possible, the results obtained are few and very specific. This is probably not only the case of LBA but of most global environmental change research programs, possibly due to the fact that transdisciplinarity alternatives are not considered since the building of the research agendas and, like a domino effect, passes throughout all of science production.

Much is said about "social demand", but what in fact is this social and this demand? Scientists and science policy-makers assume that they know what are these social demands without putting their "objects to object" (Latour 2000). The possibility of "putting the objects to object" is to open the debate in order to incorporate different spheres of society including the immoral part and weak actors. Not doing so will maintain the *status quo* of science and society and the high levels of deforestation. New perspectives have to be opened and a more comprehensible understanding of social demands has to be made. Open spaces for public debate and popular participation have to be constructed in order to give

voice even for those that we do not want to hear, for, like it or not, they are part of society.

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