

Integrating traditional and scientific knowledge(s) for an equitable and use of natural resource	Titulo
Kleiche-Dray, Mina - Autor/a;	Autor(es)
En: . () . :	En:
	Lugar
Institut de Recherche Pour le Développement	Editorial/Editor
2012	Fecha
	Colección
Sociology of science; Natural resources; Environmental governance; Scientific knowledge; Traditional Knowledge; Knowledge production; Anthropology; Agriculture; Health; América Latina;	Temas
Doc. de trabajo / Informes	Tipo de documento
"http://biblioteca.clacso.org.ar/clacso/engov/20130828063928/ENGOV_AFR_WP5_IRD.pdf"	URL
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Integrating traditional and scientific knowledge(s) for an equitable and sustainable use of Natural Resources

Analytical Framework Report

D.5.1

Deliverable 5.1 – Analytical Framework Report

Project N°: 266710

Funding Scheme: Collaborative Project

Objective: FP7-SSH-2010-3

Status: Final version, 2012-01-29

Due date of delivery: 29/01/2012

Work Package: WP 5 – Building and Exchanging knowledge(s) on Natural Resources

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1. Introduction: Contribution of knowledge(s) to the environmental governance's issue.

Current debates on environmental governance emphasize the need for building new knowledge, in order to better address complex socio-ecological processes. In this context, countries in Latin America and the Caribbean (LAC) are among those being most directly affected by these changes due to their biological and cultural diversity. 20 years ago, the inclusion of *traditional knowledge(s)*¹ in the Convention on Biological Diversity (CBD) opened to them the possibility of integration into the building of *environmental governance*, what would allow an equitable and sustainable use of natural resources. The CBD recognizes, particularly in its famous article 8.J, the respect for "*indigenous and local communities embodying traditional lifestyles relevant for the conservation*" but also the need to "*encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices*".

In LAC there are hotspot countries (home to over 50% of the biological resources of the planet) that have implemented strategies (regional forums, decisions and directives, national and regional laws) to mobilize with respect to negotiations on the CBD. In this countries societies, debates (on topics such as sovereignty of biodiversity, access to natural resources and *traditional knowledge(s)*, intellectual property rights on innovations based on natural resources, the right to development for *traditional communities and indigenous peoples*, and researchers' right to freely conduct their research on biological material for the benefit of humanity) are then identified as important issues that become subject to public policies (Aubertin et al., 2005). In this context, all the different branches of academic science with an interest in natural resources (botanists, pharmacologists, anthropologists, biologists and chemists in particular), knowledge(s) and know-how of *traditional communities* had to reconsider, in recent years, their relationships with those knowledge(s) and their representation of those knowledge(s), which cannot only be seen from a disciplinary point of view.

"*Traditional*" and "*scientific*" knowledge(s) on nature are then at the centre of this debate, as well as how they can be integrated (Freire, 1998; Ellen and al. 2000; Berkes and al., 2008) in order to allow policy makers to incorporate all skills and learning (by integrating

¹ One of the main objects of our WP5 consists precisely in discussing all the words in italics to historicize and finally define them.

traditional knowledge(s) with *scientific knowledge(s)*) and bond all those interests in order to reach an equitable and sustainable use of natural resources.

Marginalized or excluded in the past and sometimes disused today (or to the contrary, appropriated and valued), "*traditional knowledge(s)*" about nature have influenced "development" policies. They have also had an impact on the new configuration of knowledge on nature (as our biophysical environment) and on the social relations that "knowledge holders" (*scientific* and *traditional* actors) maintain. Thus the debates about "good governance" toward the equitable and sustainable use of natural resources challenged the construction – and the history- of knowledge in the twentieth century (Lemos and Agrawal, 2006).

The *integration of knowledge(s)* on natural resources involves the exchange and internalization of different sources of information, lore and experiments embedded in different cultures, values and institutions of both *scientific* and *traditional* actors. This drew attention to different "*épistémès*" (Foucault, 1969), "*views of nature*" (Levi-Strauss, 1962; Descola, 2005), "*Champs*", "*Habitus*" (Bourdieu, 2001), or "*cognitive / organizational blocks*" (Shinn & Marcovich, 2009; Waast & Shinn, 2010), on how these actors produce different "*knowledge(s)*", to what extent they can converge and how each of them is legitimized, politicized and merchandized in different participatory spaces. This WP aims at exploring this field through these main questions: ***How are scientific knowledge(s) and traditional knowledge(s) involved in the construction of environmental knowledge(s)? What is the contribution of these knowledge(s) to the issue of environmental governance?*** Our approach raises the distinction between *traditional knowledge(s)* and *scientific knowledge(s)* as an artificial distinction, because the main issue consists in understanding the involvement of different *knowledge holders* in the production of nature by their use of natural resources. Thus, we believe we can bring our contribution on how nature can be used in an equitable and sustainable manner in LAC. Our main questions are based then on the following three matters: What does the concept of "environmental governance" hold? What are the links between "environmental governance" and recomposition of knowledge(s)? Which are the uses (policies) of these approaches? Largely, we aim at making the genealogy of these approaches, and to show - based on the countries compared - the emergence and ways of use of these concepts, by identifying the channels that connect actors and the social relations that cross them.

2. State of the Art.

Up to now, traditional knowledge(s) and scientific knowledge(s) on natural resources and environment have been studied at great length but separately.

In turn, ethnologists took an interest in botanical inventories by the end of the 19th century (their predecessors had done so much earlier and all over the world). Later, by the mid-20th century, they developed a new approach (ethnobotany), which was meant to be as free as possible of the colonial preconceptions (Posey, 1999; Cunningham, 2002). They showed the various uses of plants, their worth, their symbolic values, and the meticulous practices in which they are embedded. Such studies have been a focus point for researchers in Latin America (Hersh-Martinez and al., 2004; Fernandes, 2004).

At the same time, *anthropologists* had described the relations that local communities maintain with their environment. (Descola, 1996; Almeida, 2004). They developed the concept of “*Traditional/Indigenous Knowledge*” (as a knowledge arising from intuition, experience and the cognitive ability of the body) (Ingold, 2000) and emphasized that there is no boundary in this conception between the human being and its natural surroundings. Philosophically, these studies question deeply the dividing line established between Nature and Culture (Descola & Pálsonn, 1996; Escobar, 1998; Descola, 2005).

Environmental sociology studies the roots and rise of this new field. Several studies have demonstrated how domestication of plants and animals as well as natural resource management practices have enabled the development of traditional societies in Latin America in the past (Young, 2006; Miller 2007; Berkes and al., 2008). Traditional farming, agro forestry, health systems and hundreds of local varieties of healing plants, maize, potato, manioc, beans, and squashes which were once the sources of nourishment and medicinal system in the region (Altieri, 1999; Pretty, 2008; Zolla & Argueta, 2009), are now gradually being replaced by varieties developed in laboratories for large-scale agribusiness and pharmaceutical systems (Bedoya, 1991; Lazos, 2008; Otero 2008, Hersh-Martínez et al., 2004). Environmental sociology considers thence a large range of actors. Recently, local and national indigenous organizations in many Latin American countries (e.g., Mexico, Ecuador, Bolivia and Brazil) started to demand rights to their territories, management practices, and food sovereignty through active participation in local and national development programs (Warman & Argueta, 1993; Lazos, 2010). In this context, the combination of traditional and scientific “knowledge(s)” on bioprospection, intellectual property rights and environmental

law (Kerry & Laird, 2002; Dumoulin & Foyer, 2004) becomes relevant to produce effective impact on policies for conservation, development and poverty reduction in rural areas (Anderson, 1990). The approach is focused on the actors (Redclift & Woodgate, 1997): stakeholders that clash with scholars, activists and delegates of indigenous communities (Ollitrault, 1996; Massardier 1996; Hammam et al., 2002, Callon et al., 2001). This implies that understanding the interactions between scientists and indigenous /traditional communities requires a deep analysis of their networks, including a number of intermediary actors. The *translations* of ideas that take place between them establish some sort of continuum between human beings and natural subject, between society and science and between culture and nature (Larrère & Larrère, 1997; Leff, 1998; Toledo, 2000): this is the main topic for environmental sociology.

With a dissimilar perspective, *social studies of science* discuss the succession of different modes of scientific production, which direct its topics, procedures and underlying conceptions (Vessuri, 1983, 2007, Saldana, 2006), and through which western science got institutionalized. The case of “colonial science”, that became later “national sciences”, and maybe now “cosmopolitan science” is then discerned. These modes of scientific production have an impact not only on the course of knowledge production but also on public views, discourses and, ultimately, on policies and even politics (Kleiche-Dray y Casas, 2008; Kreimer, 2010a). The present concerns about environment and climate changes provide a good example.

3. Beyond the State of the Art: Research gaps.

Inversely, very little has been done to investigate the convergences and differences between “*traditional*” and “*scientific*” knowledge(s) or to study the experiences of communication and collaboration between them (Nakashima, 2000), except for a few provocative attempts to treat all sorts of knowledge (including “*Western science*”) such as “*ethnoscience*” (S. Harding, 1996).

There is even less material available when it comes to the transition from knowledge (“*scientific*” or “*traditional*”) to policy discourses (among activists, elites or the general public) and from discourses to environmental action: some debates between scientists and activists (Hammam et al., 2002) or between scientists and indigenous communities (Roué, 2003) have been described and analysed. Another topic, well documented by the social

studies of science in India, relates to the integration of exogenous knowledge by local societies (Prakash, 1999; Raina, 2003). Three fields of particular interest for us have been investigated according to this approach in Latin America: Natural Sciences and Botanical Gardens (Aceves, 1987, Lopes, 1992); the origins of environmental debates (Vitale, 1983; Drummond, 1991; Durham & Painter, 1995); and “*traditional*”/ “*indigenous*” *knowledge(s)* versus “*scientific knowledge(s)*”.

The opposite is also barely documented: the influence of public debates on the course of science, the separate evolutions of *traditional and scientific knowledge(s)*, and little is known on the course of ideas off the beaten track, the role of lobbies (scientific or activists), of spokespersons, of international organizations, and of decision makers. Our purpose is to make a step forward on these topics.

4. WP5’s contributions: To study knowledge (s) on natural resources needs *establishing bridges between the disciplines*

Our effort will aim at *establishing bridges* between disciplines that are most concerned by one or another of these topics, or by one or another of the actors linked to achieving such transitions. Action needs exchanging to channel it and knowledge to nourish it. This WP5 deals with an arduous parameter for any policy: knowledge has to be meaningful and acceptable to the stakeholders. “Acceptable Knowledge” rests on ways of living and understanding the world, on “*épistémès*”/ *socio-cognitive blocks* /*Nature’s view*/ that provide guidance on issues that are worth being addressed, on methods to settle them, on the reception, filtering or exclusion of “other” sorts of knowledge, as well as on the translations and communication between them. This applies equally to scientists, traditional communities, and decision makers.

Our multi-disciplinary strategy follows Vessuri’s perspective (2007) by focusing not only on the knowledge building process, but also on public views, speeches and on state and international policies. We are considering three main streams of literature that link *sociology and the politics of knowledge* in Latin America: *ethnoscience*, developed by natural sciences and botanical gardens; *political ecology*, that focuses on the causes of environmental degradation (Martinez-Alier, 2002), and the debate on differences between “*traditional*” or “*indigenous*” *knowledge(s)* versus “*scientific knowledge(s)*” (Hersch-Martinez, 2002; Hersch-Martinez and al., 2004).

Indeed, we will need some theoretic support. We shall draw on then the theory of “*translations*” between actors belonging to different worlds (Callon, 1986, 1998), which is necessary to link them in a network ready to work towards a common project. We shall also have recourse to Shinn & Waast’s approach on *socio-cognitive blocks* that firmly bond contrasting allies from different levels (from rank and file to decision makers, from scientists to traditional actors or ruling classes, on account of their perception of their specific place and role in their own world). In addition, we will identify the identification of the distinctive *épistémès* among *knowledge holders* (even within scientific communities) in order to obtain as outcomes the diverse conceptions of “good” knowledge and viable action (Bonneuil, 2006).

5. Methodology : following transformation chain of knowledge(s) based on case studies, survey, bibliometric analysis.

We decided to proceed with caution, through a selection of *critical case studies*. Their clear delineation was though an important task: We have taken account of the long standing experience of our members about LAC and their perceptive acquaintance with events in this field. We shall make a more comprehensive presentation of our choices a little further. Let it be said that our aim is to combine these case studies and to carry out a controlled generalization, with the perspective of suggesting methods for a better circulation of ideas and a quicker consideration and correction of errors or deadlocks in policies and governance.

We observe the multidisciplinary approach, which was established from the moment of setting up of our team. This should allow us to follow the “*transformation chain of knowledge(s)*” that leads from *traditional knowledge* to a certified *scientific* one or to an integrated one that can be shared by a number of stakeholders. We shall emphasize in each case study the interactions, the exchanges, the spreading of knowledge(s) built in different ways (traditional, indigenous, popular, scientific, hybrid, political, economic) and the fluctuation of perceptions and practices on natural resources (formalism, objectivity, instrumentalisation) with the aim to cross these issues. We will consider natural resources and *indigenous knowledge* in their cultural context - including the symbolic and material uses ascribed to natural resources- and investigate changes through development. We will also discuss the evolution and amendments of *scientific knowledge* in the last forty-year period and identify *intermediary actors* as well as their link with *merchandisation and politicisation* of “traditional knowledge”, “scientific knowledge” and “natural resources”. In effect, the merger between environmental issues and criticism of techniques began in the

1970s (including agricultural productivism and nuclear energy)(Hourcade, 2008). Next to the report of the Club of Rome (Meadows and al., 1972) on the depletion of non-renewable resources (energy, materials), many have pointed out that economic development must be subject to the preservation of ecosystems as potential resources needed for sustaining life. This report was seen as a speech carrying additional barriers to development. Of all the scientific critics of the Club of Rome's report, the report of the Bariloche Foundation for Latin American Countries (Herrera y al., 2004) is significant concerning the responses of intellectuals in the Third World, who demand systematic treatment of the environment and of poor people's basic needs. The creation of UNEP after the UNO conference of Stockholm in 1972 showed for the first time an attempt to reconcile two movements - contradictory, in part - protecting the environment and promoting economic growth through the formulation of a common ambition: sustainable development.

The debt load, the partialities in the direction of technical progress dominated by rich countries, the relationship between town and country, the social divisions in megacities and the breakdown of local cultures are then considered, at least, as dangerous as the ecological challenge (*ecodevelopment*, Ignacy Sachs, 1973). For its part, Brundlandt's definition of *sustainable development* confirms in this context the anthropocentric view of Stockholm and the rejection of a naturalistic view already operated by the International Union for Conservation of Nature and its resources. In 2002, the Earth Conference in Johannesburg decided to adopt *sustainable development* as the key element of balance between economic development and environmental protection. In the conclusion of this work, a change in patterns of production and consumption with the aim of protecting natural resources (as foundations of economic development) appears as a means to eradicate poverty. However, *sustainable development* includes an ambiguity in terms of the relationship between environment and development: Defined broadly, the environment has become a non-operative catch-all (Escobar, 1995; Norbert-Hodge, 2002), but the notion of sustainability has legitimized a questioning about the contents of growth and technical progress in the "North" and in the "South". In effect, these debates are also part of a context of multiplicity for different issues (health impacts of urban air pollution, groundwater pollution by nitrates and pesticides, protection of endangered species - whales, elephants, bears -, soil laterization, desertification, genetically modified organisms(GMOs)) that will accompany the rise of environmentalism and sustainability and legitimize the need for international coordination in the awareness of the changing relationship between knowledge and decision.

Thus, the environment has become an inspiring challenge for global governance. It has been

identified as a set of common problems, clearly perceived as marginal when compared to main issues, that relate anyway to key sectors of the economy through energy and food production (Hourcade, 2008).

This shows that *sustainable development* is the result of a long history that should not be seen as an environmental matter in the strict sense, but as a 'place' to manage multiple tensions and to discuss matters of guidance (lifestyles, technology models, methods of space management). In consequence, the WP5 will try to position the evolution of different '*knowledges*' in these relationships between development issues, environment and the evolution of these *knowledges* in LAC countries.

We chose to follow the chain of *knowledge(s)* in order to clarify the building of knowledge on nature, encapsulated in the culture, values and institutions of the following three main actors ("knowledge holders"):

- ☒ *Traditional/indigenous* actors
- ☒ *Scientists*
- ☒ *Intermediary actors* (merchandisation and process(ing) actors, activists, NGOs, managers, international organizations etc.)

"*Knowledge holders*" are considered in eight case studies (described in section VII) in order to reach these objectives. First, we will conduct intensive *field work* for each case study in several countries (one team in each country) following appropriate methods based on common questions for each group of knowledge holders:

"What knowledge(s)? Knowledge(s) applied to? What nature? For what governance?"

These questions will allow us to identify and characterize the knowledge(s) mobilized and the 'nature(s)' generated, to understand how such knowledge(s) and these nature(s) (nature epistemologies) connect, and, ultimately, to examine the articulation of these epistemologies with environmental governance.

Each question will be divided in sub-questions. In fact, beyond the schematic oppositions "scientific knowledge(s) / traditional knowledge" and the monolithic representations of these categories, the challenge is to finely characterize the forms of knowledge to which the case studies will be confronted on their fields and beyond:

1. What are the forms and the main categories of knowledge(s) that can be distinguished

(scientific knowledge(s), peasant's knowledge(s), 'indigenous knowledge(s)', therapeutic, magical knowledge(s), moral, political knowledge(s))? What are their dynamics and modes of transmission? In addition to their cognitive dimensions, what are their practical dimensions?

2. What are the types of nature? What is the vocabulary used to describe nature (nature, biodiversity, natural resource, genetic resource, etc.)? Is nature perceived as a simple inert object or rather as an entity with which knowledge holders have relations of reciprocity? What is the level of representation of nature from the more general (the universe, the cosmos, creation) to the more particular (the molecule, the atom)? To what extent is nature integrated (systemic) or, on the contrary, scored, crumbled in reducible units: the cosmos, the biosphere, the planet, the ecosystem, the fields (*milpa, huerta*), the plant, the gene the molecule, the atom...? To what extent is nature reduced or not to a particular function? What is the purpose of nature: Is it to feed on, to heal, to entertain, to generate money or to maintain the different equilibria (environmental services)? What are the other non-functional representations of nature (spiritual, aesthetic, moral)?

3. What are the different epistemologies of nature for the various holders of knowledge(s)? This question meets the other two and is designed to match the types of knowledge with the types of nature by trying to identify a typology in knowledge-nature configurations.

4. What governance copes with environmental governance and what are the environmental policies that mark the land? In what way environmental governance exerts an influence on the knowledge(s) of nature? In what way the production of knowledge(s) of nature has an impact on environmental governance?

In second place, we will try to understand how they communicate between each other in order to define the meaning of “translations” in the different systems of culture, values and institutions. Then, the results will be distributed both among classical academic audiences and the general public (specifically: through meetings with the key stakeholders).

6.Outcomes: To identify the links between knowledge(s) on natural resources.

In this context, WP5 tries to reach four main outcomes:

- To describe and to analyse *indigenous knowledge(s)* as practices and discourses in

LAC in their cultural context -including the symbolic and material uses ascribed to natural resources- and changes as a result of development.

- To analyse the construction of *scientific knowledge(s)* on natural resources since the 1970s in LAC.
- To assess the codification of indigenous knowledge for merchandisation and manufacturing purposes.
- To identify the links between these different systems of knowledge through the politicisation of the issues of “traditional knowledge” and “natural resources”.

As far as environmental and equitability are concerned, our studies will be directly linked to the historical roots of knowledge building (WP2), the role of experts as new elites (WP3), the politics of participation of local communities in traditional knowledge (WP 8), and knowledge construction for climate-change mitigation and adaptation solutions (WP9). Moreover, the linking of scientific and traditional knowledge is a question of crossing boundaries between epistemic communities and indigenous cosmologies (WP10).

7. Case studies, surveys and bibliometrics analysis

In order to reach these goals, the WP5’s team has selected a range of relevant natural resources, actors and spaces (regions and institutions) that are connected with our topic on how different “*knowledge(s)*” are modified and how they take new configurations in diverse contexts. However, the WP5’s team chose case studies that can be connected and made complementary and that help focusing on the issue of environmental governance. The team has also carried out bibliography analysis and several meetings with French and Latin-American specialists before selecting the case studies and establishing a precise schedule.

The first goal consists of analysing *indigenous “knowledge(s)”* through the speeches and practices of different actors in their cultural context, including the symbolic and material uses ascribed to natural resources and changes in order to understand how they take part in the environmental governance alignment. Several complementary and comparative studies about the evolution in the use of medicinal plants, farming practices, cooking, craft and diet -mainly focused on maize- have been undertaken in State of Mexico (Malinalco’s area), State of Oaxaca (Mixteca and Costa Chica areas), and in Brazil (in Rio Negro, the northeast area, and at the Arch of Deforestation of the Brazilian Amazon). These studies are related to the environmental issue that we will analyze via the many networks of actors involved,

particularly, from a local knowledge anthropological perspective.

The second goal consists in throwing light on the evolution of “natural sciences” since the 1970s (leading disciplines, main topics, networks and exchanges with Europe). By adopting a socio-historical perspective, we will form the social and institutional path of disciplines related to natural resources and environmental issues. In this part, we will follow two methods: qualitative and quantitative surveys (through archives, interviews and questionnaire) and bibliometric studies focused on some disciplines related to natural resources.

We assume that interactions between different fields of *scientific / traditional knowledge(s)* cannot be understood, and not even properly described without a close analysis of the roles played by intermediary actors (merchandisation and process(ing) actors and think tanks, NGOs, businesses, actors from public organisations) and of the translations that go together with these processes. However, the meaning of traditional knowledge about natural resources is not stabilized and opens possibilities for numerous instrumentalists of the definition of this knowledge. It embraces strategies of identity and heritage (or even the possession of land), the role of agrifood and pharmaceutical enterprises, policies for nature conservation, new-age perspectives, encyclopaedic projects of computer databases on a global scale (Agrawal, 2002), utopias based on the diversity of the world or "double conservation" (Shiva, 1993; Toledo, 2000), usurped identity stigmatization, and so on.

7.1. Dynamic processes in the use of Natural Resources in therapeutic and food systems by indigenous and mestizo communities in Mexico and Brazil

Currently, therapeutic and food systems of indigenous and mestizo communities are the result of the interaction between knowledge(s) and practices regarding the collection, production, exchange of remedies among families and the purchase of medicines and food through welfare programs (or allowances sent by relatives, in Mexico). These systems are dynamic processes in time and place determined by the access to community natural resources and to family production and harvesting systems, that depend on the socio-economic, cultural and political framework at regional and national levels (Chambers and al., 1989);. In this respect, we must understand the links between the actors involved in the construction of the therapeutic and food sovereignty: mestizo communities and indigenous communities, farmers, healers, indigenous organizations, consumers, civil associations,

authorities, local and government institutions.

The ideas about the backwardness of the traditional health system and the traditional agricultural system are internalized in Latin American societies, particularly among decision-makers of health and agrifood policies. In fact, the descriptions of the low access to the public health system and of the low agricultural production are not impartial or neutral. On the contrary, they assume values, goals and models through a language of representations that are connected under a structure of power and hegemony. However, indigenous and mestizo populations in Brazil and Mexico have therapeutic systems (Linares and Flores, 1999), family production systems (Alvarez-Buylla y al., 2011) and knowledge(s) of medicine and particular culinary production associated with knowledge about the environment. In many Latin American countries, the traditional knowledge of these populations is often ignored or despised. This frustrates a dialogue permitting to understand health and agrifood problems as well as environmental degradation and poverty in Latin America and the Caribbean.

In the Amazon -a bio-geographical region known as a precious ecosystem that hosts great diversity of flora and fauna often threatened of extinction-, environmentalists have valued certain indigenous knowledge on nature (Carneiro da Cunha and Almeida, 2000), as a way of protesting against the devastating impact of intensive farming, illegal deforestation for commercial purposes and, recently, against soybean crops, predatory practices which are responsible for the formation of the so-called Arch of Deforestation in the Brazilian Amazon. However, environmentalists have not publicised therapeutic, agricultural or culinary knowledge(s). In Brazil, research on medicinal plants has focused on their capability to deliver active ingredients to major international pharmaceutical companies that favour their integration into industrial pharmaceutical production. However, their use and handling within indigenous and mestizo communities has not been considered. In the same way, Agricultural production has focused on commercial agriculture and biotechnology, favouring productivity rather than agro biodiversity or sustainability. In Mexico, similarly, despite the recognition of the historical importance of the use of endemic plants in the production of medicine (contraceptive pill obtained from barbasco) and of the cultural and food importance of maize for traditional farmers, their traditional therapeutic and agricultural systems are still regarded as backward and unproductive. The indigenous cuisine heritage, even if it is the origin of Mexican cuisine, has been recently recognized by the UNESCO but has not yet received the recognition it deserves (Boege, 2008). The same case occurs in Brazil, where the indigenous population represents a minority: indigenous cuisines are

ignored by the majority of the population. Moreover, in a context of globalization, migration and urbanization in both countries, the agricultural and traditional culinary knowledge(s) are threatened. On the other hand, civil society movements and recent initiatives of heritage declaration taking place in both countries try to resist these threats (Ellen and al., 2000; Toledo, 2000).

The case studies that we will carry out will allow us:

- a) To record the *indigenous and mestizo knowledge(s)* built from the use of natural resources, by identifying the practices and representations of *indigenous and mestizo* use, handling and management of these resources.
- b) To explore the links between government institutions and indigenous and mestizo communities;
- c) To record the discourses and social movements that indigenous and mestizo communities have been promoting concerning natural resources in order to rescue the knowledge(s) of these organizations and associations (indigenous, mestizo, national and international NGOs).

From these case studies, focused on food and therapeutic systems of some indigenous and mestizo populations in Brazil and Mexico, we will have recourse to the methodology of surveys on knowledge(s) and therapeutic, farming, harvesting, eatery and food diet practices in indigenous and mestizo communities with contrasting natural and political environments. Interviews with various community members (men, women, elderly, farmers, healers...), authorities (directors and representatives of the ministries of agriculture, environment, Indigenous Affairs, Health...), international organizations and NGOs (local, national and International) will allow us to collect the history of therapeutics and agrifood as well as the socio-political and economic framework in the area.

7.1.1. Case study I: Ethnopharmacopeia of "Malinalco Orchards" (*Huertas de Malinalco*)

This implies the analysis of the origin, production, transmission and use of knowledge of local healers associated to the production of therapeutic knowledge about plants grown in the gardens of people known in their community as sages and healers in a region of high biodiversity of crops (Martinez de la Cruz, 2010) and with a well-known tradition of using medicinal plants in healing practices: the community of the municipality of Malinalco, State of Mexico (Aguilar-Gomez y Rivas-Manzano, 2006).

This case study will include:

- 1) Local flora used for therapeutic use: identification, origin, nomenclature, production cycle, usual care (watering, protection against predators, etc.), parts of plants used (leaves, stems, flowers, branches, roots, etc.), time and ways of collection, mode and place of preservation and conservation;
- 2) Types of medicines produced by plants, including the kind that evokes the etiologic healer;
- 3) Ways to prepare the remedies and the recommended doses;
- 4) Types of people in treatment categorised according to age and sex.

7.1.2. Case study II: Natural resources in agriculture, cooking and diet, in indigenous and mestizo population of Brazil and Mexico: Challenges facing development plans.

Regarding the issue of the food system, this research focuses on Mexico (the State of Oaxaca, in the Mixteca and Costa Chica areas) and Brazil (in Rio Negro, the northeast area and at the Arch of Deforestation of the Brazilian Amazon, the Indigenous Territory of Alto Turiaçu (MA), between the Brazilian states of Para and Maranhao) regarding the evolution of farming practices, cooking, craft and diet (mainly focused to maize). We are going to analyse how these populations have contributed to the conservation of natural resources with their knowledge and modes of using and handling the environment.

7.2. Natural resources as scientific objects: production of knowledge and socio-political legitimization in Argentina and Mexico.

The purpose here is to outline the social and institutional evolution of disciplines related to natural resources. We will follow three methods here: a thorough work in the archives, qualitative and quantitative surveys (through interviews and questionnaire) and bibliometric studies focused on some disciplines (natural products chemistry, botany, ethno-botany, pharmacology, biochemistry, conservation biology) or related to some natural resources (maize, medicinal plants, water, forestry, improved genetics of seeds). All of these studies will be conducted from a socio-historical perspective. Argentina and Mexico will be compared.

It is possible to distinguish three factors for the transformation of science since the end of

1960's: (i) the multiplication of actors, (ii) the "big science" with very large projects targeting complex issues (cancer, climate change, etc...) and (iii) a combinatorial organisation of science. While some disciplines languish (botany), others bloom (soil science), expand (ecology) or attempt to emerge (a new kind of transdisciplinarity triggered a deep change in scientific practices and identities (Pestre, 2003). We are witnessing now a re-configuration of traditional fields (e.g. botany) and the emergence of new ones, like molecular biology, ecology and biotechnology and, more recently, nanosciences. Coalitions are forged and grow through the dialogue with public or governments.

7.2.1 Case study III: focus on some disciplines and some natural resources

Case studies of natural products chemistry, ethnobotany and conservation biology focus on institutional history and on links with other disciplines. Two doctoral PhD are conducted on related subjects: the first involves the participation of the Mexican scientific community in the field of sapogenin steroid research (1950-1975), largely supported by the Rockefeller Foundation; the second analyses the role of The Mexican Institute for the Study of Medicinal Plants, established in 1975 as part of the creation of the Collaborating Centres for Traditional Medicine for the construction of alternative medicine in several developing countries (China, India, Egypt, Madagascar), supported by WHO.

In these cases, we will try to understand: the impact of "industrial upgrading" policies of the 1950s in the guidelines for research on natural resources in Mexico, as well as the impact of the search for alternative development in a country like Mexico since the 1970s, on the basis of its cultural and natural specificities.

We will describe the selected subjects in specific contexts and their links to various disciplines including botany, biology, ecology, agronomy and pharmacology. In Mexico, in the nationalist contexts of the 1970s, the early research on environment and rural development made by semi-public research centres was followed by the austerity of the 1980s, in which themes of self-development became central, before the emergence –during the 1990s– of new paradigms taking into account biodiversity and the environment.

7.2.2. Case study IV: Bibliometric analysis.

Bibliometrics is based on a set of databases that goes through a number of journals. Bibliometric analysis can display the evolution of scientific production in a country over a period of time. Thus, a bibliometric study by country consists, first, in bringing together all the production of papers of this country in a particular database. Then, a division is made, according to, for instance, the affiliation of the authors (like their city, institution or

laboratory). It is then possible, for example, to define the profile of the production of a city, or a theme, or to “cross” both of them.

As part of our WP5, the idea is to implement an historical approach and to observe how certain keywords appear, disappear and even change in studies on natural resources. We want to go beyond the traditional approaches by analysing texts, by considering the content of documents and counting the "key" words they include. It is then possible to calculate the frequency of a word in a set of articles (represented as a words cloud) and to observe its evolution over time. A second step consists in analysing the frequency of co-occurrence of words: it is possible to define then the words most frequently used and how they relate to each other.

We will use the bibliometric study as a research, as case studies analysis *per se* and as *a tool* that will help us to establish quantitative and qualitative samples to deal with qualitative and quantitative surveys on natural resources, as a research topic for scientists. This will allow us to identify and characterise the factors that structure the research on natural resources in LAC.

How is the research agenda defined? We assume that training and scientific cooperation are crucial, not only in terms of teaching and scientific contents, but also in terms of socialization: the "ways of doing" science, in terms of contact with peers and in terms of networks. So, to what extent do the training of researchers - in terms of trajectories and place of training - and partnerships play a role in these research guidelines? Also, to what extent is research the product of networks of researchers, local and foreign or not? These questions allow us to highlight the issue of the conditions and the logics of production and spreading of knowledge in sciences that have natural resources as their object of research. The result will also consist in the building of a data base and a *meta-review* of the scientific production on Natural Resources in Latin America. Several preliminary bibliometric studies focused on Latin American data bases, such as the *SNI (sistema nacional de los investigadores)* data base, which has recorded all Mexican scientists' publications since 1982. We have to carry out an identical research work to analyse the case of Argentina, where the Conicet database should allow us to conduct a comparative study. In addition, the existence of the *Periodica* data base, which has recorded the main scientist's publication in Spanish since the end of the 1970s, should allow us to develop a study about other Latin American countries. These data bases will enable us to analyse the evolution of scientific knowledge on natural resources through scientific production (papers and patterns) and to select the

more relevant scientific disciplines which positions “natural resources” as a topic.

7.3. Circulation of knowledge in merchandising and processing natural resources

Intermediary actors are in fact connected to *traditional* and *scientific* actors. However, we shall carry out specific case studies : two case studies will deal with the analysis of a Mexican federal plan of developing maize agriculture (the Promac), and with the analysis of participative projects (Cata) promoted by public institutions of agronomy research (Universidad Autonoma de Chapingo, Mexico); and two other case studies will focus on processing/merchandising, related, first, to bioprospection in Mexico and, second, to the introduction of organic agriculture in Brazil. These specific studies will open new insights of the interaction between *traditional and scientific knowledge(s)* focus on the politicisation of issues of “traditional and scientific knowledge(s)” and “natural resources”.

We propose then to focus on projects which are consistent with the frame of the issues and debates on environment and biodiversity and on how the different actors have transformed the use, handling and management of natural resources stocks (Ellen et al., 2000). From linkage to other case studies involving agrifood systems, cooking and diet of the populations in the State of Oaxaca (focusing on indigenous and mestizo populations, government officials and on NGOs) we are going to complete this outlook on the basis of case studies that will focus mostly on government officials, NGOs, Policy-makers Actors.

These studies will reflect the contribution of the *circulation of knowledge by merchandising and processing natural resources* between different actors to the modification of relations between science and society. To do this, we will try to answer the following questions: What is the social acceptability of such practices and to what extent do they cause controversy? To what extent are *merchandising and processing natural resources* involved with the redefinition of the relationships between scientists, merchandising and processing actors, policy makers, legal aspects, indigenous, mestizo peoples and farmers over the years?

7.3.1. Case study V: The Promac as a program of Payments for Environmental Services?

The Promac is a governmental environment program established in 2008 by the National Commission of Natural Protected Areas (CONANP) of the Ministry of Environment (SEMARNAT) (CONABIO, 2011). The Promac program is original for two reasons: First, it aims

at the conservation of agro-biodiversity by implementing reserves for this particular type of biodiversity. Secondly, it is similar to a program of Payments for Environmental Services since it funds the planting of native maize for farmers and organized individuals (Garriby, 2012). As such, it is worth examining what are its achievements and limits. We will carry out our analysis both nationally, in the CONANP offices, and locally, in rural communities of Oaxaca, to accurately understand how this program is implemented.

7.3.2. Case study VI: Interactional and communicative practices of scientists and farmers in agronomic participatory research: The Cata in Mexico.

The participatory learning centre, Cata, established by the Autonomous University of Chapingo (Texcoco, Mexico) in the Municipality of San Juan Colorado (Oaxaca State) (MacSems, 2007) as a platform for exchange of experiences and knowledge(s) among farmers of different villages (4 Mixtec and 3 of African descent), will allow us to examine *the dialogue* of different forms of knowledge(s) (academic and non-academic) in agronomic participatory research (Silitoe and Pottier, 2002).

First, we will analyse *in situ* the interactive and communicative practices of scientists and farmers. Agreements, in general, move a set of objects to coordinate the different activities and actors. Then, we will be particularly attentive to the uses, spreading and redefinitions of objects born from participation. Besides, we will also analyse the nature of *knowledge(s)* and their methods of mobilization during participatory meetings.

The study then will be interested in the uses of these *knowledge(s)* outside the participatory field. The research will focus on analysing the way the *knowledge(s)* born from agreements are used and processed within each community: the local one and the scientists. It will mean, particularly, to question the relevance of a centre such as the Cata from the point of view of Chapingo agronomists based in Oaxaca and Texcoco and from the point of view of the institution and the farmers.

To do so, we will carry out participatory observations, we will systematically extract the objects of participation and organise individual interviews with: (i) farmers (participants and non-participants) in the villages where the Cata intervenes, (ii) agronomists in charge of the site and Chapingo agronomists based in Oaxaca and Texcoco. In the end, we will base the analysis on the study of various written sources (diffusion brochures, scientific articles, etc.) emerged from Cata activities.

7.3.3. Case study VII: Actors, plants and natural substances: report, meaning and

projections of bioprospecting activities in Mexico.

Bioprospecting can be defined as the search for natural active compounds (genes, proteins...) on which industrial products can be developed. This research includes an exploration of biodiversity in situ, a possible involvement of "*traditional knowledge*", as well as laboratory experiments with these compounds isolated and chemically characterised. We must therefore consider bioprospecting in all of its stages, from the collection of biological material to the moment it is placed on the market. This chain of activities may involve a wide variety of actors and 'knowledges', from healers in the indigenous communities - that can serve as informants - to laboratories in private firms.

Bioprospecting has long been a discrete activity, confined to science and industry. It became much more open to the social field though, when the Convention on Biological Diversity (CBD) of 1992 attempted to regulate and institutionalise it with a model of bilateral contracts based on the principles of benefit sharing previously agreed and notified.

Twenty years later, the belief in the enormous economic value of biodiversity and traditional knowledge seems to be basically in progress for the very few commercial products developed on the basis of these agreements. However, the Nagoya Protocol has recently given a strong relevance to issues of access to genetic resources and to bioprospecting. But, what is the reason for negotiating an international protocol when the promise of bioprospecting is far from being fulfilled?

We therefore propose to analyse:

- i) The various initiatives of bioprospecting in Mexico since the adoption of the CBD;
- ii) The projections and methods of bioprospecting post Nagoya.

The activities of the studies we will undertake include:

- 1) a summary of the various formal bioprospecting projects in Mexico and the controversies to which they have led;
- 2) A survey in the CONABIO and in the SEMARNAT on the projections for the implementation of the ABS (Access and Benefit Sharing) Protocol of Nagoya and on the adoption of a law of access to genetic resources.

7.3.4. Case study VIII: Organic Farming and family farmers: new networks, new values and rules in the peripheral area of Sao Paulo.

We will analyse here how the inclusion of the Brazilian family in the Brazilian Organic Farming sector reshaped their agricultural knowledge and practices (Bellon and Abreu, 2009) in relation to governance issues. The purpose is not only to analyse the dynamic construction of knowledge per se - involving farmers, agricultural advisers and scientific organizations with which they collaborate-, but also to include the factors affecting the demand and the use of this knowledge and, in this way, to emphasise the role played by values, rules and standards established within the actor-networks emerging in this sector (Blanc & Kledal, 2012).

We will work within Veravà quarter, Municipality of Ibiúna, located in the Metropolitan Region of São Paulo, at about 60 kilometres southwest of the Capital. Due to its water and forest reserves, it is part of an environmental protection zone (*Area de Proteção Ambiental Itupararanga*) and of the buffer zone of the Sao Paulo City's Green Belt Biosphere Reserve, which was added to the Mata Atlântica Biosphere Reserve in 1993.

It is at the same time a major organic vegetables production centre in the region. 60 families, living mainly from agriculture, converted to organic farming (vegetable production) in the mid-90s. These farmers were initially supported by local NGOs and extensionists from church-related entities, and have been included in the Brazilian organic sector via its "alternative" food system. Farmers have progressively developed different distribution channels, but supermarket chains are becoming the main one now. At the same time, different categories of agricultural advisers from both public and private sectors provided outreach efforts.

In order to carry out this work, we are creating a set-up of surveys, targeting all the actors involved in these organizations, from local farmers to supply chain actors, as well as public and private agricultural advisers and members of organized civil society (NGOs, Association) involved in the farmers' strategic framework.

8. Final words

Each of these activities will give rise to contributions to workshops and policy papers issued by WP5 and to further dissemination through seminars and conferences, according to the opportunities available to participants. Among other things, though, these communities mainly demand support for their production and sale of food, indigenous art (crafts and

material culture), particularly the women who created the initiative of becoming associated to strengthen their productive project. Thus the purpose of this proposal is to contribute to strengthen indigenous and mestizo initiatives related to the production of products derived from agricultural production (from maize), of traditional cuisine and of indigenous art as a source of income generation for communities, as well as to focus on knowledge about traditional therapeutics, indigenous and mestizo agriculture and on species of great cultural significance to indigenous peoples and mestizos, such as the production of food or beverages consumed during ritual festivities.

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