UNIVERSITY OF CALIFORNIA,
IRVINE

The Financialization of Amazonia: Scientific Knowledge and Carbon Market in Brazil

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Anthropology

by

Shaozeng Zhang

Dissertation Committee:
Professor George E. Marcus, Chair
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2014

DEDICATION

To

my parents, wife and children

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I would like to express the deepest appreciation to my committee chair, Professor George E. Marcus, who has the attitude and the substance of a genius: he continually and convincingly conveyed a spirit of adventure in regard to research and scholarship, and an excitement in regard to teaching. I would like to thank my committee members, Professor William Maurer and Associate Professor Kristin Peterson. Without their guidance and persistent help this dissertation would not have been possible.

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Education

University of California, Irvine, USA	Anthropology	Ph.D. 2014
Peking University, Beijing, China	Anthropology	M. A. 2007
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Publications

- 2014 coauthored article "REDD+ [1] policy networks in Brazil: constraints and opportunities for successful policy making", forthcoming, *Ecology and Society*.
- 2013 article "Rethinking collaboration in scientific knowledge production: climate change mitigation through REDD+ in the Brazilian Amazon," revising for resubmission, *Anthropology Quarterly.*
- 2007 chapter "The Story of Camel and People: an Ethnography of Total Social Fact" in Zheng Yefu et al., eds. *Sociological Masters Degree Papers from Three Universities*. Jinan, China: Shandong People's Press.
- 2007 review article "The Impact of Modernity and Continuation of Nativeness." *Journal of China Agricultural University (Social Sciences Edition)*, 2007 Vol.1.
- 2005 article "Ethnographic Study Based on Legal Pluralism," with Bingzhong Gao, *Social Sciences in China*, Vol.155.

Teaching Experiences

PEKING UNIVERISTY — Beijing, China

Guest Lecturer — Jun.-Jul.2012

- Taught graduate students on ethnographic methods.

UNIVERSITY OF BRASILIA — Brasilia, Brazil

Visiting Scholar — Mar.2011-Feb.2012

- Made a series of lectures on anthropology of science, technology and environment to graduate students.

UNIVERSITY OF CALIFORNIA, IRVINE — Irvine, USA

[1] REDD+: Reduced Emissions from Deforestation and forest Degradation, an environmental financial mechanism to reduce emission and deforestation.

Teaching Assistant, *School of Social Sciences* 2008-2013

- Taught undergraduate courses, including Cultural Anthropology (5 terms), Bio-Anthropology (3 terms), Global Economy (1 term), Computer-Based Research Methods of Social Sciences (1 term; SPSS, Excel, & research design);
- Assistance work for the whole class of 400 students: helped with the leading professor's lectures and exams;
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Research Experiences

SUSTAINABLE AMAZONAS FOUNDATION Manaus, Brazil

Collaborative Researcher Jun. -Aug. 2011

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- Used methods of community-based participatory research, and structured interview.

AMAZON ENVIRONMENTAL RESEARCH INSTITUTE Brasilia, Brazil

Collaborative Researcher Jan.-May 2011

- Designed sustainability indicator system for a Payment for Environmental Services project in the state of Pará;
- Used methods of community-based participatory research, and structured interview.

CENTER FOR INTERNATIONAL FORESTRY RESEARCH Brazil & Indonesia

Consultant Researcher, Apr.2010-Mar.2011

Program of Tropical Forests & Climate Change Adaptation

- Conducted fieldwork, data analysis and report writing of the Brazil REDD+ policy network research project;
- Used methods of structured survey, semi-structured interview, and network analysis (with the software UCINET).

BLUE WAVE FOUNDATION Salvador, Brazil

Research Intern Aug. 2008

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Conference Papers

- Nov. 2013, "Revisiting the making of carbon market: REDD+ leakage in the Brazilian Amazon", at the annual conference of American Anthropological Association, Chicago;
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Affiliations

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- 2008, Editorial Intern, journal *Cultural Anthropology*;
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Grants and Fellowships

- 2013, Graduate Dean's Dissertation Fellowship, University of California, Irvine;
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ABSTRACT OF THE DISSERTATION

The Financialization of Amazonia: Scientific Knowledge and Carbon Market in Brazil

By

Shaozeng Zhang

Doctor of Philosophy in Anthropology

University of California, Irvine, 2014

Professor George E. Marcus, Chair

This dissertation is about the epistemic and policy evolution of the environmental financial mechanism of REDD+ (Reduction of Emissions from Deforestation and forest Degradation) in Brazil. Derived from the ecological or environmental economic model of creating economic incentives, REDD+ is rather a grand economic project of financializing the Amazonia, through public funds or markets, to reduce deforestation and greenhouse gas emissions. This dissertation examines the mobilization, production and competition of various forms of knowledge(s) in designing and testing this economic invention.

In this study, I propose three research hypotheses. The first and underlying one is that in the cause of developing a global environmental financial mechanism as REDD+, there is not a single universal knowledge producer or justification, but rather there are multiple modes of knowing and thus multiple kinds of "knowers" as local or native to their social cultural contexts of knowing. The second hypothesis is that the multiple modes of knowing are in collaboration and negotiation with each other in a shared project, in this case, of REDD+. The third one is not so much a theoretical hypothesis, but more of an

exploratory attempt on the role of anthropological research in collaborative knowledge production as in this case.

This ethnographic study is based on eighteen months of fieldwork among scientists, policymakers, carbon market practitioners, environmentalists as well as forest community residents in Brazil. My fieldwork relied primarily on ethnographic research methods, including participatory observation, in-depth interviews and archival research, but was also complemented by more structural and quantitative methods, such as policy network analysis and survey research.

This dissertation concludes supporting my first two research hypotheses. Ethnographic accounts of REDD+ knowledge production and mobilization reveal that multiple modes of knowing collaborate and negotiate with each other. Moreover, ethnographic research brings forth the productive, but yet informal, culture of cross field collaboration in scientific knowledge production. Beyond that, anthropologists may also help to enable various stakeholders to keep track of their positions in the complex process of carbon market making, especially those unprivileged stakeholders, such as the forest community residents, and the "Third World scientists."

CHAPTER 1

REDD+: Introduction

REDD+: Reducing Emissions from Deforestation and forest Degradation in developing countries, Plus forest conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries.

——*United Nations Framework Convention on Climate Change (UNFCCC), 2010*

REDD+ is an environmental financial scheme officially proposed to the United Nations (UN) in 2005 to compensate and thus encourage forest conservational efforts in developing countries. REDD+ is such a heavy and even odd acronym that whenever I want to talk about it, I have to first explain the term and its contexts of climate changes and tropical deforestation. Just as am I doing at this very first paragraph of my dissertation. Brazilian scientist Paulo Moutinho and his colleagues were among the first contributors to the original idea underlining REDD+ and their proposal in 2003 was "Avoided Deforestation Compensation," a concept simpler and more straightforward than REDD+. This policy-market scheme and the term of REDD+ evolved from the underlining ideas as such and included many additions before arriving at REDD+. The trajectory of evolution has been full of controversies and challenges, being scientific, technological, environmental, market and political economic if not more. It is a result of constant collaboration and negotiation, and the lack thereof, between various groups of

stakeholders and involved parties, including academics, policymakers, carbon market practitioners and environmental activists among others. Actually, the technical and legal formulation of the REDD+ mechanism has not been finalized yet by the time of writing.

The critiques I learned at the very beginning of my fieldwork in Brazil were concerned with the impacts of REDD+ on the Amazon forest residents, mostly small farmers that belong to indigenous peoples and traditional populations. In preparation for my first field trip to the pilot REDD+ project site of Juma forest reserve, I was seeking advice on where to buy a hammock in the city of Manaus. The then Juma Project director *Raquel Luna*, told me the joke often made by the carbon funders and market practitioners: "*REDD+ para rede*" (REDD+ for hammock). It refers to the negative racial stereotype of indigenous peoples and the traditional populations as lazy since the colonial times in Brazil. With the REDD+ mechanism, they would be paid not to clear primary forests for family swidden farming (*roça*). It thus invokes a scene of REDD+ financing to pay the forest residents for doing nothing but resting in their hammocks. Given the same pronunciation of the two words *REDD+* and *rede* (hammock) in Brazilian Portuguese[2], this joke has the critical implication that REDD+ would make no difference in reality but further some kind of Amazonian inertia. I could easily discard such critiques as prejudicial, but what I could not disregard was the lack of the voices of the forest residents actually affected by REDD+ in this joke as well as in most of the academic and policy debates I had read.

This does not mean that scientists involved with REDD+ would have the strongest voice or comprehensive knowledge in the evolution of REDD+ in Brazil. In early 2010, I

[2] Some Brazilian academics and policymakers pronounce the term REDD+ as an English word (same as "red") in both English and Portuguese conversations.

had my first interview with another Brazilian scientist Britaldo Soares-Filho, specialized on the modeling and mapping of Amazon deforestation and leading author of the Simamazonia model (Soares-Filho 2006) published on *Nature* and popularly used for deforestation prediction and REDD+ carbon accounting. After answering my predesigned questions on his academic career and his research, he said to me "please do share with me your research results." A bit surprised, I paused pondering whether he meant it or he was just being polite. He followed to confirm he was "serious." He confessed that he had been concentrated on his research and modeling work in collaboration with more policy-oriented scientist such as Paulo Moutinho, but not well oriented in the broader picture of REDD+. He was eager to know more about the REDD+ policy evolution and the voices of forest residents in it. He was getting anxious about the uncertainties and risks in working with REDD+, and especially concerned that the Simamazonia model could be abused for ill-intended REDD+ projects beyond his control since the model was published for open use. This interview turned out to be much longer and more inspiring than I expected, and Soares-Filho became one of my key interlocutors.

This dissertation is about the development of this overloaded and contested measure of REDD+ in Brazil. Derived from the ecological or environmental economic model of creating economic incentives, REDD+ is rather a grand economic project of financializing the Amazonia, through public funds or markets, to reduce deforestation and greenhouse gas emissions. This dissertation examines the mobilization, production and competition of various forms of knowledge(s) in designing and testing this economic project. It also explores what the intervention of an anthropologist both in fieldwork and after writing could mean or contribute to the grand project of financializing the Amazonia.

Research questions

In this dissertation study, I propose three research hypotheses. The first and underlying one is that in the cause of developing a global environmental financial mechanism as REDD+, there is not a single universal knowledge producer or justification, but rather there are multiple particular modes of knowing and thus multiple kinds of "knowers" as local or native to their social cultural contexts of knowing. The second hypothesis is that the multiple modes of knowing are in collaboration and negotiation with each other in a shared project, in this case, of REDD+. The third one is not so much a theoretical hypothesis, but more of an exploratory attempt on the role of anthropological research in collaborative knowledge production as in this case.

All the chapters to follow will directly engage these three hypotheses, but with different foci. The second chapter explores a particular form of collaboration in scientific knowledge production, collaboration not only interdisciplinary but also across the fields of academia, policymaking and market. This chapter is based on ethnographic fieldwork with groups of environmental scientists and non-academic experts in Brazil who worked on the projection of future carbon emissions from deforestation in the Amazon. Their work was characterized by the interfolding uncertainties both in the future scenarios of carbon emissions from deforestation and in the policy arena of climate change and carbon market. They were reflexive upon the policy and market contexts of their knowledge production, and determined to make their knowledge products accountable to a wider set of economic, social and ethical standards. This case shows how collaboration between scientists across fields leads to the epistemological shift from pursuing pure or universal

truth to producing scientifically valid and "socially robust" knowledge (Gibbons 1999). I further argue the voluntary reflexivity of such collaborative scientists is productive and even essential to this epistemological shift. However, such reflexivity has been largely informal or un-institutionalized. It is the aim of this article to capture and understand this informal culture. In this sense, this chapter demonstrates how ethnographic research may contribute to the project of "rethinking of science" (Gibbons 1999; Nowotny et al. 2001).

The third chapter examines the techno-scientific knowledge practices in defining the decisive technical principle of additionality in the REDD+ mechanism and the global carbon finance broadly. It looks at their varied approaches to and reflections upon the concept of additionality and the validation of a REDD+ carbon accounting methodology. The different modes of knowing among these collaborative experts will lead to discussions about the techno-scientific, market and political roles of a methodology in defining and achieving additionality and beyond. In so doing, this chapter brings forward the politico economic context of the knowledge practice (Haraway 1988; Latour 1993) in defining additionality and developing methodology, such as the established international knowledge authority regime under UNFCCC in this regard. The established knowledge authority regime poses challenges, such as high cost of methodology validation, to the "Third World" experts (in their own words), but they strategically contextualize their knowledge production practice in it in order to effectively appropriate the promised global financial resources. In such conscious contextualization of knowledge production (Gibbons 1999; Nowotny et al. 2001), the Brazilian REDD+ experts were contributing not only to the techno-scientific definition of (environmental) additionality of REDD+, but also to the achievement of the promised financial additionality of REDD+.

The forth chapter examines how the technical issue of leakage in carbon trading had been addressed in the pilot REDD+ project in Juma and in REDD+ policy developments in Brazil. Recalling the theoretical conception of leakage as externality in economics (Coase 1960, 1988; Daly 1968), this chapter explores leakage in and beyond its technical definition in the Juma REDD+ project design and maps out various socio-technological conduits of leakages, being negative and positive, environmental and social-economic. It demonstrates how the carbon market making is embedded in various social relations(Polanyi 1957 [1944]; Granovetter 1985; Callon 1998a), such as those between the different REDD+ market stakeholders, and in other institutions, such as the local agenda of sustainable development. This chapter suggests at last that a better market, should be always open to uncertainty and contestation, or in other words, should be always an open experiment (Callon 2009; Law 2004). This is how economic anthropology and other social sciences can get in and contribute to the formation of economic theories and models in economics and their performance in market making.

This dissertation study aims to engage the literature primarily on anthropological studies of knowledge, or broadly on the social studies of science and technology. Anthropological studies of science by "real" anthropologists as such began in late 1980s and early 1990s with the works of Sharon Traweek (1988), Emily Martin (1987), Donna Haraway (1989), and Sheila Jasanoff (1990). Most of these works actually did not start from science studies. But rather, as illustrated below, they have a wider range of actors, institutional accountabilities, political economy and media focus, class-linked cultural analysis, and other interests. They are considered as science studies as opposed to general anthropological work, because they exhibit an intense interest in the materials, tools,

technological assemblages, and epistemic objects of the sciences and engineering technologies, and how these in turn structure the worlds in non-intuitive ways. While at the same time, they also take advantage of the reflective momentum in anthropology in the 1980s to reintegrate political economy with cultural analysis (Marcus and Fischer 1986).

Generally speaking, anthropological studies of knowledge take a model of culture to approach science (e.g. Haraway 1991). Marilyn Strathern, for example, describes science or broadly knowledge practices as "established ways of bringing ideas from different domains together" (1992b). A crucial issue directly related to my study is the embeddedness of local scientific cultures in transnational associations and wider (competing/conflicting) cultural meanings. Arturo Escobar argues "any technology represents a cultural invention, in the sense that it brings forth a world; it emerges out of particular cultural conditions and in turn helps to create new ones" (Escobar 1994:211). This argument is elaborated in the works done by David Hess (1993, 1995) and edited by George Marcus (1995) which explore science as a multicultural field. Hess describes science as a site of conflicting worldviews in evaluating the operation of truth-falsity polarities at work in the assessment of the paranormal, such as that offered in spiritualist, New Age, and pagan movements. Marcus presents a collection of essays chronicling changes in international scientific culture resonant with the volatile geopolitical transformations of the post-Cold War era.

The differentiation of different kinds of science helps clarify presupposed social requirements or exclusions (Fischer 2007:559). These constraints differ considerably in different countries because of differing cultural presuppositions or "civic

epistemologies", which in turn create different boundary objects, and "co-produce" regimes of knowledge and power (Jasanoff 2005). However, the concern with the transnational/multicultural associations and larger sociopolitical institutions in studies of science poses methodological difficulties. In this regard, anthropologists are privileged with the multi-sited approaches to ethnographic research of science by investigating multiple contexts in which techno-scientific artifacts travel and make sense.

The difference between local scientific cultures resonates with a classic topic in the whole literature on science studies: universalism and particularism in values. The sociological studies of cumulative advantage theory and the Sociology of Scientific Knowledge literature demonstrated the widespread importance of various types of particularistic values. These values play a variable role in key decisions such as the evaluation of personnel, choice of research problems and materials, and theoretical and methodological preferences.

Sheila Jasanoff has shown the standards for knowledge justification in applied (regulatory) science and research science can be very different (1990). Social studies of science as exemplified above usually take a descriptive approach to science and technology, and demonstrate how particularistic values or social interests shape theory choice (e.g., Knorr-Cetina and Mulkay 1983:3). In descriptive accounts, it is useful to distinguish between private or covert criteria for theory choice (those that individuals keep to themselves or share only among networks of allies) and public criteria, which often emerge to legitimate positions in controversies (Hess 1997a:39). Public criteria (as they appear in publications, memoirs, or public disputes) usually correspond to one of the philosophical ideals for theory choice, whereas private or cover criteria do not. The

Sociology of Scientific Knowledge advocates have accused the Mertonian sociology of science of leaving the "black box" of content unopened and examining only the exogenous, contextual aspects of science and technology (Knorr-Cetina and Mulkay 1983:6; Whitley 1972; Hess 1997a:81). Thus, it is important to follow scientists in action—in the laboratory and behind the scenes. Empirical studies of this sort have shown that in addition to universalistic values—such as accuracy, consistency, and simplicity—scientists evaluate theories and observations by reference to particularistic or personalistic criteria (e.g., Latour 1987; Latour and Woolgar 1979). The limitations of universalistic values, especially for descriptive accounts of scientists' action, have been recognized by philosophers as well, because scientists turn out to be much more particularistic than they may admit in public (e.g., Longino 1990:4).

It is necessary to clarify that particularistic criteria are more than trivial or harmful weeds that tends to remain hidden; they may also play an important functional role in science, for example, as preliminary screening devices. Particularistic criteria, such as personal and professional reputation of individual scientists are widely used and relatively effective preliminary screening guides in theory choice. Particularistic values do play a significant role in the evaluation of research programs, theories, and empirical claims. The mixing of particularistic and universalistic criteria in actual science does not necessarily harm science, but can even benefit it by, for example, allowing researchers to spend less time writing proposals and providing conditions for more creative work (Cole 1992:203). However, particularistic criteria may function in different ways and/or to different extents across scientific disciplines, and Hess believes that they operate more

powerfully the closer the case is to applied science, economic and political interests, gender- and race-related issues, the research front, and controversies (Hess 1997a:43).

Feminists have led the way in including particularistic criteria in prescriptions for theory choice. They usually start with a moderate constructivism and believe that in order to be able "to detect the values and interests that structure scientific institutions, practices, and conceptual schemes", and therefore to move on to better but nevertheless ultimately fallible and culture-bound accounts, one good strategy is to begin research with the perspectives of marginalized groups (Harding 1992: 581). For example, Donna Haraway's concept of "situated knowledges" is developed to analyze theories, theorists, and sciences by giving them a social address or location (1991). "Unmarked knowledges" are those characterized by a presumption of objectivity that usually obfuscates their social embeddedness in white, male, or other dominant cultural perspectives (ibid). Haraway's studies of primatology (1989) suggest that women and Asian primatologists entered the field, they led significant reforms that substantially improved the quality of theories, methods, and observations.

Particularistic criteria have been explored and discussed in social sciences and some areas of natural sciences, such as biomedical sciences, where social biases have frequently distorted theorizing and empirical inquiry, but their utility remains to be demonstrated in the exact, physical sciences. Work of this kind has been barely done in scientific and technical disputes over environmental issues while it is highly recommended (Hess 1997a:46). Last but probably more importantly, a mixture with particularistic approach to science and technology can make valuable contributions only if it goes beyond the perspectives of marginalized groups (ibid). In this sense, the

inclusion of particularistic approach makes up a methodological prescription that is similar to anthropology's cultural relativism: to start with local points of view. Furthermore, the two methodological prescriptions are also similar in this respect to Marxist critiques of bourgeois science from a proletarian perspective (Hesse 1994). All three begin their critiques with local or excluded viewpoints.

Thus it is highly recommendable to take a combined approach of particularism and Marxist political economic critique to science-based environmental issues, such as climate change and carbon market policy making. This side of science is particularly evident in environmental conflicts between communities and large corporations or the state (e.g., Fortun 2001), and pharmaceutical controversies between the public and large corporations (e.g., Hess 1993b). Here, the wealthy institutions often amass large quantities of well-funded and well-credentialed science as part of an overall political strategy to undermine the claims of communities or the public.

Ultimately, anthropology itself is a science and has the tools to understand science as form of culture (Franklin 1995:165). The culture concept in anthropology has been reshaped by the necessity to interrogate its own knowledge practices since early 1980s. This move enables anthropologists to operationalize analytical models that are understood as both cultural and scientific. Thus, anthropology is uniquely positioned to attest to the value of a multi-perspectival science, which situates itself as partial in the representation of its objects.

On the research subject side, as observed by Fischer (2007:567), scientific fields have been transformed dramatically by new machines (as in the case human genomic research, Sunder Rajan 2006), as well as by experimental systems (Rheinberger 1997).

Ethical dilemmas have become no longer containable only through self-policing by scientists. This is partly because of the vast amount of money in play in a field that in 20 years had transformed from one in which at least academic biologists steered clear of entanglements with corporate profit drives, to one in which almost every successful academic biologists in involved in a company as a necessary means to protect patented discoveries and produce them in forms that are no longer merely experimental but can be used, licensed, traded, and put to therapeutic use. At every level, there seems to be not just small changes, but changes that synergistically accumulate toward complexly interactive systemic change.

Therefore, the new generation of studies of scientific and technological developments needs a refashioned ethnographic eye to clearly see the political, cultural, technological, financial, institutional, and human capital building blocks and barriers. Generalized frames of postcolonial relations, for instance, while they serve well to highlight legacies of in-egalitarian and dependency relations, cannot explain the successes and growth points of developments especially in the worlds outside Western Europe and North America (Fischer 2007:574, 576). At issue here is (also) the creation of political consciousness out of science communities' inventive use of changing assemblages of political resources.

As a latecomer but with a more reflexive spirit, the anthropology of science is acquiring a unique niche in science studies that meets the demand of changes of science and its cultures but also leads anthropology towards more challenging arenas. We need an anthropology of science and technology that pays detailed attention to fundamental epistemologies, cultures of science and presuppositions of policy formulation, making

them more reflexive, inclusive, and open to airing and negotiating conflicting interests, situations, requirements and demands in ways that build legitimacy, without thereby making them unwieldy or formalistic (Fischer 2007:540-541).

Beyond that, the anthropology of science is reaching out into new terrains. Some recent finance studies are partly inspired by the new sociology of scientific knowledge (Knorr-Cetina 2003; MacKenzie 2006; Riles 2004) and partly demanded by the need to understand the the political economy of biotechnologies and other techno-scientific arenas (Sunder Rajan 2006). Anthropologists have been also following the science involved in global environmental issues, such as that in determining the role of the Amazon forests in the global carbon cycle and climate change and the Brazilian and western scientists working in and out of the contexts of hegemonic U.S. and European assumptions about how forests work, one of the contentious North-South divisions over the global political economy (Lahsen 2002, 2004, 2005). The historical horizon in these new terrains for anthropology of science could be overlapping with as well as quite different from that of colonial, development, new nations, or even postcolonial studies, such as Richard Grove on colonialism and environmental knowledge (1995, 1997) and Timothy Mitchell on expertise in Egypt (2002).

Research methods and fieldwork

This dissertation is an anthropological ethnographic study. It is based on eighteen months of fieldwork among scientists, policymakers, carbon market practitioners, environmentalists as well as forest community residents. My fieldwork relied primarily on conventional ethnographic research methods, including participatory observation, in-

depth interviews and archival research, but was also complemented by more structural and quantitative methods, such as policy network analysis and survey research.

In geographic term, I conducted my fieldwork mostly in Brazil. I also participated occasionally in international climate change policy events held outside Brazil, such as the Fifteenth Conference of Parties (COP 15) of the United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen, Denmark in December 2009, often referred to as the "Copenhagen Climate Summit." In addition, I did online archive research and long distance interviews by using the internet communication software Skype.

More specifically, my fieldwork was focused on two clusters of REDD+ experts in Brazil. One was centered on the Amazon Environmental Research Institute （IPAM hereafter, as from *Instituto de Pesquisa Ambiental da Amazônia* in Portuguese), including its close collaborators at the Federal University of Minas Gerais (UFMG hereafter, as from *Universidade Federal de Minas Gerais* in Portuguese). IPAM moved its headquarter from Belém, Pará to Brasília right before the beginning of my fieldwork. UFMG is located in Belo Horizonte, the capital city of the Brazilian state of Minas Gerais.

The other cluster was centered on the Sustainable Amazonas Foundation (FAS hereafter, as from *Fundação Amazonas Sustentável* in Portuguese), including its close collaborators in the Institute for the Conservation and Sustainable Development of Amazonas (IDESAM hereafter, as from *Instituto de Conservação e Desenvolvimento Sustentável do Amazonas* in Portuguese), the National Institute of Amazon Research (INPA hereafter, as from *Instituto Nacional de Pesquisas da Amazônia* in Portuguese) and the Amazonas State Secretariat of Environment and Sustainable Development (SDS-

AM hereafter, as from *Secretaria do Meio Ambiente e Desenvolvimento Sustentável de Estado do Amazonas* in Portuguese). All of these institutions are headquartered in Manaus, the capital city of the Amazonas State and the largest city in Northern Brazil as well as in the whole Amazon Basin of South America.

For these two foci, most of my fieldwork was conducted in Brasília and Manaus, about six months each. In Brasília, I did daily fieldwork at IPAM and made occasional visits to other institutions working with REDD+, such as the Environment Ministry (MMA hereafter, as from *Ministério de Meio Ambiente* in Portuguese) and Presidential Secretariat of Strategic Issues (SAE-Pr. hereafter, as from Secretaria de Assuntos Estratégicos da Presidência). Beyond that, I also visited shortly one of IPAM's regional offices in Altamira, Pará and spent two weeks in the communities of the Transamazonica Region in Pará, a region previously under a national Payment for Ecosystem/Environmental Services (PES) project called *Proambiente* and, at the moment, in preparation for a pilot REDD+ project. In Manaus, I did daily fieldwork at FAS and visited other institutions in collaboration, mainly IDESAM, INPA and SDS-AM. Beyond that, I spent one month in the Juma state forest Reserve for Sustainable Development (Juma hereafter) where FAS had been carrying out a pilot REDD+ project since 2007. In addition, I also paid short visits to two other Amazonas state forest reserves, Rio Negro and Uatumã which had been under the statewide PES program and were turning into REDD+ projects.

Beyond Brasília and Manaus, I also travelled to other places in Brazil for preliminary and supplementary fieldwork. One of my first connections in Brazil led me to the environmental organization Blue Wave Foundation (Ondazul hereafter, as from

Fundação Onda Azul in Portuguese) in Salvador. I spent the very first month of my fieldwork at Ondazul, most of the time working in its library for archive and literature research on the environment movement and evolution of PES in Brazil. I also worked in the Latin America Regional Office of Center for International Forestry Research (CIFOR hereafter) in Rio de Janeiro for about one month divided by two stays. I visited Belo Horizonte twice to conduct intensive interviews with Britaldo Soares-Filho and his colleagues in the Center of Remote Sensing at the UFMG. During my fieldwork in Brazil, I also participated in important REDD+ policy events elsewhere, such as in Cuiabá, Mato Grosso.

REDD+ prehistory and FAS

I developed my research interests in REDD+ during my preliminary fieldwork on the Payment for Ecosystem/Environmental Services (PES) in Brazil. At the moment, PES was mobilized by academics and policymakers as a functioning mechanism to implement REDD+ on the ground. The Millennium Ecosystem Assessment (2005) defines "ecosystem services" as those benefits that people obtain from ecosystems. These benefits can be direct, as in the production of provisions, such as food and water ("provisioning services"), or the regulation of features such as floods, land degradation, desiccation, soil salinization, pests and disease ("regulating services"), or indirect, through the functioning of ecosystem processes that produce the direct services ("supporting services"). Examples of supporting services would be the processes of photosynthesis and the formation and storage of organic material; nutrient cycling; soil creation; and the assimilation, neutralisation and detoxification of wastes. Ecosystems

also provide people with non-material benefits such as aesthetic pleasure, recreational opportunities, and spiritual and cultural sustenance ("cultural services"). There are thus a range of ecosystem services, some of which benefit people directly, others which do so indirectly.

Obviously, changing land uses also make a different for what type of service an ecosystem will produce. Some services have the characteristics of "public goods" in that people usually cannot be excluded from benefiting from them, and the use of the service by one person does not significantly diminish the availability of that service to other users. Nevertheless, people can degrade the capacity of ecosystems to continue supplying these services, either through changing the composition and structure of a system and how it works, or through extracting material from the ecosystem at a rate that is above the replenishment capacity of the ecosystem. Paying for ecosystem services is aimed at providing land users with incentives not to degrade ecosystems and their services, but rather to protect them.

Whereas the different elements of an ecosystem, and therefore the various services that an ecosystem provides, are functionally linked, in any one instance a buyer of "ecosystem services" (more usually referred to as environmental services) is likely to be interested in the measurable, or at least verifiable benefits of a particular service, rather than the whole suite of them. The management required to provide these services will also vary, depending on the service concerned. Environmental services are therefore usually bundled into four main classes: watershed services, concerned primarily with the provision of adequate amounts of good quality water, and secondarily with hydrological control of such phenomena as flooding, erosion and soil salinization; carbon

sequestration, involving the long-term storage of carbon in woody biomass and soil organic matter; biodiversity conservation, related to those processes that determine and maintain biodiversity at all levels (landscapes, species and genes); and aesthetic features or landscape beauty, the maintenance of which serve as sources of inspiration, culture and spirituality, as well as commerce in the form of eco-tourism. Those are the four service areas where actual payments have so far been made.

Payments for environmental services (PES) are a class of economic instruments designed to provide incentives to land users to continue supplying an environmental (ecological) service that is benefiting society more broadly. In some cases, payments may be made to land users to adopt land use practices that will produce the required service from scratch (e.g. growing trees for carbon sequestration). These payments have five defining features. First, PES is a voluntary, negotiated agreement, not a command-and-control measure. Potential services providers must have real land use choices, with the land use providing the service usually not being the one most preferred by the land user. Second, what is being bought must be well-defined − either a measurable service (e.g. tons of carbon stored) or a cap on land-use, limiting it to those practices likely to provide the service (e.g. forest conservation providing clean water). Third, there should be a transfer of resources from at least one ES buyer to, fourth, at least one provider, directly or through an intermediary. Finally, payments by the buyers must be truly contingent on the service being provided continuously for the duration of the contract period. This last prerequisite is important as it establishes conditionality between service provision and payment: no provision, no pay.

Ideally, payments should be made on a sliding scale based on the amount or quality of the ES that is supplied, at least up to some mutually agreed maximum. Buyers of ES would monitor the providers' compliance, for example whether hunting or deforestation has really been contained in the way stipulated in the contract. Payments may be in cash or kind, for example, providing materials and training for an economic enterprise such as in the case of the Amazonas State Program of Forest Allowance (PBF) including the Juma REDD+ Project.

The project of Compensations for Environmental Services (*Compensações por Serviços Ambientais*, CSA) carried out by a Brazilian environment NGO, Vitae Civilis, is the first experiment in the kind of PES in Brazil. Funded by the Ford Foundation, the CSA project started in the end of 1999 in several local communities of native Indians and traditional populations (such as rubber tappers) in Mata Atlantic, the Brazilian Atlantic Forest along the coast the Atlantic Ocean. The experimental nature of this project lies in that it was aimed intentionally "to study, evaluate, contribute and monitor the viability of several economic instruments in environment management based on the protection of nature services"[3]. This project served as the experimental and academic model to disseminate the scheme of PES in Brazil and eventually to introduce this scheme to the Brazilian legislature.

In 2000, based on this project, Vitae Civilis carried out a study to evaluate the opportunities to introduce the PES scheme to the Brazilian legislature. In 2001 and 2002, Vitae Civilis coordinated joint researches with three other environmental NGOs (*Fase, Fundação Vitória Amazônica* and *IMAZON*) on local communities' perspectives about their necessities and demands in compensation to some life activity changes to make

[3] http://www.vitaecivilis.org.br/default.asp?site_Acao=MostraPagina&PaginaId=1547

external (regional, global) benefits, and invited the three NGOs to disseminate the CSA scheme in Mata Atlantic and Amazon, the two most important Brazilian biomasses. These researches resulted in a book "*Protecting Social and Ecological Capital: Through Compensations for Environmental Services*" with Portuguese and English versions (Vitae Civilis, *Proteção do capital social e ecológico por meio de Compensações por Serviços Ambientais*, 2002). Vitae Civilis has also been active in promoting the CSA scheme nationwide by communicating its project and study in various academic and policy events, for example, on the forum of the School of Economy and Administration of University of São Paulo, and on the seminar of the Brazilian Ministry of Environment and Institute of Economic Researches of the Federal Government (Instituto de Pesquisas Econômicas do Governo Federal, IPEA) in May 2003[4]. The proposition of law act PL-792/2007 which defines the concept of environmental services and the mechanism of PES directly cited the study of Vitae Civilis as a justification.

The link of PES to REDD+ has been an economic tool invention along with the evolution of international climate change mitigation policies, and the REDD+ mechanism in particular. The evolution of REDD+ could be dated back to the Kyoto Protocol approved in 1997, a protocol to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC). UNFCCC is an international environmental treaty produced at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro, Brazil, from 3–14 June 1992. The treaty is intended to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The Kyoto Protocol establishes legally binding

[4] http://www.vitaecivilis.org.br/default.asp?site_Acao=MostraPagina&PaginaId=1547

commitments for the reduction of greenhouse gases (GHG) produced by industrialized nations, as well as general commitments for all member countries. To date, 183 parties have ratified the protocol, which was initially adopted for use on 11 December 1997 in Kyoto, Japan and which entered into force on 16 February 2005.

Kyoto Protocol includes defined "flexible mechanisms" such as Emissions Trading, the Clean Development Mechanism and Joint Implementation to allow industrialized economies to meet their GHG emission limitations by purchasing through financial exchanges GHG emission reductions credits from other industrialized countries with excess allowances or by investing in projects that reduce emissions in non-industrialized countries. In practice this means that non-industrialized countries have no GHG emission restrictions, but have financial incentives to develop GHG emission reduction projects to receive "carbon credits" that can then be sold to industrialized buyers, encouraging sustainable development.

The Emissions Trading mechanisms allow parties to the Kyoto Protocol to buy greenhouse gas emission permits from other countries to help meet their domestic emission reduction targets. Through the Clean Development Mechanism (CDM), countries can meet their domestic emission reduction targets by buying GHG reduction units from (projects in) non-industrialized countries or developing countries to the Kyoto protocol. These two carbon trading schemes are commonly referred to as “global/international carbon markets”. Under the agreement reached in Bonn in July 2001, however, only reforestation and afforestation in areas deforested prior to 1990 are considered eligible under the CDM mechanism of Kyoto Protocol. The first commitment period (2008-2012) of the Kyoto Protocol excludes forest conservation and avoided

deforestation from the CDM for a variety of political, practical and ethical reasons. However, carbon emissions from deforestation represent 18-25% of all emissions, and will account for more carbon emissions in the next five years than all emissions from all aircrafts since the Wright Brothers until at least 2025. There had been growing calls for the inclusion of forests in CDM schemes for the second commitment period (2012-2016) from a variety of sectors.

REDD is a recent breakthrough to include avoided deforestation in carbon trading schemes. The UNFCCC agenda item on "Reducing emissions from deforestation in developing countries and approaches to stimulate action" (REDD) was first introduced at the Conference of the Parties (COP-11) in December 2005 by the governments of Papua New Guinea and Costa Rica, supported by eight other Parties. The challenge was to establish a functioning international REDD finance mechanism that can be included in an agreed post-2012 global climate change framework. A functioning international REDD finance mechanism needs to be able to provide the appropriate revenue streams to the right people at the right time to make it worthwhile for them to change their forest resource use behavior. Requests from countries, and encouragement from donors, Food and Agriculture Organization (FAO), United Nations Development Program (UNDP) and United Nations Environment Program (UNEP) have developed a collaborative REDD program in July 2008. The UN-REDD Program is aimed at tipping the economic balance in favor of sustainable management of forests so that their formidable economic, environmental and social goods and services benefit countries, communities and forest users while also contributing to important reductions in greenhouse gas emissions. The aim is to generate the requisite transfer flow of resources to significantly reduce global

emissions from deforestation and forest degradation. The immediate goal is to assess whether carefully structured payment structures and capacity support can create the incentives to ensure actual, lasting, achievable, reliable and measurable emission reductions while maintaining and improving the other ecosystem services forests provide.

On the other hand, there have been carbon sequestration projects through (re)forestation on the local level in Brazil since late 1990s which were intended to explore possible mechanism(s) to put the Kyoto Protocol agenda into action but not envisaged to obtain tradable carbon credits in the carbon market. The first project in this kind is the Ilha do Bananal[5] project (*Projecto de Seqüestro de Carbono da Ilha do Bananal*, PSCIB), which was conceived in 1997 and initiated in 1998 when most of the rules regarding implementation of the Kyoto Protocol and the carbon market were still in a very embryonic stage (May, Boyd, Veiga and Chang, 2004: 52). This 25-years project is financed by the AES Barry Foundation, and implemented by a Brazilian NGO, *Instituto Ecológica* (and its partners). AES Barry Foundation is a non-profit foundation associated with AES Barry, a British natural gas company. The ultimate aim of this project is to develop and implement an innovative, equitable and sustainable system to offset greenhouse gas emission (of AES Barry) through the sequestration of carbon in the forest ecosystems on the Bananal Island (May, Boyd, Veiga and Chang, 2004: 53). The project includes three major components: 1) forest; 2) environmental research and carbon monitoring; and 3) the social component. The forest component is the one responsible for generating carbon through a) as the major cause, the permanent preservation of forest in existing national park and protected area on the Island, b) reforestation of degraded

[5] Ilha do Bananal (Bananal Island) is located in the newly established Brazilian state of Tocantins in northwestern Amazon.

forests and deforested areas on the Island, and c) agroforestry systems in the adjacent municipalities. The central objective of the research component of this project is to develop methodologies for carbon monitoring. The social component was focused on environmental education related to the generation of alternative sources of income, such as, organic fruit production in agroforestry techniques and ecotourism.

As one of its major credits, the project introduced the concept of "social carbon"—carbon projects that focus on local development and at the same time contribute to build up the investing company's image of socially and environmentally responsible enterprise. With the insolvency of AES Barry in 2001, the project experienced a critical financial crisis and was forced to seek alternative financial backers through the emergent carbon market, although not very successfully (so far).

This experimental carbon project has impacts and implications important to the emerging arena of carbon market in Brazil. To name some, the first implication is that from its very beginning, the project was conceived primarily (83.6% deriving from preservation) from the standpoint of avoided deforestation, an approach of carbon sequestration excluded in the first commitment period of Kyoto Protocol and continuously under discussion until the its inclusion in the REDD program in late 2008. Secondly, this project pioneered in resorting to the international carbon market for financial support for both private forests and public conservation units. This financial recourse would be taken up by other carbon projects very soon. Thirdly, the project's partnership with adjacent municipalities resulted in the elaboration of a municipal environmental law with actions to combat global warming, one of the first such laws at the municipal level in Brazil.

The Juma REDD+ Project, one of the foci of this dissertation study, is located in the Amazonas State and was initiated as part of the state PES program, called the Forest Allowance Program (Programa *Bolsa Floresta*). Located right in the middle of Amazon basin, the State of Amazonas is the largest state in Brazil, with 157 million hectares and 98% forest cover (only 2% deforested so far). It is 50% larger than Indonesia (another major host country of tropical forests) or 30 times the size of Costa Rica. Therefore, the State of Amazonas with its vast tropical forests plays an important in regulating regional and global climate. From 1990 to 2006, the State of Amazonas had an average deforestation rate of 0.07% of its total service a year (while the whole Brazilian Amazon had a rate of 0.35%) (Governo do Estado do Amazonas 2007). In 2007, the state PES program was initiated to reward the traditional and indigenous populations who commit to stopping deforestation. State legislature authorized the establishment of the semi autonomous organization Sustainable Amazonas Foundation (FAS) and delegated the administration of this program to FAS in 2007. The State Secretariat for Environment and Sustainable Development (SDS-AM) had been working on the launching of this program and has been in support to FAS for this program since 2007.

In recent years, the State of Amazonas has been very active on the domestic and international discussions on carbon market-based PES mechanism specifically and on climate change and deforestation in general. In November 2005, it hosted in its capital city, Manaus, a "Conference on Mechanisms of Compensations for Environmental Services Provided by Land and Forest Use Changes" (*Reunião sobre Mecanismos de Compensação Ambiental por Serviços Ambientais Providos por Mudanças do Uso da*

Terra e Florestas)[6]. The participants of the conference included many Brazil's governmental institutions, scientists and NGOs. A key agenda was to discuss how to insert the PES mechanism into the global climate conventions. It is reported that the state government organized the conference to gain support for its proposal of the PES scheme to the 11th Conference of the Parties (COP-11) of UNFCCC to be held one month later. In December 2005, the proposal of "A Mechanism for Compensation for Ecosystem Services Provided by Amazon Forests"[7] drafted by the State of Amazons on the Manaus conference was officially submitted by Brazil's Minister of Environment, Marina Silva, to UNFCCC COP-11 held in Montreal, Canada. In November 2006, a refined version of this proposal, the "Amazonas Initiative" was presented at the UNFCCC COP-12 in Nairobi, Kenya.

In June 2007, the SDS-AM gathered a group of experts, on a boat on the Amazon River near Manaus, for presenting the "Amazonas Initiative" and discussing the technical, economic and scientific aspects to be improved. This group was institutionalized as the Advisory Committee of the Amazonas Initiative (AC-AI), and since then the Committee has been working on the "Structuring Plan for the Amazonas Initiative" (still commonly referred as "Amazonas Initiative" for short) which would be put into action in the state with support of the World Bank.

In June 2007, along with the establishment of AC-AI, the State of Amazonas enacted State Law 3135/2007 creating the Amazonas State Climate Change Policy—the first of its kind in Brazil—and the complementary Law 53/2007 creating the State System for

[6] http://www.amazonia.org.br/noticias/noticia.cfm?id=186336

[7] Available online, titled as "Reducing emissions from deforestation Amazonas Brazil: A state Government ś proposal for action" (Viana, V., M.C. Cenamo, W.M.Manfrinto, 2005). http://www.sds.am.gov.br/programas_02.php?cod=2485, access at March 28, 2009.

Protected Areas. These laws establish the legal framework necessary for implementing a financial mechanism of payments for environmental services as well as other activities reducing emissions from avoided deforestation and carbon sequestration. Besides institutional support, the SDS-AM also provided assistance to the initial financing of FAS, more specifically by securing donations of US$20 million, half from the State Government and the other half from Bradesco, the largest private bank in Brazil.

The "Amazonas Initiative" published in late 2007 (Governo do Estado do Amazonas 2007) includes the results of many ongoing studies either carried out by AC-AI or commissioned by the Amazonas State Government. The studies covered the areas including: a) forest carbon dynamics, b) carbon stocks and baseline for deforestation in Amazonas, c) economic costs of Reducing Emissions from Deforestation (RED)[8] in the state of Amazonas, d) Costs of implementation in the State of Amazonas System for Protected Areas (SEUC), and e) implementation strategy (the legal structure for RED). These studies, focused on the dynamics of carbon sequestration and carbon credits, directly shaped the state's policy evolution from the existing PES scheme to a much more elaborated legal/bureaucratic structure of transferring environmental services and carbon credits, as shown in the graph below.

[8] Name used in this document, as an earlier version of REDD+. Please refer to the second chapter of this dissertation for the evolution of the term itself.

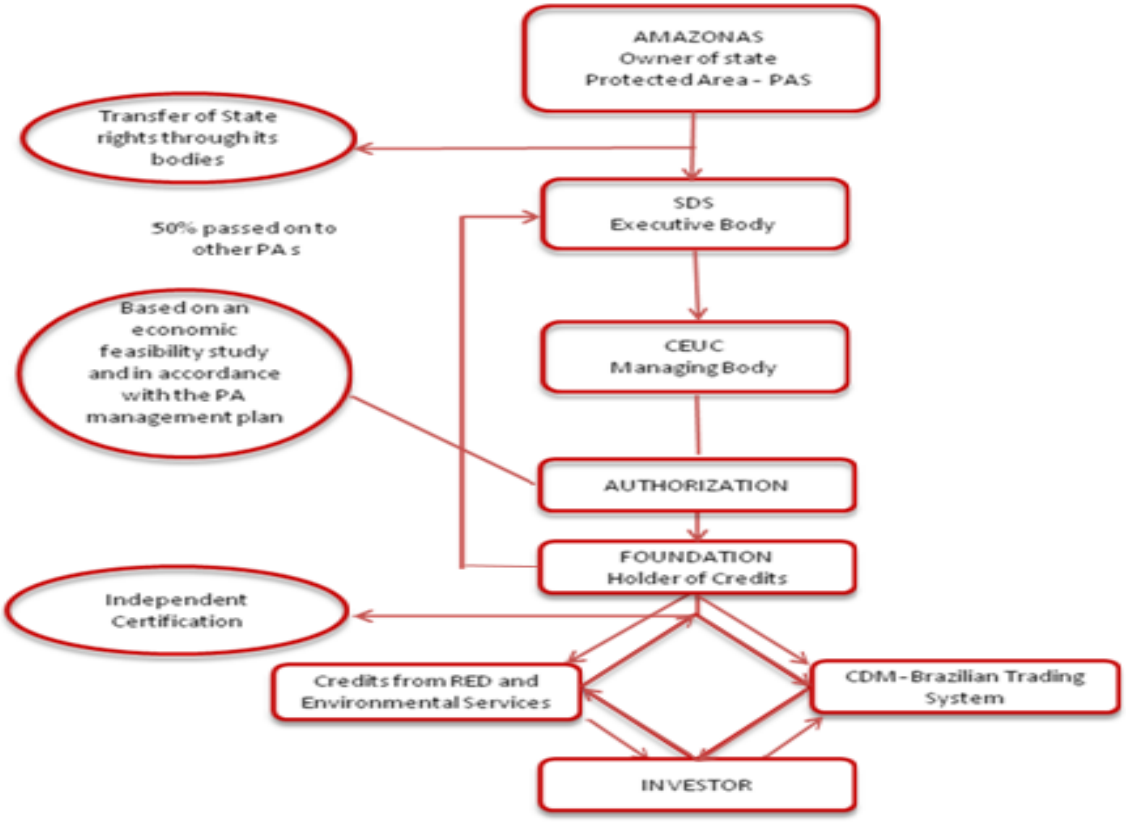

Figure 1.1: Legal/bureaucratic structure of transferring environmental services and carbon credits. Adjusted from "Amazonas initiative on climate change, forest conservation, and sustainable development" (Governo do Estado do Amazonas 2007).

The Amazonas State also organized policy events to promote the linking of PES to the global carbon markets. The first influential event in this kind should be the "Conference on Mechanisms of Compensations for Environmental Services Provided by Land and Forest Use Changes" (*Reunião sobre Mecanismos de Compensação Ambiental por Serviços Ambientais Providos por Mudanças do Uso da Terra e Florestas*)[9] hosted by the State of Amazons, as mentioned above. After the first meeting, this conference

[9] http://www.amazonia.org.br/noticias/noticia.cfm?id=186336

was actually turned into a periodic Forum of Governors of Legal Amazon (*Fórum de Governadores da Amazônia Legal*). In May 30th, 2008, the governors of seven Amazonian states presented a letter to the president Luiz Inácio Lula da Silva, in which the governors urged the federal government to strengthen the legal control of forest reserves and to create financial mechanisms to guarantee the PES implementation[10]. Along with the letter, several governors advocated for their urges through media.

In November 2008, the governors of three Amazonian states, Ana Júlia Carepa of Pará, Eduardo Braga of Amazonas and Blairo Maggi of Mato Grosso attended the Global Forum of State Governors on Climate Change held in Los Angeles, USA. On the conference, the three Brazilian state governors advocated for carbon market-based PES schemes[11]. They voiced strongly that the Amazon forest benefits the whole plant and the people of Amazon should be rewarded for conserving the forest standing and providing environmental benefits for the planet. The representative of World Bank, Michelle de Nevers, announced on the conference that the World Bank has included PES of avoided deforestation and reduced carbon emissions in their institutional financing, and that it would provide R$150 million (Brazilian currency, about US$80 million) for the Amazonian states to reduce carbon emissions through avoided deforestation and another US$200 million to be invested in other projects in this cause. The three governors also signed several collaborative documents with province/state governors from USA, Indonesia and Papua New Guinea.

In February 2009, the Forth Forum of Governors of Legal Amazon was held in Boa Vista, the capital city of the State of Roraima, Brazil. The governors (or their

[10] http://www.amazonia.org.br/noticias/noticia.cfm?id=272330
[11] http://www.amazonia.org.br/noticias/noticia.cfm?id=292648

representatives) of seven Amazonian states attended this forum and drafted a document of "21 Points of Roraima Letter" (21 Pontos da Carta de Roraima) which again advocated for financial supports for their developing PES mechanisms and also dealt with other environmental and agricultural issues[12].

This forum soon involved the participation of environmental NGOs and academic researchers and promoted the collaboration between them. Only with academic support from the knowledge producers in domestic and mostly international agencies, could the governments of the Amazonian states design the carbon market oriented PES mechanisms and campaign at home and abroad for the institutional and financial support for their PES mechanisms. On the other hand, the PES and carbon experts take advantage of the collaboration with the Brazilian governments (and also NGOs) to carry out field studies and then further develop their theories, and at the same time, to promote their theories and especially their (re)designs of PES and carbon trade mechanisms.

Among all these efforts in PES and carbon trading mechanisms in the state of Amazonas, the Juma REDD+ Project stood out as the first REDD+ project in Brazil to successfully sell its credits to the global voluntary carbon markets. This was the primary reason that I chose the Juma Project as one of the foci of my dissertation study, and the Juma Project experts mostly from FAS, IDESAM, INPA and SDS-AM, as one of the two focused groups of interlocutors for my fieldwork.

Policy network analysis and IPAM

I used more structural and quantitative method, policy network analysis based on questionnaire survey, to identify my other focused group of interlocutors, the one

[12] http://www.amazonia.org.br/noticias/noticia.cfm?id=300888

centered on IPAM. This analysis also confirmed the high importance of FAS and its close collaborators in the policy arena of REDD+ in Brazil. In 2010, I worked as a consultant researcher for the Center for International Forestry Research (CIFOR). I was responsible for the REDD+ policy network analysis research in Brazil, as part of CIFOR's multi-year project of the Global Comparative Study of REDD+ conducted in most developing countries with tropical forests.

The methodological design of this policy analysis research was a collective work. The principles were outlined Brockhaus and Di Gregorio (2012). The field research first relied on expert panel consultations to identity a list of relevant REDD+ policy actors in Brazil. With the support of CIFOR researchers in Brazil, Peter May and Sven Wunder, I nominated the experts for consultations and created the list of 65 policy actors, across multiple scales, local/regional, national and international, and across various sectors, governmental, academic, NGOs or civil socity and the private or industrial. 56 out of the total identified organizations (see table 1.1 below) completed the survey that included a questionnaire and a semi-structured interview. I participated in the design of the questionnaire and the semi-structured interview questions before the survey.

I conducted most of the survey interviews and all the data entry and analysis. Data analyses of the section on Networking are made through the Network Analysis software UCINet (Borgatti et al.: 2002; Hanneman and Riddle: 2005); and data analyses of other sections are made through Microsoft Excel. More specifically, the structured questionnaire for quantitative analysis was made up of two parts: stances and networks. The stances analysis focused on key topics related to REDD+ implementation, such as the distribution of REDD+ benefits, land conflicts, and challenges for REDD+

implementation. The second strand of quantitative research analyzed network influence. Organizational representatives were asked to name from the list of 65 those actors that had a perceived "strong influence" on the national REDD+ regime, and with which they "regularly exchanged information and collaborated".

Semi-structured interviews were conducted as supplementary data to triangulate and verify the actors' roles. These interviews provided more depth and detail on the main stances and the preferred policy options of the organization. The semi-structured interviews covered four topics: beliefs and interests; main challenges posed by REDD+; governance and consultation processes; and policy directions in terms of effectiveness, cost efficiency, equity, and other co-benefits. The analysis of these data focused on benefit sharing, equity, effectiveness, and challenges of REDD+ implementation, as these topics proved controversial and were thus useful for identifying opportunities and constraints. These topics also feature in the national strategy under debate within the Ministry of Environment and among network actors and therefore are highly relevant to the performance of REDD+ in Brazil (MMA 2011).

Initial analysis results from this research informed my fieldwork, especially my targeting at IPAM and its collaborators. Official final report of this research was not submitted to CIFOR until early 2012, but I had had preliminary analysis in late 2010. I highlight some of my analysis results here to demonstrate the importance and thus representativeness of IPAM, FAS and their collaborators in the REDD+ policy arena in Brazil.

From an internal point of view, IPAM and FAS were among the top four who claimed over 90% of their institutional efforts devoted to REDD+. While FAS was created

specifically to work on REDD+, IPAM's concentration on REDD+ had been a reorientation since late 1990s. In the semi-structured interview, Paulo Moutinho, the then director of IPAM clarified that since the approval of Kyoto Protocol and Clean Development Mechanism (CDM) as a flexible mechanism for emission reduction, IPAM became interested in exploring and promoting a mechanism, similar to CDM but, specifically for the emission reduction through reduced deforestation. As the REDD+ scheme has been emerging and taking shape, IPAM diverted more and more organizational efforts on REDD+-related research and policy consultation.

From an inter-organizational point of view, the network analysis of this research revealed the crucial roles of IPAM, FAS and their collaborators. The interviewees of this research were asked to "indicate those organizations that stand out as especially influential on domestic REDD policies". The measure of InDegree Centrality is adopted here to indicate the degree of influence of each organization by displaying the number of other organizations which identified this organization as "especially influential". The Table 1.1-appendix shows the basic descriptive statistics of data based the responses to this question. The measure of degree centrality includes also an index of Network Centralization which indicates the degree of the centralization of a network. As a result, IPAM has the highest InDegree Centrality since 41 out of all other surveyed organizations (i.e. 55) indicated IPAM as especially influential on domestic REDD policies in Brazil.

Table 1.1: Surveyed organizations and their InDegree Centrality based on perceived influence

Organization	InDegree Centrality	Organization	InDegree Centrality
IPAM	41	GTZ(GIZ)	15
MMA	38	MAPA	15
INPE/MCT	33	FBOMS	14
FAS	33	WB	13
CC/Pr.	30	GCF	12
MCT	29	CONAMA/MMA	11
GTA	29	ICV	11
ISA	28	Norway	11
IMAZON	28	CIFOR	11
FA	27	MF	11
TNC	27	Dep.Garcia/Câmara	11
WWF	26	FOE	10
MRE	25	EDF	10
SDS-AM	21	CNA	9
IDESAM	21	COICA	9
SFB/MMA	21	FUNAI	8
COIAB	21	IPEA/Pr.	8
OC	20	IBAMA	7
FGAL	19	CEBDS	7
INPA/MCT	18	SPVS	6
PPCDAM/MMA	18	FNDF	5
CI	18	UFMG	5
Greenpeace	17	Petrobras	5
SAE/Pr.	17	FGV	5
EMBRAPA	16	FUNBIO	4
CNS	16	ABIOVE	4
SEMA-AC	16	CONAFLOR/MMA	4
Vitae Civilis	15	ABRAF	3

Table 1.1-Appendix:

	InDegree Centrality
Mean	16.286
Standard Deviation	9.348
Minimum	3
Maximum	41
Number of Organizations	56
Network Centralization Index	45.752%

Another question regarding networking was "on which organizations does your organization rely on to obtain reliable scientific information on REDD". The measure of InDegree Centrality is adopted again to indicate the importance of each organization in providing scientific information for other organizations in the network. The Table 1.2-Appendix further below shows the descriptive statistics of this measure, including the network centralization index. The Network Centralization Index is 58.281% which could be considered as a high degree of centralization. It means that the providers of scientific information are concentrated on a small group of organizations in this network. As shown in Table 1.2, scientific information provision for this network is highly dependent on National Institute of Spacial Research (INPE hereafter, as from *Instituto Nacional de Pesquisas Espaciais* in Portuguese) and IPAM.

Table 1.2: InDegree Centrality based on scientific information source

Organizations	InDegree Centrality	Organizations	InDegree Centrality
INPE/MCT	36	FBOMS	2
IPAM	27	CONAFLOR/MMA	2
INPA/MCT	17	FOE	2
IMAZON	16	CI	2
ISA	12	FAS	2
EMBRAPA	12	WB	1
IPEA/Pr.	10	GCF	1
IDESAM	9	CEBDS	1
WWF	8	SPVS	1
SFB/MMA	8	MAPA	1
TNC	8	SAE/Pr.	1
CIFOR	7	COIAB	1
MMA	7	CC/Pr.	1
OC	5	MF	1
FA	5	FUNAI	0
EDF	5	FGAL	0
UFMG	5	ABIOVE	0
PPCDAM/MMA	4	COICA	0
IBAMA	4	MRE	0
MCT	4	ABRAF	0
FGV	4	CNA	0
GTZ(GIZ)	3	CONAMA/MMA	0
SEMA-AC	3	FNDF	0
ICV	3	CNS	0
Greenpeace	3	FUNBIO	0
Vitae Civilis	3	Petrobras	0
SDS-AM	3	Norway	0
GTA	3	Dep.Garcia/C âmara	0

Table 1.2-Appendix

	InDegree Centrality
Mean	4.518
Standard Deviation	6.604
Minimum	0
Maximum	36
Number of Organizations	56
Network Centralization Index	58.281%

The interviewees were also asked to indicate the organizations with which "your organization regularly collaborate concerning REDD related issues and politics", or simply put, to indicate the regular collaborators. Multiple analyses are made based on the responses to this question. InDegree Centrality analysis shows that IPAM and MMA have the largest number of other organizations that considered them as regular collaborators. The Network Centralization Index is 28.264% which is not high.

Table 1.3: InDegree Centrality based on regular collaboration

Organizations	InDegree	Organizations	InDegree
IPAM	21	CIFOR	5
MMA	21	Norway	5
WWF	12	MRE	4
COIAB	12	IPEA/Pr.	4
ISA	11	Greenpeace	4
TNC	11	FUNAI	3
OC	11	UFMG	3
GTA	11	ICV	3
INPE/MCT	11	IBAMA	3
IDESAM	10	FGV	3
EMBRAPA	10	CONAFLOR/MMA	3
CC/Pr.	9	PPCDAM/MMA	2
CNS	9	COICA	2
SDS-AM	9	WB	2
SFB/MMA	9	Vitae Civilis	2
SEMA-AC	8	SPVS	2
CI	8	ABRAF	2
FA	8	ABIOVE	2
IMAZON	8	Dep.Garcia/Câmara	2
GTZ(GIZ)	6	FOE	2
INPA/MCT	6	GCF	2
FAS	6	Petrobras	1
MAPA	6	FNDF	1
FBOMS	5	CONAMA/MMA	1
EDF	5	FGAL	0
MCT	5	CNA	0
SAE/Pr.	5	CEBDS	0
MF	5	FUNBIO	0

Table 1.3-Appendix

	InDegree Centrality
Mean	5.732
Standard Deviation	4.588
Minimum	0
Maximum	21
Number of Organizations	56
Network Centralization Index	28.264%

In addition, clique analysis is also made based on the responses to question about regular collaborators. In network analysis, a clique is a subgroup of the network in which each two of all actors (also called nodes) are connected directly with each other. In this case, a clique means a subgroup of organizations in which each two of them collaborate regularly with each other. In this analysis, five cliques are found, as shown in Table 1.4 below. IPAM is a member of four out of these five cliques, a fact that suggests IPAM be an organization very well embedded into the regular collaborative relations among the organizations of this network.

Table 1.4: cliques based on regular collaboration

Cliques	**members**
1	IPAM, ISA, CNS
2	IPAM, ISA, COIAB
3	ISA, CNS, EDF
4	IDESAM, IPAM, COIAB
5	IPAM, CNS, GTA

As illustrated above, the REDD agenda creates a new policy arena which puts various organizations into actor networks and political plays. It redeploys existing organizations such as MMA and IPAM for new tasks and even gives birth to new organizations such as FAS specifically working on REDD. A few organizations, such as IPAM and FAS, are standing out as coordinators or centers in policymaking processes.

IPAM is actually one of the best connected with multiple networks and I would argue it is the only one with a central role in all the fundamental fields, policy information distribution, scientific knowledge production and provision, and regular

collaboration with other organizations. As REDD is an innovative technical invention yet to be materialized as national policy, scientific knowledge, technological capacities and policy information related to REDD are also an important factor in shaping policy networks and policymaking processes. The provision of and access to information plays an important part in network dynamics especially in the early stages of REDD policymaking. The Ministry of Foreign Relations (MRE hereafter, as from *Ministério de Relações Exteriores* in Portuguese) thus stands out as a crucial provider of information, especially to other governmental organizations, and IPAM to a lesser extent has a similar role especially among non-governmental NGOs. The authority in scientific knowledge and technological capacities establishes the central roles of certain organizations in policy networks, as in the case of INPE—even INPE has not been outspoken or active in REDD policymaking processes—and to a lesser extent IPAM. These organizations are looked up by others for the formulation and later on the implementation of REDD policy or program in Brazil, more specifically the MRV (Monitoring, Reporting and Verification) of REDD.

CHAPTER 2

Baseline: Rethinking collaboration in scientific knowledge production

> *Baseline projections: Description of the most likely land-use scenario in the absence of the (proposed carbon emission reduction) project activity.*
>
> ——*Project Design Document of the Juma REDD+ Project submitted for carbon credit validation (FAS 2008)*

Paulo Moutinho is one of the key authors of the scientific model *Simamazonia* which predicts future deforestation scenarios in the Amazon (Soares-Filho et al. 2006). This model was used to calculate the baseline ("business-as-usual") emissions of the Juma REDD+ carbon project by predicting the future deforestation scenarios in the project area (FAS 2008). Moutinho was also a member of the scientific committee of the Juma Project and supportive of the baseline calculation of the project. In our interview in May 2011, our conversation went on the current debates in Brazil regarding REDD+ baseline. He was critical about the baseline approach to REDD+ project. I was thus confused: how could he be critical about the baseline approach overall, yet supportive of the application of this approach to a particular project? This confusion led our conversation to the particular social contexts of the techno-scientific practice of baseline calculation and opened up an emerging epistemic culture of collaborative scientists.

REDD+ (formerly RED or REDD) is a mechanism to reduce global greenhouse gas emissions by compensating actions of preventing deforestation and forest degradation

in developing countries. REDD+ stands for Reduced Emissions from Deforestation and forest Degradation. REDD+ was approved by the UNFCCC in 2009 as another flexible mechanism of emission reduction and credit trading in the global compliance carbon markets from 2013 on. However, REDD+ carbon credits, such as those from the Juma Project, have been traded in voluntary carbon markets before 2013. The Juma Project was an early pilot REDD+ project in the Brazilian Amazon (Viana et al. 2008). The calculation of the Juma baseline was conducted in 2007 and 2008 with the support and approval of the scientific committee, which included Moutinho and seven others. The member scientists of this committee had been doing crucial works related to REDD+ across the fields of science, policy and market. They did so through substantial collaboration with one another. Both the Juma Project and the *Simamazonia* model were good examples of their collaborative work.

Focused on these two knowledge products, in this chapter I examine the collaborative mode of scientific knowledge production in doing REDD+ related science in the contexts of global climate change mitigation and Amazonian deforestation containment. More specifically, I explore the so called "epistemological shift" brought by collaborative science practice, a shift from pursuing pure or universal truth to producing scientifically valid and "socially robust" knowledge (Gibbons 1999). As I will show, the scientists in collaboration are not only aware of the contexts, such as the policy and market relevance of their knowledge practice, but also voluntarily reflecting upon the implications of such contexts to their knowledge products and even integrating such contexts in their knowledge practice. I argue the voluntary reflexivity of collaborative scientists is productive and even essential to the epistemological shift. However, such

reflexivity has been largely informal or un-institutionalized. Based on ethnographic research, this chapter is aimed to capture and understand this informal culture. In this sense, this chapter demonstrates how ethnographic research may contribute to the project of "rethinking of science" (Gibbons 1999; Nowotny et al. 2001).

This research is based on fieldwork for 18 months from 2009 to 2011 in Brazil. The fieldwork included six months' daily work at the Sustainable Amazonas Foundation (FAS hereafter, as from *Fundação Amazonas Sustentável* in Portuguese) in Manaus and another six months at IPAM in Brasilia. Most of participant observation and interviews were conducted during my on-site work at FAS and IPAM. Additional fieldwork was conducted at FAS's and IPAM's regional offices and pilot project sites, especially the Juma forest reserve, and also at other involved institutions, such as the Federal University of Minas Gerais (UFMG hereafter, as from *Universidade Federal de Minas Gerais* in Portuguese) and the National Institute of Amazonian Research (INPA hereafter, as from *Instituto Nacional de Pesquisas da Amazônia* in Portuguese).

Challenged baseline

There have been various technical discussions over the baseline method of the REDD+ mechanism (Busch et al. 2009; Griscom et al. 2009; Huettner et al. 2009). Social scientists, many from the perspective of Social Studies of Science, have also looked into the issue of baseline calculation, especially its scientific (un)reliability amid all kinds of uncertainties and its political economic implications to the carbon markets (Lohmann 2005, 2010; MacKenzie 2009). Informed by these studies, this chapter, however, is not a

technical analysis of the scientific (un)reliability in baseline calculation of a specific project or the REDD+ mechanism in general.

A major part of the techno-scientific work to develop a REDD+ project is to establish the baseline (or business-as-usual) scenario of future deforestation and calculate the carbon baseline emissions in the project area (FAS 2011). The baseline method of carbon accounting was first adopted by the Clean Development Mechanism (CDM) under the United Nations Framework Convention on Climate Changes (UNFCCC). The REDD+ mechanism is an adaption of the CDM for reducing emissions from deforestation and adopts the baseline method of CDM as well. Any REDD+ carbon project eligible for carbon credit trading is required to prove that it achieves emission reduction "additional to" the baseline scenario (UNFCCC 2008; Michaelowa 2005). Or in other words, the project will reduce emissions below the baseline level, i.e. the expected level without the project intervention (see figure 2.1 below).

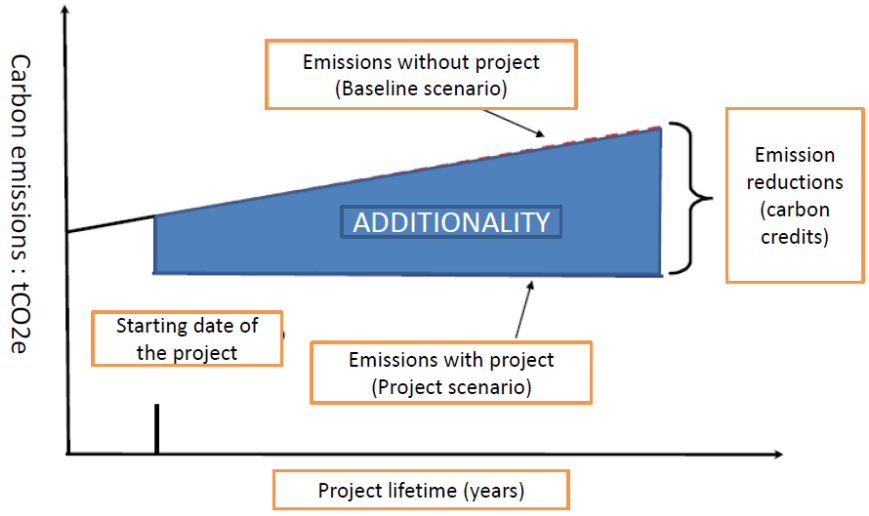

Figure 2.1: Figurative graph of "baseline scenario, project scenario and additionality". My adaptation from Cenamo (2009) and FAS (2011)

The Juma Project developers used the Simamazonia model (Soares-Filho 2006) to establish the project's baseline scenario (FAS 2008: 30-33). This model forecast eight scenarios till 2050 for the entire Amazon Basin in South America. One of these scenarios is the conventional "business-as-usual" scenario in which the low governance would continue as before and the predicted deforestation rate would be the highest among all the scenarios. This scenario projects deforestation trends based on historical deforestation rates, taking into consideration the effects of economic drivers, such as the planned road constructions, agricultural expansion and demographic changes. The Juma Project adopted the business as usual scenario from this model as its baseline scenario (see Figure 2.2 below). In this scenario, 65.8% or 3,661.5 km2 of the forest cover of the Juma reserve would be deforested by 2050. The other seven scenarios projected by the model take into consideration also the expected gradual increase in the government's influence and law enforcement in the region. Thus, those scenarios are more optimistic.

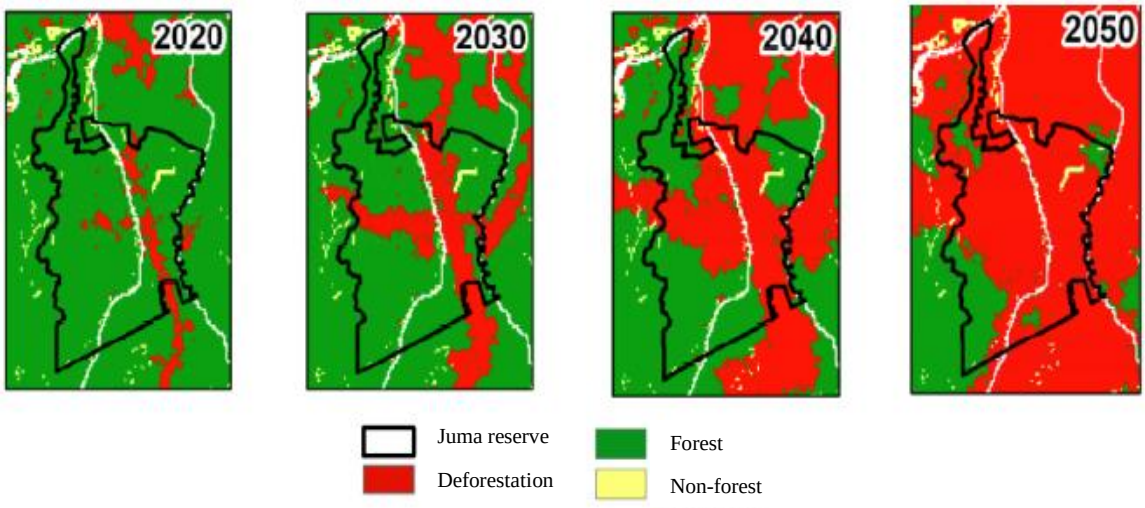

Figure 2.2: The baseline scenario of the Juma Project (adapted from FAS 2008):

business-as-usual scenario simulated by the Simamazonia model (Soares-Filho 2006)

However, there have been critiques on the baseline of this pioneering project, including an intensive case study of future deforestation of the Juma region. In her master degree dissertation submitted to INPA in 2010, Aurora Yanai analyzed the deforestation scenarios by using another model AGROECO. The AGROECO model was developed under the leadership of Yanai's advisor Philipp Fearnside, also a member of Juma Project's scientific committee (Fearnside et al. 2009). In the business-as-usual scenario of Yanai's simulation, 18.9% or 1,052.4 km2 of the forest cover of the Juma forest reserve will be deforested by 2050 (Yanai 2010: 107), less than a third of the deforestation in the business-as-usual (baseline) scenario of the Simamazonia model. Such a big difference in these two simulations seems to justify the concerns over the Juma Project baseline calculation and even over the reliability of the Simamazonia model.

The disagreement is centered on the determination of the uncertain dynamics of future deforestation. Social scientists have looked into the problematic of baseline building in carbon markets with (future) uncertainty as a central issue. They have made insightful critiques of scientific fallacies and contradictions in CDM project baseline calculation (for example, Lohmann 2005). They reminded the "trickiness" of baseline calculation as a techno-scientific exercise (MacKenzie 2009) and even criticized carbon project baseline as a simply "imaginary scenario" (Lohmann 2005, 2010). This chapter does not attempt to criticize any fallacy or contradiction in the baseline calculation of carbon projects. But rather, it takes up uncertainty as an analytical concept for the interpretation of scientists' collaborative practice and reflexivity.

Interfolding uncertainties

Uncertainty in science and policymaking has been studied by anthropologists among others. While real problems in the real world are infinitely complex, and for any given problem, science offers only part of the picture, certainty has always been favored and often believed as attainable (Funtowicz and Ravetz 1990; Jasanoff 2007). In this trend, many decision makers and advisory scientists believe that decision making ideally should rest on reliable and hence certain scientific knowledge. Called a form of modernity (Jasanoff 2007) or of scientism (Shackley and Wynne 1996), this trend has been a frequent component of decision making and policy practices, especially in areas related to environmental issues (for example, Jasanoff and Wynne 1998; Shackley 1995; Weale 1992). In this vein, uncertainty posed by the real world has been approached as a challenge to science and decision making and thus as a problem to be fixed. Indeed, as Sheila Jasanoff put in her recent article, "uncertainty has become a threat to collective action, the disease that knowledge must cure. It is the condition that poses cruel dilemmas for decision makers; that must be reduced at all costs; that is tamed with scenarios and assessments…" (2007).

Beyond the instinct to fix or cure uncertainty, other suggestions have also been made to approach uncertainty more realistically and effectively. For example, it is suggested to acknowledge the constant presence of uncertainty as an integral part, or rather an intrinsic limit, of science (Bradshaw and Borchers 2000). This section will look into uncertainties as both the object and context of science and policymaking.

The uncertainties in future deforestation dynamics, as in the above contestation between Yanai's study and Juma Project baseline calculation, pose great challenges to deforestation modeling and projection. Deforestation dynamics is constantly shaped by variables at multiple scales, such as national development policies, regional projects of highway construction, state initiatives of forest conservation as well as community or even family decisions on land use. Therefore, modelers would need dada of multiple scales as well to represent these shifting variables and the overall dynamics.

But for any scientists it is practically impossible to collect sufficient data at all scales, so sometimes modelers, as in the case of the Simamazonia model, would have to use data at one scale to represent that at another. One example was dealing with the super big municipalities which were not uncommon in the Brazilian Amazon. They are so big that the modelers were unable to set up sufficient sample areas and had to use data of only one or two sample areas to represent the entire municipality. "Even you know this is problematic, you cannot just leave this as a hole in our model. Modeling always has this drawback, so we try to do it with as much caution as possible," as put by Ane Alencar, one of the authors of the Simamazonia model, a veteran yet young scientist at IPAM. In a word, modeling always suffers from the insufficient representation of the constantly changing realities at multiple scales and as a result, it is always a simplification of complex and uncertain reality.

On the other hand, the whole field of climate change and carbon market making has been a highly uncertain policy arena (Whitington 2012). The evolution of the REDD+ mechanism in particular has never taken a well defined route. Its formulation and

function in the global and Brazil's domestic carbon markets are still under techno-scientific experimentation and political negotiation by the time of this writing.

Amid the policy uncertainties, the developers of the Simamazonia model were a major group of scientists among the earliest worldwide to push the REDD+ agenda at both national and international levels. Most of them are affiliates of IPAM. In 2000, out of the dissatisfaction with UNFCCC's decision on not including deforestation reduction in the Clean Development Mechanism (CDM), IPAM created its Program of Climate Changes with the mission to identify possible mechanisms to include "avoided deforestation" in CDM. At the COP 9 of UNFCCC in Milan in 2003, Moutinho representing IPAM proposed the scheme of "Compensated Reduction of Deforestation" which contributed to the emergence of the mechanism now termed as REDD+. Domestically, IPAM has been producing basic researches on climate changes and the Amazon Forests, such as the correlation between fire, drought and deforestation in the Amazon, as well as drafting policy proposals to governments. In 2011, IPAM published the book *REDD in Brazil: a Focus on the Amazon* (CGEE et al. 2011). This book, in Moutinho's words, basically provided a technical structure for "a REDD+ policy framework in Brazil".

The Juma Project was but a demonstrative project for policy lobbying. Since before the conception of the project, the project developers in the state of Amazonas had been trying to push the Federal Government to open up a policy platform to adopt and advance the REDD+ scheme. But at the time, Brazil's Federal Government was reluctant to adopt the REDD+ scheme, especially market-linked REDD+, according to Viana who later led the Juma Project. With the support from the then State Governor, they created a state

initiative based on the REDD+ scheme. Viana presented this initiative at the UNFCCC in Montreal in December 2005. In 2007, the Amazonas State legislature passed an ad hoc state law to institutionalize this initiative. More specifically, this law created the state program of climate change mitigation and Payment for Environmental Services (PES) and the semi-autonomous foundation FAS to implement this program.

But strangely, neither the state initiative nor the state law used the term REDD+ (RED, or REDD). In a long interview at lunch time in August 2011, I brought this up to Viana. He smiled in the middle of my question, signaling he had understood it before I finished: "We knew (at that time) that REDD+ as an international mechanism was still in discussion and construction. We were at a stage of pushing the agenda, so we could not produce a law (including the term REDD+ that might turn out to be) obsolete or overstepped depending on whether UNFCCC would go this way or that way." I further brought up the critiques of the Juma baseline, particularly the use of the Simamazonia model for baseline calculation. He reminded me of the lack of any previous example to draw for REDD+ baseline calculation at the time. Then he stressed that "at a moment of uncertainties (*incertezas*) ," they had to take the risks and move forward. One year later, Juma became the first validated REDD+ project among the 15 state forest reserves under the state program. Viana reemphasized that "The state initiative and the state law were moves to pressure and educate the Federal Government to move forward with REDD+".

The developers of Simamazonia model and the Juma Project were facing not only the uncertainties in the scientific work of modeling and calculating future deforestation dynamics, but also the policy uncertainties in the evolution of the REDD+ mechanism. These uncertainties are not unrelated from each other, but rather they interfold with each

other as in the calculation of the Juma baseline and in the technical design of the REDD+ mechanism. There has been a wide consensus since recently that an "age of uncertainty" has become the newly explicit environment to science and decision making (Gibbons 1999: C81; Nowotny et al. 2001; Strathern 2004: 466). Much of the earlier studies on uncertainties took for granted the two autonomous fields of science and decision making and went ahead discuss issues such as translation, communication and boundary works of the two separate fields (e.g., Funtowicz and Ravetz 1990; Jasanoff and Wynne 1998; Martin and Richards 1995; Shackley 1995; Shackley and Wynne 1996). However, the established separation between fields has been increasingly challenged by uncertainties that often interfold and cross demarcated domains. This challenge is particularly apparent at moments of perceived crises and disasters and calls for collective reactions (Callon 1998; Strathern 2004: 475), global climate change being a perfect current example.

Collaborative scientists

The interfolding uncertainties call for science to dialogue and engage with other disciplines, such as history, moral philosophy, political theory and social studies of science, and with non-academic practitioners, such as policymakers and the public (Jasanoff 2007). This is the case of the collaboration between the scientists in this study. Amid the uncertainties and complexity of deforestation dynamics and climate changes, neither an individual scientist nor scientists from single institution or field is capable to advance the REDD+ related science and the REDD+ policy-market. Scientists collaborate not only with fellow scientists from other fields, but also with non-scientists, such as government technocrats, business people and the public in general (Callon 1998:

262; Gibbons 1999: C83; Strathern 2004: 475). Such engagements further erode modern society's stable categorizations, namely the state, market, culture and science (Gibbons 1999: C81). Collaboration in knowledge production to address complexity and uncertainties has been increasingly prevalent and this phenomenon has been well noted in social studies of science recently (e.g. Callon 1998: 262; Gibbons 1999; Nowotny et al. 2001; Strathern 2004; Konrad 2012). Gibbons suggested "collective narratives of expertise" (1999: C83) need to be constructed:

> The limits of competence of the individual expert call for the involvement of a wide base of expertise that has to be carefully orchestrated if it is to speak in unison. Since expertise now has to bring together knowledge that is itself distributed, contextualized and heterogeneous, it cannot arise at one specific site, or out of the views of one scientific discipline or group of highly respected researchers. Rather it must emerge from bringing together the many different 'knowledge dimensions' involved. (ibid)

The scientific committee of the Juma Project is an advisory body to support and supervise the techno-scientific work of the project. It was convened by FAS, but institutionally external to FAS. FAS decided to use the Simamazonia model for the Juma baseline calculation and thus invited to join the project's scientific committee two of the leading authors of the model, Britaldo Soares-Filho of the Federal University of Minas Gerais (UFMG), and Paulo Moutinho of IPAM. One of the primary reasons for this

collaboration is that this model was, in Viana's words, an "independent" one. It is independent because none of the authors of this model was affiliate to FAS and the development of this model by the time did not integrate the scheme of REDD+ in it. Overall, the members of the scientific committee of the Juma project had different academic and institutional backgrounds. Indeed, it is the differentiation among the scientists that forms part of the initial condition for collaboration to be identifiable and productive (Strathern 2012: 109).

The Simamazonia model was developed through collaboration for much longer term. Before the Simamazonia model, future-oriented scenario research had been conducted and applied by IPAM in policy consultation. In 2000, IPAM officially started its research Program of Scenarios aimed to simulate future deforestation in the entire Amazon Basin resulted from infrastructure constructions. Daniel Nepstad, senior scientist of Woods Hole Research Center (WHRC, an American research NGO) and co-founder of IPAM, had known Soares-Filho from a joint project around the same time. In 2001, Nepstad invited Soares-Filho to collaborate with IPAM in developing the Simamazonia model.

IPAM and Soares-Filho's team at the Center of Remote Sensing at UFMG had complementary specializations and enjoyed productive collaboration. In this collaboration, Soares-Filho's team played the role of modelers. A modeler, in his own words, has the capability to construct models based on knowledge that often is not his own, so he works with those people who have knowledge but don't know how to represent that knowledge in a communicable language—he puts that knowledge into operation. Therefore, modeling is usually an interdisciplinary and collective work.

IPAM's job was first to delineate the framework of dynamics, including the variables and their correlations. Then a fundamental job was to do the basic research on the ground, in the forests and communities, to measure and generate the parameters, such as economic activities, vegetation regeneration and regional breakouts, which continuously "feed" the model. Soares-Filho was not trained in biology or forestry, so he had been not familiar with land use dynamics and its economic, ecological and social components; but he was skillful and efficient in representing and implementing the parameters and correlations in mathematical and computerized language. After ten years of working with IPAM, he became to know very well about the dynamics of land use change and deforestation. As a result, in Alencar's words, "he won, and we won; our collaboration never broke up, because we not only respect each other's participation but also build up each other."

The collaboration of scientists across varied fields brings forward the particular contexts of their science practice, as their collaboration juxtaposes and contrasts the institutional and epistemological differences between them. These differences give shape to multiple logics of science, or multiple "modes of knowing" (Barbira-Freedman 2012: 42), for instances, the search for pure universal truth and the pursuit of policy or market recognition of the baseline calculation.

Reflexive scientists

This section looks into the collaborative scientists' self-analytical and reflexive moments when the "many different knowledge dimensions" are brought together and interfold with each other. It discusses how such moments can be essential to the epistemological shift in knowledge production.

The Juma Project developers were well aware of the critiques of the Juma baseline calculation, such as by Yanai's study using the AGROECO model. Their responses to the critiques open up the multiple logics in the production and validation of knowledge products (Gabriel Ribenboim 2009, Mariana Pavon 2011, Viana 2011: interviews). According to them, the Juma baseline is certainly "scientific enough." First, it is based on the simulation result of the Simamazonia model which is published in *Nature*, a peer-reviewed science journal with highest credibility worldwide. In practical term, the Simamazonia model was the only available scientific tool specialized in Amazonian future deforestation projection at the moment of developing the Juma Project—even if it turned out to be inaccurate in retrospect years after. Second, it was built under the advice of a scientific committee made up of senior scientists and experts in related fields, including the leading authors of both the Simamazonia model and the AGROECO model.

Moreover, the Juma Project developers also referred to the market recognitions and REDD+ policy agenda advancement to legitimize the carbon accounting of the Juma Project, including its baseline calculation. In September 2008, the Juma Project received the validation in the category of GOLD, the first in the world, issued by the German audit firm Tüv Süd according to the Standard of CCBA (Climate Community and Biodiversity Alliance), a widely referred carbon project standard in the global voluntary carbon markets. The carbon credits generated by the Juma Project were successfully (pre-)sold to the Marriot Hotel International Network. After all, as discussed above, what is more important to the Juma Project developers is not about a single project or a single model. It is to demonstrate the idea that "it is possible to project future deforestation and eventually

to change the current paradigm of land use in the Amazon," as in Viana's words. He believed that they were on the right track to do so, through the Juma REDD+ Project.

That said, they recognized the imprecision of the Juma baseline calculation, as compared with the simulation results by the AGROECO model. But they considered this imprecision not as an unforgivable flaw specific to this project, but as a general problem in science. "Anyone from the science world," Viana said, pointing swiftly at himself and me in our interview, "knows that science is never precise and there is always margin error."

The difference in the results of projecting deforestation in the Juma region by the two models does not lead to a simple conclusion on which model is correct or better. It should be interpreted in the different modalities of these two forecastings. For one thing, the Simamzonia model covers the entire Amazon Basin of the South America continent. In contrast, the AGROECO model covers only the southeastern part of the Amazonas State that the Juma reserve. While both models had set up acceptable and similar ranges of margin errors, the margin error is relative to the spatial scale of the particular model. The margin errors of the two forecastings could be translated into big difference when calibrated to a same sub-area. In plain terms, it is always easier to represent the reality of a smaller region.

While among the author scientists of the Simamazonia mode, their approaches to the model, or to science in general, are not entirely the same. Beyond the shared fundamental positions, subtle differences emerged as they engaged with REDD+ projects. They shared the opinion that current science and technology were not capable of determining and quantifying future deforestation scenarios.

Or in short, there was "no ready solution for REDD+ (yet)," as put by Soares-Filho. In our interview at a campus restaurant in UFMG in 2009, he clarified that Simamazonia was not developed for REDD+, so it could be crude if used to establish baseline scenarios for REDD+ especially at the project level. In his opinion, any REDD+ project baseline was a speculation, too imprecise to be a scientific base for REDD+ carbon credit accounting. I reminded him that from the perspective of REDD+ project developers, there was not a perfect model for project baseline calculation. He agreed, and suggested they stop looking for such a model, "because they are running after a *Holy Grail*"—a model that can generate scientifically reliable simulation of baseline does not exist. In our meeting two years later in his office, he told me that he had been receiving a phone call every month asking him to do baseline simulation for REDD+ project. "One guy offered me up till one million dollars, but (I cannot do it ;) my career in science would be over if I do so," he laughed, and added "we must have a neutral science and cannot have our studies abused (by carbon speculators)."

Moutinho did not favor the model being used for REDD+ project baseline calculation either, for the same reason and beyond. He believed that for individual REDD+ projects, carbon project baseline would be inevitably imprecise but could be acceptable if calculated with caution—with support of further field research and adaptation to the local social-economic-ecological realities. As he had been more involved in policy consultation than Soares-Filho, he was more concerned with the technical and political uncertainties that baseline calculation of carbon projects would add to the emerging REDD+ carbon market. The Juma Project baseline was acceptable to him because it was a single project at a moment (2007) supposed to be experimenting with the technical and

political uncertainties. “But,” in my interview with him in 2011, he pointed out the difference in policy contexts, “REDD+ is now on the track to a national program and global markets.” In this new context, “technical imprecision or even worse, speculatively hyped imprecision in baseline calculation of many many individual projects will accumulate to a technical chaos beyond the accounting and regulatory capabilities of both national REDD+ regulation and global carbon markets”.

While the retrospective critiques of the Juma baseline such as by Yanai’s study were certainly legitimate in the position of conventional science, such critiques do not simply rule against the scientific validity of the Juma baseline calculation or that of the Simamazonia model. Rather, the validity of the two knowledge products is a question of negotiation between multiple logics of science, as the knowledge production process was carried out in a complex arena where multiple “modes of knowing” were at play. The self-reflections of the collaborative scientists as above were mostly enkindled by the difference between their own approaches and by their difference from the approaches of model users, especially carbon market speculators.

In the case of the Simamazonia model, the modes of knowing of the collaborative scientists vary, with Soares-Filho and his team more confined to the conventional neutral science and the IPAM scientists more attending to pragmatic aims. Together, the author scientists always take a strong hold onto reliable science and deal carefully with uncertainty and complexity associated with their model, while the model users, being other scientists, policymakers or business people, often seek certainty and deterministic solutions (Bradshaw and Borchers 2000). Even aware with the uncertainty and indeterminacies, the users of knowledge product tend to perceive it as more certain

(Collins 1992; MacKenzie 1990). The constant reflexivity of the Simamazonia scientists made themselves more conscious of their own approaches, more accountable to the collaborative relationship, and more daring to navigate in the uncertainties and unpredictable across the fields of science, policy and market.

Contextualized science

It has been argued that knowledge production is situated in the particular moment always filled with historical, political and cultural contextual forces (Haraway 1988; Latour 1993). As discussed earlier on, the contexts of the Juma Project and the Simamzonia model were characterized by the various kinds of uncertainties. The developers of the two knowledge product were not simply subject to these uncertainties, but rather they rode on these uncertainties, even created some of them. In short, they integrated the contextual forces to their knowledge work.

As the host organization of the Juma Project, FAS is not an academic or science institution. Its primary responsibility, delegated from the Amazonas state government by state law, is the management of state forest reserves for sustainable development and climate change mitigation. FAS's approach to baseline calculation is different from that of academia which may be called the "search for truth" universally reliable (Gibbons 1999); instead, it is particular to the moment of producing the specific knowledge. From the very beginning, the Juma Project baseline calculation integrated in itself both the best contemporary scientific validity and the expected market recognition. Moreover, the Juma baseline was supported by the project scientific committee, despite the retrospective critiques from some of the members, and was well recognized by the market, represented

by the project validation firms and the project credit buyers in this case. Therefore, both the production and the validation of the baseline calculation as a knowledge product were contextualized in the specific moment and extended from the conventional science community to the market. Such contextualization of knowledge production is not limited to the Juma baseline calculation or the knowledge practice of FAS, an institution more oriented towards policy and market; it is even more delicately negotiated and realized in the development of the Simamazonia model.

With the legacy from its prototypes that evaluate infrastructure effects on deforestation, the Simamazonia model has always integrated pragmatic aim which is to provide a scientific knowledge base for policy consultation in "territorial planning (or land use planning)." So the projected future scenarios were meant to be first as "an alert or alarm primarily to the governments, as Moutinho put it, "if you keep doing this and this (road construction and agricultural expansion etc.), you are expected to have so and so much deforestation by certain time in the future—business-as-usual (scenario), in a fashionable term."

The model was not directly involved with REDD+ until after the publication of Simamazonia 1 in 2006. The REDD+ mechanism was integrated into the upgraded versions of the model in sophisticated ways from 2006 on. The upgrading from Simamazonia 1 to Simamazonia 2 was focused on the integration of the economic factors (Soares-Filho et al. 2008). Technically speaking, the integration of economy into Simamazonia 2 was made by incorporating calculations of "opportunity costs of land use changes", a terminology from the technical conceptualization of the REDD+ mechanism which changed the language of the Simamazonia model. Calculation of opportunity costs

of land use changes, typically the conversion of primary forests to cattle ranch, soy plantation, small family farm, locates the potential risk of deforestation and thus improves the simulation of future deforestation scenarios, because economy is the process behind the decisions to occupy a forest land or not.

By incorporating calculations of opportunity costs of land use changes, the Simamazonia 2 anticipated and took into consideration the REDD+ scheme, although without specific reference to the term REDD+, as a significant financial resource for sustainable use and conservation of forest. More specifically, REDD+ could add extra economic incentives to sustainable agro-forestry production, such as sustainable harvest of brazil nuts, and thus make these areas resistant to destructive economic activities, such as cattle ranching. In their own words, the upgraded version of Simamazonia is aimed to geographically orient and channel the potential REDD+ investment."

Overall, the Simamazonia model had been well appreciated for territorial planning and policy consultation including for the REDD+ agenda both in Brazil and internationally. In Brazil, as aforementioned, the model was taken up to develop pilot state-level REDD+ project to push the national agenda. At the global level, this model and its simulation results were cited in the reports of IPCC (Intergovernmental Panel on Climate Changes) of UNFCCC and presumably supported the REDD+ agenda (IPCC 2007). This had a big impact, according to Moutinho, on the discussions about deforestation in the UNFCCC commissions since 2006 and even on the eventual approval of REDD+ in 2009.

Gibbons observed earlier that "research activities now transcend the immediate context of application, and begin to reach out, anticipate and engage reflexively with

those further entanglements, consequences and impacts that it generates" (1999: c84) not only across disciplines, but more profoundly across fields of academia, government and markets. The contextualization of knowledge production (Haraway 1988; Latour 1993; Gibbons 1999) is realized through the integration of the policy-market scheme in the model making. The model making anticipated and integrated its potential and/or intended social implications, "before it leaves the laboratories" (Gibbons 1999: c83; Strathern 2004: 474). Moreover, the model sought approval not only by the conventional science community by publication in the best science journals, but also by policymakers and the market world.

Such contextualized collaboration did not compromise the conventional ethics of neutral science, but rather concretely identified and maintained the conventional ethical line in the particular work. Again, this model stands for an epistemological shift from conventional science confined to itself. The product of such contextualized, collaborative science is of a special kind, "socially robust knowledge" (ibid).

Conclusion

The various uncertainties in climate change science and policymaking have long been problematic, as they undermine scientific authority and public trust and thus stymie decision making (Martin and Richards 1995, Shackley and Wynne 1996). The interfolding uncertainties, especially at moments of crises such as climate change and massive deforestation, call for science to dialogue and engage with other disciplines and other fields, such as policy and market (Callon 1998; Strathern 2004: 475; Jasanoff

2007). Even further along this line, Gibbons (1999) and Nowotny et al. (2001) proposed the project of "rethinking of science."

The techno-scientific exercises in promoting and operationalizing the REDD+ mechanism in Brazil open up the contemporary terrain of knowledge making that is full of uncertainties and complexity across the fields of science, policy and market. The REDD+ scientists and experts have voluntarily (re-)organized themselves into collaborations in both basic scientific research and more pragmatic knowledge making. The institutional and epistemological differences between them give shape to multiple logics of science, or multiple "modes of knowing" (Barbira-Freedman 2012: 42), with some of them more confined to the conventional neutral science, some others more attending to pragmatic aims, and others with an market approach to knowledge. However, collaboration alone, even across the established fields, does not guarantee effective engagements towards the rethinking of science. It is because the collaborative scientists yet need the reflexivity over the contextualization of their knowledge production.

Anthropologists have been observing techno-scientific knowledge practices facing the challenge of ongoing and future uncertainties and complexity that often reach the limits of existing methods of calculation and measurement. The in situ reflexivity in such knowledge practice has been called "experiment ethos" by some (Holmes 2009; Holmes and Marcus 2012). It is called so in the sense that the involved experts "understand that they must continually create agile theoretical accounts in order to capture the dynamic character of this global system and they do this with a remarkable degree of candor and reflexive acuity" (Holms and Marcus 2012: 139).

The experiment ethos emerges especially when knowledge practices extend across fields and knowledge production relies on collaboration between different modes of knowing. Thus, part of the experiment ethos is the curiosity or even the necessity to understand the particular perspectives of their collaborators and other fields. This "curiosity elsewhere" (Holmes and Marcus 2012: 129,132) is crucial to the collaborators' reflection upon themselves and upon the intellectual modality of collaboration. The collaborators' curiosity elsewhere has the potential to bring forward, and identify the conditions of, their reflexivity.

The anthropological interests in the experiment ethos among collaborative scientists facing contemporary uncertainties lead the ethnographic gaze of this research beyond the obvious boundary-crossing of collaboration and to the scientists' curiosity elsewhere and their reflexivity over collaboration. As in the development of the Juma Project and the Simamazonia model, the diverging modes of knowing enkindled critical discourses and reflections among the scientists. The constant reflexivity of the REDD+ scientists made themselves not only more conscious of the approaches of their own, but also more attentive to those of their collaborators. Their reflexivity is found to be essential to scientific knowledge production, as it leads to the contextualization of knowledge production. Without compromising the ethics of conventional science, the knowledge production process in both cases anticipated and integrated its potential and/or intended social implications. Moreover, the knowledge products sought approval not only by the conventional science community but also by policymakers and the market world. Such contextualized, collaborative science produced the so called "socially robust knowledge" (Gibbons 1999) or "Mode 2 knowledge" (Nowotny et al. 2001). It is in this sense that

such collaborative knowledge practice stands for an epistemological shift from more closed conventional science to more open and accountable science. In practical term, such knowledge is the kind of knowledge urgently needed by climate change policymaking.

CHAPTER 3

Additionality: the global political economy of knowledge production

> *Additionality: "Emission reductions resulting from each project activity shall be certified by operational entities … on the basis of: … (c) Reductions in emissions that are additional to any that would occur in the absence of the certified project activity."*
>
> *——Article 12 of Kyoto Protocol, Paragraph 5(c)*

"It was at the Super Bowl night in 2006 in Washington D.C., in the house of Mark London. Mark London is the author of the book *The Last Forest* (London and Kelly 2007) and a lawyer of the Marriott Hotels Network International. In his house, I and my wife were with the President of the Marriott and his wife, the then Governor Eduardo Braga (of the Brazilian State of Amazonas) and his wife, and Denis Minev (the to-be State Secretary for Planning and Economic Development in Amazonas) and his wife. It was a mess, with the football game, and a half American and half Brazilian dinner. In the middle of this mess, Mark London and I were thinking of making some partnership between the Amazonas state and the Marriott; he could do this because he was very close to the Marriott president. So, I did a calculation of offsetting Marriott's carbon emissions and got an amount as big as 50 millions of dollars. The President said, 'no, no way.' Towards the end came the cheesecake. I love cheesecake and I have been longing for it. After the cheesecake, I said, 'well, what if instead of you paying for the offset, we have

the guests pay?' He said, 'now we are in business.' So began the idea of the Juma REDD+ Project. … The Juma REDD+ Project with Marriott was an invention."

This was a story told by Virgílio Viana, the then Secretary of Environment and Sustainable Development (SDS) of the Brazilian state of Amazonas and since 2007 the Superintendent of the Sustainable Amazonas Foundation (FAS). Before this confirmation of his own in our interview in 2011, I had heard this story several times since I first started my fieldwork on REDD+ in Brazil in 2009, because this was often what I was told when I asked the question "how did the Juma REDD+ Project start". I was not present at the "messy" Super Bowl dinner. Even I had started my fieldwork at that time, I am afraid I would not be able to be present at this intimate social event of top elites of two countries. I was first gladly surprised by how fast and easy the deal was made. I was soon a bit disappointed by the same fact, because my research was intended to study the techno-scientific challenges of REDD+. I was wondering how such a big-money deal of a knowledge-intensive project could be made before any scientific validation of the project or scientific approval of its additional emission reduction. This is how this chapter starts.

This chapter explores the particular issue of additionality, a most decisive principle of carbon finance including REDD+. Additionality first refers to the environmental additionality in carbon finance, as differentiated from financial additionality which will be discussed later in this chapter. Greenhouse gas (GHG) emission reduction is not qualified for carbon finance unless proved to be additional to what would happen anyway without carbon financing. In other words, it is the additionality that makes GHG emission reduction creditable and thus eligible as the commodity exchanged in carbon markets or other non-market forms of financing. The

additionality of a carbon project is proved in the Project Design Document (PDD), a technical document produced under the strict guidance of a carbon project methodology.

The chapter will be focused on the Juma REDD+ Project and its associated methodology to discuss the techno-scientific knowledge practices in defining the additionality in the REDD+ mechanism and the global carbon finance broadly. Both this project and the methodology were produced though collaboration of experts from different institutional and professional backgrounds. This chapter will look at their varied approaches to and reflections upon the concept of additionality and the validation of this methodology. The different modes of knowing among these collaborative experts will lead to discussions about the techno-scientific, market and political roles of a methodology in defining and achieving additionality and beyond.

In so doing, this chapter brings forward the politico economic context of the knowledge practice (Haraway 1988; Latour 1993) in defining additionality and developing methodology, such as the established international knowledge authority regime under UNFCCC in this regard. The established knowledge authority regime poses challenges, such as high cost of methodology validation, to the "Third World" experts (in their own words), but they strategically contextualize their knowledge production practice in it in order to effectively appropriate the promised global financial resources. In such conscious contextualization of knowledge production (Gibbons 1999; Nowotny et al. 2001), the Brazilian REDD+ experts were contributing not only to the techno-scientific definition of (environmental) additionality of REDD+, but also to the achievement of the promised financial additionality of REDD+.

The "counterfactual" additionality

This section of the chapter will first briefly introduce the issue of additionality. Then it will discuss the varied approaches to the definition and understanding of additionality by the different scientists and experts who were collaborative contributors to the Juma REDD+ Project and the associated REDD+ methodology.

The achievement of additionality has been required for all compliance-based carbon offset projects (e.g. CDM, short for Clean Development Mechanism, and REDD+ from 2013 on) under the Kyoto Protocol and also extendedly for voluntary carbon offset projects (e.g. REDD+ before 2013) such as those under Voluntary Carbon Standard Association (VCS). Despite over a decade long of attempts to define and operationalize this concept, additionality remains the single most contentious issue in the development of carbon finance markets (Baumert 1998; Meyers 1999; Trexler et al. 2006; Streck 2010). Critics point out that "the most important reason for the controversies around additionality lies in its counterfactual nature that makes it impossible to ever prove additionality", because the absolute testing of additionality involves the establishment of the baseline (or Business As Usual) reference scenario against which reality is gauged (Streck 2010).

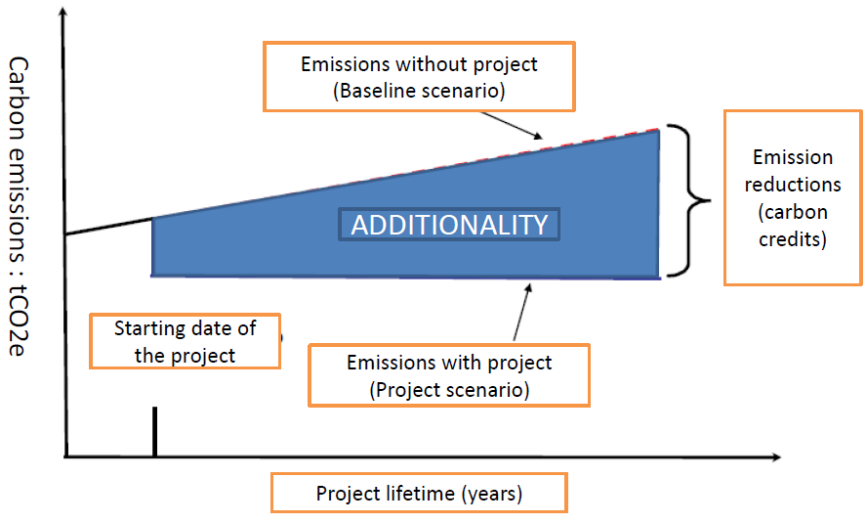

Figure 3.1: Figurative graph of "baseline scenario, project scenario and additionality". My adaptation from Cenamo (2009) and FAS (2011)

This chapter is not intended as a technical analysis of the additionality per se. But the discussions in this chapter will contribute to the debates over the additionality issue, such as its counterfactual nature, especially since the extension of the additionality requirement from CDM to REDD+ has been little studied (Doyle 2009).

The validation process of the focused methodology reveals the involved parties' approaches to the issue of additionality. The focused REDD+ methodology was a knowledge product of collaboration between scientists and experts of different institutional and professional backgrounds. This methodology was proposed officially by FAS and the BioCarbon Fund of World Bank. It was developed through the collaboration of experts of three institutions, the Costa Rican consulting firm Carbon Decisions International (CDI), the Brazilian research NGO Institute of Conservation and Sustainable Development of Amazonas (*Instituto de Conservação e Desenvolvimento Sustentável do Amazonas*, IDESAM) and FAS. It was approved in July 2011 by the

Voluntary Carbon Standard Association (VCS) as a REDD+ carbon accounting model for global use.

The methodology's instruction for determining additionality appears simple in content, but is loaded with history of evolution. This instruction has only two sentences and the first says "Additionality of the proposed AUD project activity must be demonstrated using the most recent VCS-approved 'Tool for the Demonstration and Assessment of Additionality in VCS AFOLU Project Activities'…", and the second a note (FAS 2011: 18). However, earlier versions of this methodology had very detailed step by step guidance on additionality for over ten pages long. During the process of validating this methodology, one of the two validators, the American NGO Rainforest Alliance, objected the original guidance and indicated clearly that "The methodology uses its own additionality tool when a very similar VCS approved one already exists. It should consider using the VCS tool for additionality" (Rainforest Alliance 2011: 30, 47).

The VCS validation process is a bureaucratic and authoritative one. VCS is a nongovernmental non-profit entity founded in 2008 by a group of most renowned international NGOs specialized on forests and/or climate change. It thereafter becomes "a global benchmark for carbon", as the slogan on its homepage says, and registers most of the carbon projects for voluntary carbon market and validates methodologies for global application. Thus, it is not surprising that the validators required the determination of additionality be consistent to VCS approach and thus applicable worldwide. The VCS validation process is a double approval process which involves two assessments, each by an independent third-party validator. In the case of the focused methodology, the second validator was the Norwegian firm Bureau Veritas Certification (BV).

On the other hand, the validation process of the methodology left out its rich and localized origin history. A comparative reading of the approved and earlier versions of this methodology finds out major differences between VCS additionality tool and FAS's own additionality guidance. FAS's own guidance has a step 0 "Preliminary screening based on the starting date of the REDD project activity," while the VCS additionality tool does not (VCS 2010), before the almost identical four steps. The step 0 in FAS's own guidance is crucial in proving the additionality, at least of the Juma REDD+ project whose Project Design Document (PDD) was the base for the development of this methodology.

The additionality of the Juma Project is seemingly very questionable. As the Juma area had been already demarcated as a state reserve committed for forest conservation in 2006, it seems to be illegitimate for the REDD+ project initiated in 2007 to claim the deforestation prevention in Juma as additional GHG emission reduction. The PDD of the Juma Project uses over two pages under the step 0 of determining additionality to prove the deforestation prevention in Juma as effort incentivized by REDD+ carbon finance and thus additional to the local business-as-usual scenario (FAS 2008a: 157-159). In brief, the state reserves including Juma were created anticipating an international carbon finance mechanism that afterwards took shape as REDD+. Even further, Juma had been intended as a pilot project to push the domestic as well as international policy agenda of REDD+. This political venture was orchestrated by Eduardo Braga, the then governor of the Amazonas state, and Virg ílio Viana, then Professor of University of S ão Paulo and later the Secretary of Environment of the Amazonas State. So the Juma REDD+ certainly has

additionality given the political speculation by the collaboration between politician and technocrat in planning the project.

The policy speculation in REDD+ proved the additionality of the Juma Project but brought challenges to legal work. The REDD+ carbon credits of the Juma project were successfully presold to the Marriott Hotel International Network in 2008. Dr. Ludovino Lopes was the consultant lawyer who drafted the contract of sale of the Juma carbon credits. Ernesto Roessing was the then director of the Amazonas State Center of Climate Changes and later colleague of Ludovino Lopes. Roessing had been closely involved in the "sale" and explained to me in our meeting in Manaus in 2011 about the contract: "in legal terms, it was actually not a sale, but a contingent donation." Upon my puzzled face, he further clarified, "a donation contingent on future results of forest conservation: you receive that money (from Marriott) only if you prevent the expected deforestation; this is the logic of contract." The contract was also an "innovation" in Virgílio Viana's word, because it was created when the REDD+ mechanism was yet an indeterminate policy proposal in international negotiations and did not have a proper legal framework in Brazil to rely on. Nonetheless, this contract realized the conception of REDD+ including the principle of additionality.

Lopes and Roessing further reflected upon their approach to REDD+ and the additionality issue specifically. In Lopes's words, "the major challenge of this (legal) innovation is how to translate the scientific concept into a legal question, to transform carbon into something possible for transaction by using available legal norms." In a word, their legal approach to additionality is a pragmatic translation of scientific concept into operational legal terms, while personally they were critical of the scientific

conception of additionality. Roessing lamented that carbon credit was a "virtual or intangible" commodity, because the whole carbon finance (including CDM and REDD+), maybe except only reforestation in CDM, is based on a "counterfactual presumption" which is "a question for the methodology to test."

This section so far demonstrates different approaches to and reflections upon the additionality issue. Despite the chronic controversies over additionality, the global carbon validators held a self-assertive and bureaucratic position on this issue at the risk of losing local particularities of project and methodology. Politicians and technocrats in the Amazonas state had an early and quick grasp of the conception of additionality and took advantage of it through political speculation. While critical to the scientific conception of additionality, the lawyers' approach to this issue in their practice was very pragmatic and grounded in the legal framework available at the particular moment. The differences between the various approaches to the additionality bring forward the specific political economic contexts of the different fields of expertise in understanding and determining additionality.

The validated methodology

It is reasonable to expect a REDD+ methodology to provide a scientifically sound solution to the additionality issue. This section will look into how the focused methodology deals with this issue, why in this way, and what it means to the methodology as a knowledge product.

The critique of the counterfactual nature of additionality is resonated by the concerns of the author scientists of the methodology. Gabriel Carrero is one of the key

contributors to the techno-scientific work of both the Juma Project PDD and the methodology. In an interview over coffee in the backyard of the IDESAM office, I raised the question of uncertainty in scientific research related to REDD+. His first response was about the issue of additionality: "(because) it's counterfactual; once a project is carried out, you will never know what would really happen (without the project), whether the area would be deforested as expected or not."

More specifically, he was concerned with the simple extension of the concept of additionality from CDM to REDD+. First of all, "it's easier to determine the additionality of replacing a factory boiler that burns coal with another that burns natural gas and then to say so much emission was reduced." It is also easier "to account the additional reduction of CDM by using the books of standardized emission indices of fossil fuels although the risk of uncertainty is big too." But in the case of REDD+, he continued, "it's even more complex; you have to seriously prove step by step the deforestation pressures, the measures of preventing the predicted deforestation" in the specific areas of individual projects. So in terms of scientific validity, REDD+ "demands much more scientific and technical efforts to make sure." Carrero was actually calling for more thorough and case-specific basic research to reduce if not offset the unverifiable uncertainty in the additionality test. It is not surprising for him to propose this righteous scientific approach, as a young yet veteran scientist in the IDESAM, concentrated on foundational research work and little involved in project implementation or policy debates of REDD+.

However, the overall strategy to address the additionality issue in the methodology did not follow Carrero's approach. The first version of the methodology was developed in 2008 soon after the approval of the Juma PDD and was posted on FAS

website for open consultation. The instruction for additionality in this version had just one sentence, indicating the use of latest version of the CDM tool for additionality (FAS 2008b:9).

In later working versions including the one submitted for VCS approval in 2010, the methodology used its own guidance for the determination of additionality, as observed by the validators aforementioned. This guidance was adapted from the methodology module proposed by the Avoided Deforestation Partners (ADP). ADP is a US-based non-profit think-tank founded in 2007, "dedicated to advancing U.S. and international forest and climate protection initiatives" according to the mission statement on the organization website[13]. One of the ADP's initiatives since 2008 was to propose REDD+ methodology modules to facilitate the development of REDD+ methodologies worldwide. However, the additionality guidance in the methodology, as adapted from the ADP, was rejected by VCS.

At last, the final approved version of this methodology simply indicates the use of the readymade VCS methodology tool for additionality. As discussed above, it had to do so, because the validators requested so. VCS methodology tools are readymade accounting modules which would be preapproved if adopted by proposed methodologies, despite the particularities of each proposed methodology, such as the local intellectual origins and pilot project backgrounds. Ironically, later, the ADP methodology module on additionality was approved as a VCS methodology tool.

The evolution history of the additionality section in the methodology raises three issues. The first is the VCS validation process is not only self-assertive in its knowledge authority, but also very bureaucratic in prioritizing its procedural uniformity at the risk of

[13] http://www.adpartners.org/

disregarding the scientific validity of original proposals. Second, the methodology proponents in this case had used the CDM, ADP and VCS methodology tools for additionality consecutively as the three became available one after another. That means they had been always using the methodology modules most recognized in the international regime of knowledge authority in REDD+ at the particular moments. Third, as constantly looking up to the established international knowledge authorities, the methodology proponents' own knowledge production was fettered and not exactly in the direction of "more scientific efforts" as suggested by Carrero. To a significant extent, such limited knowledge production is a result from the discouragement by the international knowledge authority regime and its bureaucracy.

"Now the methodology can be used worldwide in voluntary markets." In our interview in FAS's meeting room in Manaus soon after the approval of the methodology in 2011, Virg ílio Viana, the Superintendent of FAS, reemphasized this fact with a confident smile. But "why to validate this methodology with VCS?" I brought this layman question to him. "It's because we need international recognition. Which is the best platform today for this? VCS. And which are the best validators for VCS? The two we used." I understood that but I was wondering a probably even naïver question in my mind: since the Juma Project was already considered as an international success, why cannot you just share the experience and knowledge directly with other project developers. Viana noticed my pause but continued by himself, "FAS has a profile of international leadership. But it doesn't help that we say we are doing something; it means little. You have to have a certification for your knowledge from someone independent and with credit….A certification is a form to say to the public that it is good according to

these criteria. This is good for our institutional strategy to consolidate our image and to strengthen our voice."

The written certification of this methodology enhanced significantly certainly FAS's international leadership in developing REDD+ project. Part of this international recognition was realized right away. Domestically, the methodology was successfully applied to the Suru íREDD+ project in another Brazilian Amazon state, Rondônia (IDESAM 2011). At abroad, the Environment Ministry of Mozambique has reached FAS for international cooperation to develop REDD+ programs with FAS's expertise and methodology.

The evolution of the methodology described as above is intended neither to question the intellectual integrity of individual scientists, experts or validators, nor to object scientific validity of the involved methodologies or methodology tools. It attempts to reveal the politics in expert knowledge production and how the politics may shape the process of knowledge production, such as the self-assertive and bureaucratic international REDD+ knowledge regime that allows little space for grassroots scientists' original contribution, as well as the political ambitions loaded in their knowledge production practice. While additionality has its counterfactual nature, the knowledge practice addressing it also has the nature much beyond the supposed scientific or factual pursuit. The rest sections of this chapter will make further discussions in this regard.

The financial additionality

This section revisits the concept of additionality and discusses its financial component. Climate changes as complex global problems require collective commitments

of all the countries for long-term sustainable management of natural resources. However, developing countries refused responsibility for global problems that affected all but were the tainted legacy of developed countries' historical patterns of industrialization and consumption (Streck 2010). Consequently, developing countries made their actions conditional on the availability of new and additional resources from developed counties for climate change mitigation activities (UN 1990). In other words, the full conception of additionality is based on the causality between international financial support from developed countries and contribution to global climate change mitigation by developing countries.

More specifically, financial component of additionality originally meant that no public money in developing countries would be spent on climate change mitigation activities in the context of UNFCCC (Jordan and Werksman 1994; Dutschuke and Michaelowa 2006). The original conception of additionality in UNFCCC indicates that

> The developed country Parties…shall provide *new and additional* financial resources to meet the agreed full costs incurred by developing country Parties ... They shall also provide such financial resources, *including for the transfer of technology*, needed by the developing country Parties to meet the agreed *full incremental costs* of implementing (the) measures ... The implementation of these commitments shall take into account the need for *adequacy and predictability in the flow of funds* and the importance of appropriate burden sharing among the developed country Parties…" (UN 1992, my italics)

The promised financial resources including necessary knowledge transfer were exactly what the Juma Project and the methodology were seeking. As discussed earlier in this chapter, the politicians and technocrats of the Amazonas state created the state forest reserves anticipating the financial additionality promised by the policy regime of UNFCCC. Actually the state government of Amazonas had never had its own budget to implement the conservation and sustainable development activities in the reserves anyway (FAS 2008a), which justified the environmental additionality of the Juma Project (Tüv Süd 2008).

The coordinator of the Amazonas State Center of Conservation Units[14] (*Centro Estadual de Unidades de Conservação*, CEUC) explained this situation in more practical terms in our interview in August 2009. The state forest reserves had been established together with the state Forest Allowance Program (*Programa de Bolsa Floresta*). With its theoretical origin from Payment for Environmental Services, the Forest Allowance Program was to remunerate the forest land users for their contribution to forest conservation and sustainability of environmental services. Broadly conceived, the financial origin for this program did not have to be carbon market; it could be money from water companies like in the case of Costa Rica based on the water conservation service of forest, or from pharmaceutical or cosmetic companies for the value of biodiversity. However, he pointed out, "Now the carbon market is coming out to be more promising."

[14] Conservation Units in the Amazonas state include the state forest Reserves of Sustainable Development (*Reservas de Desenvolvimento Sustentável*, RDS), such as Juma.

This approach was shared by scientists in Amazonas as well. For example, IDESAM had carried out long term research on the sustainable production chains in southern Amazonas in which REDD+ was but one piece of the puzzle. More specifically, REDD+ was considered as another important way to appropriate financial resources for forest conservation, a source that they could not simply discard. In Carrero's mind, he would rather they could discard REDD+, because that would reduce the complexity in research work. "But we cannot; and we do have the expertise to do this," he affirmed, "So we've been doing the things that we foresaw to do with money from carbon market. We managed some carbon finance resources that are still developing." The REDD+ projects in Juma and Suru íwould be two examples of such achievements.

But there have been also frustrations that Carrero did not understand clearly. In the work of composing the Suru íPDD, he heard that the Suru íproject had to pay money for using the FAS methodology as technical guidance. FAS and World Bank paid the validation fees and thus owned the copyright. Even Lucio Pedroni as the principal author or IDESAM as a major contributor have to pay FAS and World Bank if they want to use the methodology. Carrero had not known that a methodology would have copyright. In his words, "I found it weird. It's another story, of economy. Virg Ílio (Viana) must know more about this." He suggested at last.

Viana and his colleagues at FAS completed the "economic story" of the methodology for me. First of all, "it cost a lot money to validate a methodology," as Viana put simply. Each step of developing the methodology involved big amounts of financial costs to FAS: mainly contracting CDI and IDESAM for research and composition, contracting the Rainforest Alliance and the Bureau Veritas for the

validation, and submitting to VCS for the approval. FAS could not afford all these costs by itself and Marriott provided extra financial support for the methodology development. Right before the validation of the methodology, FAS's methodology which was focused on frontier deforestation and World Bank's on mosaic deforestation were combined into one for the final validation. A major reason for the combination was World Bank's financial capability and thus reduced cost to FAS.

The usage fee that FAS and World Bank would receive for the methodology is officially called "compensation" for methodology developers, according to VCS[15]. Project proponents, the Suru íindigenous people in the case of the Suru íREDD+ Project, would pay USD 0.1 per VCU (Verified Carbon Unit, one ton of equivalent carbon emission reduction) of "VCU Issuance Levy" to the VCS first. And then VCS pays a portion of this levy to the methodology developers as "compensation." According to Viana, the compensation rate is really low, "about one Brazilian centavo (USD 0.005) per VCU more or less." I asked him whether this was an objective of the methodology validation. "Maybe the third objective, because the financial return from this is really small," he answered. The first two objectives will be discussed later in this chapter. Besides, compensation from VCS to methodology developers had not existed yet in 2009 when FAS initiated the validation process.

Transaction cost issues like this raise the concerns with the efficiency of REDD+. Britaldo Soares-Filho, professor of University of Minas Gerais and member of the scientific committee of the Juma REDD+ Project, raised this question straightforwardly

[15] See VCS Program Guide http://v-c-s.org/sites/v-c-s.org/files/VCS%20Program%20Guide,%20v3.4.pdf and VCS Program Fee Schedule http://v-c-s.org/sites/v-c-s.org/files/Program%20Fee%20Schedule,%20v3.3.pdf for details. Access at December 29th, 2012.

in our meeting in July 2010. He was afraid that "The financial resources stay in each hand in the transaction and don't reach the land users who are the ones really doing the emission reduction." He took the Forest Allowance Program in the Amazonas state (of which the Juma Project is a part) for example: "how much money went to the intermediary agencies, how much reached the Forest Allowance Program? I am not saying the Program is bad; I am saying if you analyze the efficiency of REDD+... lots of pockets on the way to the actual land users…" he laughed out loud and stopped here for this topic.

Along with the high transaction cost of REDD+, the uncertainty in the carbon finance policy evolution also added to Carrero's frustration. He regretted that the financial resources in the voluntary carbon market never came "as they should", while the bigger source, the compliance-based market, was not clear in when and how to officially include the REDD+ mechanism—"there are good signs and there are setbacks." As to the broader context of UNFCCC, he confessed, "this is what I really don't have experience with; I am not sure about what is happening and where it goes, because it's really a matter of the political and economic interests of all the countries, a matter difficult to understand."

The individual and organizational frustrations with the financial problems of REDD+ led to the reflections over of the financial additionality of REDD+ and the global carbon finance regime in general. Politicians, technocrats and scientists had been in collaboration to appropriate the financial resources promised by the global carbon finance regime. However, soon after their involvements with REDD+, mostly the technical design of pilot projects and the development of a methodology, they experienced the

frustrations with the unexpected financial barriers, low cost-efficiency and international policy uncertainty in this field. Such frustrations led them to questioning the deeper issues of financial additionality, such as the transaction costs of REDD+ in technical terms and the political economic struggles in international negotiations. Their reflections help to further contextualize and shape their practices of knowledge production, in this case, to further develop the methodology and push the REDD+ agenda to tackle the current challenges of financial additionality.

"The Third World methodology"

This section will discuss how the methodology was developed in broader politico economic contexts. More specifically, how the contextualization of knowledge production practice could be integrated into and contribute to the knowledge production, as well as how such knowledge production could facilitate in turn not only the techno-scientific definition of environmental additionality but also the achievement of financial additionality.

One evening in early July 2011, I was invited to a late *Festa Junina* party (the June Festival or also called the St. John Festival) in Manaus. The party was in a big house which housed several young employees of IDESAM. I arrived early to help start the bonfire in the backyard and I was a bit surprised to see Carrero, one of the tenants of this house, reading the famous leftist political history book "Open Veins of Latin America" (Galeano 1997[1971]). I asked him what he thought about this book. He said he was not sure yet, because he just started reading it in the wait to use the shared shower room. The book actually belonged to Renán, another tenant of this house and curator of the database

and digital library of IDESAM. It turned out that most of the young professionals involved with REDD+ in government, NGOs and academia in Manaus came to this big party. After several rounds of food and drinks, I saw Carrero reading the book again in a corner of the yard. I went to talk with him again. He told me he always read a lot but mostly in his own field of forest engineering and conservation, while this book was different, because he "had never thought about this country or this continent in this way before."

Our short talk about the book was interrupted by the late arrival of Mariano Cenamo, the founder and the then Adjunct Executive Secretary of IDESAM. Still wondering what Carrero said, I was reminded of an even bigger and more formal gathering almost two years before the night also in Manaus. It was the First Latin American Symposium of REDD+, organized by the Amazonas state government and the FAS in September 2009 and convening technocrats, experts and scientists in the governments, NGOs and academia across Latin America. As a key author, Cenamo presented the methodology which was to be submitted for validation at the time. Off his PowerPoint slides, he said proudly that "this methodology will be the first one developed by Third World scientists!" I thought it was just something nice to say given the origin of the audience; no more than that, until this Festa Junina Party. Soon after the party, I brought out this topic at another interview with Viana, starting with a less political tone.

Zhang: It seems among the four or five existing REDD+ methodologies worldwide up till now, this is the only one of Brazilian origin?

Viana: Yes, and the only one from a developing country; all the others are from US and Europe.

Zhang: Do you mean that the others might be different in some sense?

Viana: Yes. I think all the difference comes from the process of developing a methodology which, as in the case of the FAS methodology, is more possible to be coherent with our reality, to be closer to the reality in developing countries….It's more possible to find solutions for REDD+ in Africa based on Brazilian experience than based on experience from Canada or Finland. They have forests as well, but with a reality totally different!

Zhang: In what sense? Because they don't have tropical forests?

Viana: This is the obvious difference; beyond the obvious, there're social, economic, cultural and political differences, huge ones. That's why when the Africans came here to know our project in Juma, their reaction was 'It's similar to what we have in Africa; what you do is applicable in Africa.' In the least sense, Brazil is a little better than Africa and so and so, but not a big leap forward as from Africa to Canada or Finland. Just like if you come from the poorest inland China and go to some rich place in Japan, the distance is so big that people don't even know how to start. But now if you go to some place just a little better, you manage to see how to move forward. You understood? That's why I am a big advocate of South-South cooperation.

The South-South cooperation was the second objective endowed in the FAS methodology, although originally more intended with other Latin American countries, especially other Amazonian countries. Practically, such cooperation can be expected to bring financial return to FAS as well by the methodology usage fee. The primary objective of the methodology, in Viana's word, was its application in other forests of the Brazilian Amazon, especially other state forest reserves in the Amazonas State where FAS had been delegated by the state government to carry out the state Forest Allowance Program.

However, the application of the methodology, although validated by VCS, to more Amazonian forests was far from an easy task. One strategy for the wider application of the methodology was to further intensify its "closeness to the Third World reality." The further knowledge practice based on the methodology would be a good example in this regard.

Around the same time in mid 2010, two REDD+ guidance documents came out. One was the *REDD+ Social and Environmental Standards*, led by two international organizations, the Climate, Community and Biodiversity Alliance (CCBA) and the CARE International (2010). The other was the *Princípios e Critérios Socioambientais de REDD+ na Amazônia Brasileira* (in English *Socio-environmental Principles and Criterias of REDD+ in the Brazilian Amazon*, IMAFLORA et al. 2010) proposed collectively by a group of Brazilian institutions, including mostly NGOs but also environmental certification institute IMAFLORA, Public-Private foundations such as FAS and environmental business investor Biofílica. Both documents were intended to

provide reference for future REDD+ projects or programs to respect the rights of indigenous or other local residents as well as to generate multiple co-benefits, such as social and biodiversity benefits other than GHG emission reduction only. Right after the official VCS approval of the methodology, FAS initiated the design of the monitoring indicators for the Forest Allowance Program which includes the Juma Project. The design of the monitoring indicators incorporated both the CCBA-CARE Standards which had international credibility and the Brazilian Principles and Criteria which had legitimacy in Brazil.

Actually Viana suggested to base the monitoring indicators more on the Brazilian Principles and Criteria. The Brazilian Principles and Criteria were more calibrated to the Brazilian Amazon, in terms of both the particularity of the Amazonian biome and the legal-economical-cultural specificities of the Brazilian Amazonian society. Therefore, the monitoring indicators based more on the Brazilian document would bring "bigger legitimacy", in Viana's word, to the experiences of the program, especially the methodology as its essential knowledge product.

Besides the intensification of closeness to Third World reality, another direction to facilitate wider application of the methodology falls back to the legal approach to REDD+. After raising his concerns with the financial efficiency of REDD+, Soares-Filho critiqued FAS's project-based approach by then to REDD+ in our interview in 2010. "I have disagreements with FAS on—I am not against FAS or its individual projects; as they started with REDD+, I even participated in the Juma Project. But I think we have to evolve REDD+ to another level, an approach more integrated (in) and more consistent with, let's say, the public spheres." Recalling the high transaction cost issue of REDD+

discussed earlier in this chapter, it was very costly to operationalize the REDD+ mechanism by individual projects, like Juma, each through the multi-step process of transaction with various intermediary agencies involved. An increasingly heated agenda regarding REDD+ in Brazil by this time was to build a REDD+ system of much larger scale, at state or national level. The "public spheres" in Soares-Filho's words referred to this emerging regional or national REDD+ policy structure which would be primarily founded in REDD+ legislation.

REDD+ legislation had been another field invested with collective efforts and expertise of the politicians, technocrats, lawyers and scientists behind the Juma Project and the FAS methodology. Around the time of Soares-Filho's critique in my interview in 2010, Eduardo Braga, governor of the Amazonas state since 2002, renounced in the middle of his second term to run for the election of the Brazilian Senate. Soon after his success in election, he presented his REDD+ law bill to the Senate in March 2011 aimed to install a national system of REDD+ in Brazil (Braga 2011). Before this federal law bill, during Braga's governorship, a state law on Payment for Environmental Services and climate change mitigation was drafted under the leadership of Viana's State Secretariat of Environment and Sustainable Development (SDS) and was passed in 2007 in the Amazonas state legislature, and another state law bill specifically on REDD+ had been drafted since 2010. A friend and legal consultant to Eduardo Braga since before the Juma REDD+ contract, Ludovino Lopes was the leading legal specialist in drafting Brazil's first state law bills of REDD+ including those in Amazonas and Acre, and participated in drafting the federal law bills on climate change and carbon finance.

Ludovino Lopes and his once colleague Ernesto Roessing further explained to me in our interviews their approach to the REDD+ legislation. To "translate the scientific concept of REDD+ into legal concept," in Lopes' words, the fundamental principle was to make possible the legal transference of the right of "carbon as fruit of land, rather than part of the land property or something well connected to the land tenure." Roessing further clarified this principle in a more contextualized way: a big challenge to REDD+ "here in the Amazon is that the major part of land doesn't have title, or that those who live on the land don't have land title. When you have land title, the carbon right is very clear for assignment and transaction; but if you don't have land title, can you still own or sell carbon right, can you still do REDD+? If you cannot, the majority of the Brazilian Amazon will be out of REDD+!" This was why they had to construct a national REDD+ system which would disconnect REDD+ from land title: to make most of the Amazon eligible for REDD+ and those title-less Amazon residents eligible for the REDD+ benefits.

A national system of REDD+ would address the issue of high transaction cost as well. In Roessing's understanding, the project-based approach to REDD+ had the legacy from the CDM model, but "now in 2011 we are transcending that approach and agreeing upon a national or sub-national (regional) one." Although by the time of writing, the technical details of the national system were still undetermined yet, for example, whether REDD+ accounting at national level only or also at state level, and whether reference level for carbon calculation and monitoring based on biome, land tenure category, state or municipality (Braga 2011; CGEE, IPAM and SAE 2011). But no matter which option, what combination of the above options, will be the final solution, the design, validation,

accounting and monitoring of REDD+ in Brazil would be carried out at a scale much larger than that of individual pilot project such as Juma. Such a wholesale approach, if I may call it, would significantly reduce the transaction cost of REDD+ and as expected facilitate the wider application of existing knowledge experience of REDD+, such as the FAS methodology.

To sum up, this section discusses the collaborative experts' knowledge practices in a broader politico economic context. Some of them consciously identified themselves as Third World scientists and their knowledge product, such as the FAS methodology, as closer and thus more applicable to the Third World reality not only in Brazil but also in other developing countries worldwide. The closeness and the applicability of their knowledge products to the Third World reality were strategically pursued in their knowledge practice. One example was the designing of the Forest Allowance Program monitoring indicators as a technical tool supplementary to the methodology. Another was the ongoing REDD+ legislation which aimed to make more Amazon forests and residents eligible for REDD+ benefits.

Some others of them, such as Soares-Filho, reached indirectly the global politico economic question through critical reflections over their REDD+ efforts, especially the efficiency question. In this regard, the closeness of the FAS methodology to the Third World reality might increase the financial return from wider application of the methodology in South-South cooperation. But more importantly, the ongoing REDD+ legislation would become the foundation of an emerging national REDD+ system which will establish a wholesale approach, instead of project-based, to REDD+ and thus significantly reduce the transaction cost to REDD+.

At last, in addressing the techno-scientific and legal issues of REDD+, the contextualized knowledge practices as illustrated above not only build up their expertise in their professional fields but also contribute to achieving more effectively the financial additionality of REDD+ once promised by the international climate change mitigation regime.

Conclusion:

This chapter starts with juxtaposing the different approaches to the environmental additionality concept of REDD+ by the various involved experts, including not only scientists, but also validators of global agencies, Brazilian lawyers as well as politicians and technocrats in Brazilian governments. The differences between the various approaches to the additionality bring forward the specific political economic contexts of the different fields of expertise in understanding and determining additionality.

Moreover, the individual and organizational frustrations with the financial problems of REDD+ led to the reflections over of the financial additionality of REDD+ and the global carbon finance regime in general. From different perspectives, the collaborative experts started questioning the deeper issues of financial additionality, such as the transaction costs of REDD+ in technical terms and the political economic struggles in international negotiations. Their reflections help themselves to strategically contextualize and reshape accordingly their knowledge production practices in order to tackle the current challenges of financial additionality.

Overall, this chapter reveals the political economy of knowledge production involved with the REDD+ carbon finance. Firstly, knowledge production has been

conducted in specific political economic contexts, for example the immediate context of the international knowledge authority regime in carbon finance and the broader context of post-colonial geopolitics imbued in carbon finance. Second, the political economic contexts pose challenges to their knowledge production, such as the bureaucratic limit to the Brazilian scientists' original contribution to the determination of (environmental) additionality in the FAS methodology, as well as the frustrations with the financial efficiency and the deficiency of financial additionality.

Third, the collaborating and reflexive experts are not simply aware of the political economic contexts as such, but also strategically integrate such contexts in their knowledge production practices by incorporating the bureaucratic international demands as well as by grounding their knowledge products in Third World reality. Forth, the conscious politico economic contextualization of knowledge production practice contributes to the advancement of knowledge production, not only in terms of the international political recognition of their knowledge products, such the FAS methodology, but also in terms of the applicability of their knowledge products to the Third World reality. At last, for the wide applicability of its knowledge products, such contextualized knowledge production in turn facilitates the achievement of financial additionality.

CHAPTER 4:

Leakage: an ethnographic approach to market making

> *Leakage is defined as the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and which is measurable and attributable to the project activity.*
>
> —— *The Marrakesh Accords of the United Nations Framework Convention on Climate Change (UNFCCC 2002)*

In late 2009, the communities in the Juma state forest Reserve of Sustainable Development were provided with a ferry boat as part of the REDD+ Project in this reserve located in the southeastern part of the Brazilian state of Amazonas. The boat itself was part of the in-kind payments for the communities' conservational efforts in stopping clearing new forests and, by doing so, reducing greenhouse gas emissions to the atmosphere. The Juma communities used to burn down primary forests at an average rate of one to two hectares per family per year for swidden ("slash-and-burn") farming, the major local economic activity. Swidden farming, now considered as destructive and carbon-releasing, was expected to be replaced by sustainable development, locally translated into sustainable agriculture, such as permaculture, and sustainable harvest of forest products, such as brazil nuts. The ferry boat was intended as a vessel of such

transition, as it would facilitate the transport of these agricultural and forest products for sale in the nearby cities and thus help increase family cash income.

One year later, in 2010, I came back to Brazil to continue my fieldwork, only to find that the boat did not work so much as planned. It often failed to function for the planned mission of economic activities, broken down or short of diesel. According to some project managers, it was because people in the Juma communities were not well organized and nobody took up the responsibility of maintenance. But it always functioned and was well used when there were parties and soccer games among the communities. Before this boat provided, the Juma communities had these social activities as well of course, only less frequently and with fewer participants given the capacity of their family canoes. I was amazed by the unintended developments of this boat, or of the REDD+ project writ large.

Drawing on the theoretical tenet of economic anthropology that economy is embedded in social relations (Polanyi 1957 [1944]; Granovetter 1985; Callon 1998a), this chapter is an ethnographic research of the social-technological process of carbon market making. In this chapter, I examine in particular how the technical issue of leakage in carbon trading had been addressed in the pilot REDD+ project in Juma and in REDD+ policy developments in Brazil. I look into the calculation of leakage in the Juma Project design (FAS 2008a), and discuss the technical challenges of determining REDD+ project leakage so defined as measurable and attributable displacement of greenhouse gas emissions from deforestation by individual projects (UNFCCC 2002). However, in this chapter I do not seek a technical solution to the challenges to leakage calculation. Instead, I revisit the conception of leakage in the economic origin of carbon market, especially the

economic concept of externality, the unaccounted social and environmental implications of market (Coase 1960, 1988; Daly 1968). In its original economic conception, leakage is approached as the new externalities generated by the social-technological efforts of making new market to internalize the externalities of previous markets (Callon 1998a, 1998b).

Recalling the economic conception of leakage, this chapter explores leakage in and beyond its technical definition in the Juma REDD+ project design and maps out various socio-technological conduits of leakages, being negative and positive, environmental and social-economic. As to be shown, these additional forms of leakages include, for example, 1) the emissions from fast increasing fossil fuel use associated with REDD+ project, 2) the positive social-environmental externalities thanks to the local sustainable development initiatives under this project, and 3) the market overflows back to the developed countries in the form of transaction costs. Such maps can enable the various stakeholders, especially the underprivileged Amazon forest residents, to keep track of their positions in the complex and multi-scalar process of carbon market making and thus to facilitate more participatory and informed negotiations in the formulation and "maturing" of carbon markets (Coase 1960; Callon 1998b, 2009).

The story of the Juma ferry boat brings forward the beginning of the increasing carbon emissions associated with, yet unaccounted by, the REDD+ project on the one hand, and of the social-economic benefits brought in by REDD+ on the other. It also epitomizes how the carbon market making is embedded in various social relations, such as those between the different REDD+ market stakeholders, and in other institutions, such as the local agenda of sustainable development. At last, this chapter suggests that a

better market, should be always open to uncertainty and contestation, or in other words, should be always an open experiment (Callon 2009; Law 2004). This is how economic anthropology and other social sciences can get in and contribute to the formation of economic theories and models in economics and their performance in market making.

Contested leakage accounting of the Juma Project

This section will first introduce how the Juma REDD+ Project developers defined and operationalized the concept of leakage, and how they calculated the leakage of this pioneering project. It will then present critiques of the Juma project leakage accounting, as well as alternative approaches to the leakage issue in and beyond this project. It does not join these technical debates, but rather it leads to the review of the economic origin of this concept.

The Marrakesh Accords of the United Nations (UNFCCC 2002) provided the authoritative definition of leakage for carbon markets, as cited at the very beginning of this chapter. The Juma Project followed this definition and operationalized it by adopting the instrumental concept of leakage belt, as shown in the REDD+ carbon accounting methodology developed based on the Juma Project (FAS 2011:129-130; please see more about methodology in chapter two).

> Leakage is the decrease in carbon stocks and the increase in GHG emissions attributable to the implementation of the REDD project activity

> that occurs outside the boundary of the Project area. Leakage Belt is the geographical area surrounding or adjacent to the project area which activity displacement leakage could occur. (FAS 2011:129-130)

Using this operationalized concept of leakage, the Juma Project developers made the conclusion of no negative leakage from the project. This result is presented in the Juma Project Design Document (PDD) (FAS 2008). PDD is a very technical and bureaucratic document required to validate the emission reductions of a project as eligible for trading in the carbon markets (please see more about PDD in chapter two).

> It is not expected that the implementation of project activities will generate any offsite decreases in carbon stocks.… The physical boundaries of the "surrounding zone" will be determined ... Usually this area is defined as at least a 10 km buffer surrounding the Reserve's perimeter (i.e., in the Juma Reserve the zone would be of at least 494,318 ha). The entire surrounding area will be monitored as part of the project's monitoring plan. Migrations from the communities inside the Juma Reserve to other forest areas, in addition to immigrations, will be monitored by the Bolsa Floresta Program annual activities. (FAS 2008: 84)

Despite the success in selling Juma carbon credits in the global market, the leakage accounting of this project or of carbon project in general is far from being a settled

practice. Sven Wunder, the director of the Latin American Office of the Center for International Forestry Research (CIFOR), is a senior agro-economist with advanced experiences in the fields of forest carbon. I interviewed him in his office in Rio de Janeiro in mid-2009, shortly before his own visit to the Juma project. One of his major interests was leakage accounting and he raised right away his concern with the concept of leakage belt. He believed that accurate leakage accounting is basically impossible, because the "potential leakage belt is the whole world" and the extremely complex mechanisms that could result in leakage are technically unidentifiable. His concern was based on his research in this regard. For example, in his publication one year before, he pointed out that few REDD schemes were in operation by the time, so "asking for credible leakage estimates or leakage-proof design recipes was premature" (Wunder 2008: 69). He made it clear that the short accounting of possible leakage in the Juma Project Design Document, as quoted in my previous paragraph, was too simplified in any sense and would be vulnerable to serious technical questioning or political accusation.

The Juma project developers addressed leakage accounting in a rather practical term. Mariano Cenamo is the co-director of Amazonas Institute of Sustainable Development and Conservation (IDESAM) and one of the leading scientists of the Juma Project. At the First Latin American Symposium on REDD+ organized by the Amazonas State Government and the Sustainable Amazonas Foundation (FAS) in September 2009 in Manaus, Cenamo presented an early draft of the REDD+ carbon accounting methodology (see more in chapter three of this dissertation) developed based on the Juma Project experience. In this presentation, he clarified their approach to REDD+ leakage. He first cited the definition of leakage from the UNFCCC Marrakesh Accords (2001). Then he

stressed that "Leakage must 1) be measurable, 2) be attributable to the project implementation, and 3) indicate an emissions increase compared to baseline" (Cenamo 2009; see chapter two of this dissertation for more on baseline). In other words, if any suspected potential leakage is immeasurable, or not attributable to the project given the available scientific and technological means, this leakage would have to be disregarded.

Yet as Wunder pointed out, the scientific and technological tools for REDD+ leakage accounting were limited at the time or even years after. Paulo Moutinho, Executive Director and leading scientist of the Amazon Environmental Research Institute (IPAM), was on the scientific committee of the Juma Project (see more about this committee in the second chapter of this dissertation). Moutinho and his colleagues evaluated the existing scientific and technological tools that could be mobilized for REDD+ leakage accounting. According to them, based on models such as deforestation simulation models (Soares-Filho et al. 2010), some studies had provided valid tools to evaluate REDD+ leakage, but at national or regional level, such as the whole Amazon basin, not at small scale or project level (Moutinho et al. 2011: 41, 94). They argued that unfortunately, leakage is more problematic at small scale, which is to say, individual REDD+ project is more likely to have leakage and such leakage is more difficult to be measured and attributed to the project (ibid).

Alternative approaches to leakage argued otherwise. Philip Fearnside, senior professor in the National Institute of Amazon Research (INPA), was also a member of the Juma Project scientific committee (see more about this committee in the second chapter of this dissertation). Based on his life long study of the Amazon forest ecology, he predicted that in the long term, say 100 years, virtually no unprotected forest is likely

to remain, meaning that potential leakages of deforestation from forest reserves should not matter much because any short-term leakage would be "recovered" eventually (Fearnside 2009; and interview). He thus argued that the evaluation of the benefits from creating a forest reserve, such as under a REDD+ project, and the losses of these benefits caused by leakage, would depend on how time is valued (Fearnside 2009; Yanai et al. 2012). Fearnside and his colleagues at the INPA conducted a research to evaluate the leakage effects of the Juma Project specifically (Yanai et al. 2012). Their result showed that the Juma reserve was effective in reducing carbon emission by 2050, the end year of the REDD+ project period, although not as much as calculated in the Juma Project Design Document. But the benefits of the Juma Project would be greater over a longer time frame, as the leakage would be recovered anyways eventually (ibid: 89).

As illustrated above, leakage accounting has been a challenging practice under heated debates. As pioneering practitioners, the Juma Project developers took a very practical approach to leakage accounting and operationalized the leakage concept in a way critiqued as too simplified by some. More conservative scientists, such as Sven Wunder, pointed out the potential leakage belt should be the whole world and the Juma leakage accounting was too simplified to be scientifically valid. More policy-oriented scientists, such as Paulo Moutinho, believed scientific-technological tools were provided for calculating leakage at national or regional level but yet premature for that at project level. Scientists with alternative approaches, such as Philip Fearnside, paid more attention to the time frame of leakage accounting and predicted that leakage would be recovered in longer term. I do not seek to justify or disapprove the Juma Project leakage accounting, or to provide a solution to the challenges in leakage accounting. The next sections of this

chapter will contextualize these debates in the economic conception of leakage and the project encounters on the ground.

Leakage as market overflows in economics

This section will examine the intellectual origin of the concept of leakage. Amid its market success and technical critiques, the Juma Project is indeed a pioneering project in the REDD+ carbon market in the making. This section will trace the theoretical trajectory of market making, to the economic concept of externality in particular. It will also briefly review the history of carbon market making. The economic conception of externality will open up a broader framework to engage the leakage issue in an ethnographic setting.

The intellectual origin of carbon markets lies in the economic theories since 1960s on the externalities produced by market (Callon 2009: 538). In these theories, environmental crises are considered as inefficiencies deriving from the failure to account all social environmental costs, or the failure to internalize externalities. The creation of carbon markets is a major international solution to tackle the globally recognized challenge of climate changes. The global climate change is merely the result of a long accumulated, gigantic "market failure", correctable through improved pricing and information flow (Stern 2007: viii; Lohman 2009: 501).

The economic theories behind the creation of carbon markets can be dated back to the works of Ronald Coase in 1960s (Coase 1960, 1988) and his successors later (e.g. Dales 1968). Coase was one of the first to urge that pollution be "optimized" by being

integrated as one "factor of production" among many in market calculus. He suggested that pollution be bargained into the hands of those who could produce the most wealth from that pollution, and thus the greatest good for society as a whole. John Harkness Dales put forward in detail the scheme of controlling emissions via a cap-and-trade scheme (1968). In brief, under the overall cap of pollution set up by governments, facilities with high abatement costs would buy pollution rights from facilities with lower abatement costs, saving themselves money. Facilities for whom reductions come cheaper could meanwhile make money by cutting pollution and selling the unused pollution rights they were thus enabled to stockpile. The system would reward both sellers and buyers of pollution rights, and result in pollution reductions being made where they were least expensive.

The concept of externality refers to such unaccounted social and environmental implications of market (Callon 1998). Externality can be positive, such as expiring pharmaceutical patent accessible to all. It's more often negative, such as the air pollution generated by a factory but shared by the whole city, or deforestation in the Amazon but releasing greenhouse gas to the planetary atmosphere. Carbon market is an intellectual invention to internalize market externalities formerly unaccounted, specifically greenhouse gas emissions. In this theoretical framework, leakage of carbon market is but the new externalities generated in making carbon market to internalize the externalities of previous markets.

There had been examples of pollution rights trading, primarily in the United States, before the global carbon markets. Early experiments of pollution rights trading were carried out as early as in the 1970s. In 1976, the U.S. Environmental Protection Agency

promulgated a policy allowing major new pollution sources to be sited in locations where standards were not being attained as long as they obtained offset pollution credits generated from other projects that saved or reduced emissions. The crucial development was the start of sulfur dioxide trading in the United States in 1995 (Ellerman et al. 2000; MacKenzie 2010:134).

With these experiences, in 1990s, the U.S. government successfully demanded that the Kyoto Protocol adopt a market mechanism for global emissions reduction and climate change mitigation, being the Clean Development Mechanism (CDM). What was to be included in the Kyoto Protocol was a Clean Development Fund, an essentially juridical system with fines for exceeded emissions targets earmarked for green technology for the South. At the last minute of the Kyoto Protocol negotiations, this Clean Development Fund was transformed under U.S. pressure into the Clean Development Mechanism, a trading scheme in which offsets were made exchangeable with allowances by fiat (Lohmann 2009:505). The CDM markets sanction afforestation/reforestation (A/R) as emission reductions eligible for carbon credit trading, since afforestation/reforestation directly sequestrates greenhouse gas from the atmosphere into biome. Avoided deforestation, later termed as REDD or REDD+, was not proposed to the UNFCCC until 2005. As the biodiversity and carbon stored in forests were of global importance, compensation from the world community was demanded for the "environment service" of reducing deforestation in developing countries. Thus the concept of payments for REDD+ was born (e.g. Lovera 2009:46).

In his suggestion of making market to internalize the formerly unaccounted externalities, Ronald H. Coase prescribed negotiation or bargaining between the involved

parties to solve the challenges in market making and thus the problem of unaccounted externalities (1960, 1988). Michel Callon pointed out that in this prescription Coase presupposed several conditions for effective negotiation (Callon 1998: 264-265). One of the presupposed conditions is that the involved parties, or agents in Callon's term, are equally well informed and capable of negotiating with each other. The following section will look into how negotiation can be played out on the determination of leakage on the ground and the making of REDD+ carbon market at multiple levels.

This brief review reveals that leakage in carbon markets is but a particular example of market externality. In other words, leakage is the new externality generated by the techno-scientific process of making new market to internalize the externalities of previous markets (Callon 1998, 2009; Richards and Costa 1999). Actually, more terms similar to leakage, such as overflow and spillover, were also used to refer to externality in discussing market making in general (e.g., Callon 1998) or carbon market making in particular (e.g., Sijm et al. 2004; Kuik and Hofkes 2010). The economic conception of leakage as discussed above reveals that the concept of leakage connotes much beyond the narrow definition in the UNFCCC Marrakesh Accords or the Juma Project design. Leakage could refer not only to the displacement of deforestation out of project boundary, but also to other kinds of externalities to be explored further below.

Negotiation as a solution to leakage?

This section will examine the moments of negotiation between the various stakeholders in the decision making processes in the emerging REDD+ carbon market.

However, the moments of negotiations observed in my fieldwork are far from the ideal or effective ones as expected by Coase; they are rather the lack of, unbalanced and ineffective negotiations. This is because, as to be shown, the various stakeholders are positioned in unequal social technological relations in the making of REDD+ carbon market. Focused on moments of (problematic) negotiation in this case, this section aims to reengage the issue of leakage accounting.

As recounted in the beginning of this chapter, the Juma residents and the project managers disagreed on the usage of the ferry boat. Some project managers found the ferry boat neither properly maintained nor sufficiently used. However, the Juma residents made their maintenance efforts as well as good use of the boat for social cultural activities, while the project managers intended the boat primarily, if not exclusively, for economic activities. The unexpected development of this ferry boat had its root in the lack of communication and negotiation between the project managers and Juma residents.

Unfortunately, the lack of effective negotiation was often the case, at the beginning both of the Juma Project and the REDD+ carbon market. The most salient component of the Juma Project in the first years was the monthly cash payment of R$50 per family, called "*Bolsa Floresta Familiar*" (Family Forest Allowance). The money is deposited in a family debit card issued by the *Bradesco* Bank, one of Brazil's largest banks. It takes the Juma residents 1-3 days and R$20-80 of gasoline to cash out this payment, by riding their motored canoes to the nearest bank branch and ATM machines in the municipal sit, Novo Aripuan ã The amount and vehicle of this payment were decided primarily based on the financial collaboration between the Amazonas state government, the Bradesco Bank and FAS. The Juma residents were minimally, if any, involved in this particular

decision and were not able to renegotiate afterwards. Many of the families often had their neighbors, relatives or friends to cash out the payments to save some trips and mitigate the costs.

The decisive condition of receiving this payment was to stop clearing primary forest for farming, which is the utmost objective of the REDD+ project. The slash-and-burn farming practice had to be limited to the existing secondary forests (re-grown after the removal of primary forest) and transitioned to sustainable agriculture. Moreover, such sustainable agriculture was expected to increasingly complemented by other economic activities, such as sustainable harvest of forest products. However, with no more areas converted from primary forest as required by the REDD+ project, the available secondary forests would deteriorate to the extent of infertility in about 5 years, according to the Juma residents. But by August 2011, over 3 years since the first payment of this project, I found the conventional slash-and-burn farming remained the major family economy despite various project efforts in promoting sustainable development. When asked what to do after the secondary forests run out, many Juma residents frankly responded that they would have to continue clearing new forests even at the risk of losing the REDD+ monthly payment: "if not, what do we eat?" While some others replied after a pause, "I don't know; I think the government will have to do something to solve the problem." The availability of farming land is crucial to Juma family economy and to the REDD+ project goal in reducing deforestation and carbon emissions. However, the Juma residents had passive and weak position in this crucial issue. They did not have access to the decision making process, but only looked up to the authorities' policy arrangement. As in the ferry

boat case, their negotiation power lie in their actions, such as resuming deforestation when their food supply and survival threatened.

Another major component of the REDD+ Project in Juma was the Community Residents' Association. This association was established to enhance the organization and collaboration of the community residents in advancing local sustainable development. Although founded upon the advice of the REDD+ project design and financially supported with the REDD+ project money, the association was supposed to be institutionally autonomous and independent from the project managing organizations and local governments. The association summoned regular meetings of community representatives and ordinary Juma residents usually in a community's event house. Staff of FAS and local governmental agencies often participated in these meetings. Their participation could be simply for managerial affairs, such as for the paperwork of the REDD+ Project recruitment of new member residents, and could turn into an open discussion on specificities related to the REDD+ project implementation or local sustainable development, such as on technical supports to be provided by the local government agencies for processing collected brazil nuts. There had been critiques of the insufficient participation in the association (e.g. Gebara 2013). During my fieldwork, I have also heard complaints from local residents, such as those not capable of the logistic costs of participating in the meetings, and those not used to speak publicly to a big audience. Despite these critiques and complaints, this association had become an institutionalized venue for policy discussion and negotiation between multiple parties at local level. It empowered the community residents collectively in negotiating with the

REDD+ project managers and local government agencies over the REDD+ project implementation and local sustainable development.

Migration had been one of the issues raised at and beyond the association meetings since after the first years of the project. Migration into and out of the demarcated project area could significantly affect the leakage accounting of a REDD+ project. The Juma Project tried to attend to this issue since its very beginning. The Juma Project Desgin Document indicated that both emigration and immigration "will be monitored" annually (FAS 2008: 84). The project contract with the community residents required two years of residency in the project area for them to be eligible for the benefits. However, "the complicated reality", as some community residents and project managers said, often escaped this simple criterion and monitoring plan and provoked debates between various parties.

Different kinds of migration raised various concerns and often led to negotiations case by case for solutions. Absent residents, with house and farming land in Juma but living outside (usually in nearby cities) for most of the time, argued for their eligibility to be enrolled to the REDD+ project and many succeeded in claiming the project benefits. Out of local customary rules, other residents in the communities usually did not reclaim the farming lands abandoned by the absent residents or emigrants even at the risk of exhausting the fertility of their own farming land or clearing new primary forest. The project managers could not always monitor closely the residency status of local families and might make arbitrary judgments. Thus the project managers were not always in a more privileged position in the negotiation with the suspected absent residents on their eligibility for project enrollment.

Another case would be the prospective immigrants to Juma. During my fieldwork, I met several families of this case. All of them were former Juma residents, living in the city of Novo Aripuan ãand at the moment thinking of returning to their home communities if the REDD+ Project turned out to be successful and to their interests. Many of them had tried to reclaim their abandoned farming lands and house, and some of them had also attempted the contact with the project managers, such as by participating in the association meetings.

The demographic factors, such as absent residents and immigration, would certainly affect the consumption of fossil fuel and forest resources and contribute to the leakage of the project. Open or informal negotiations at local level, between the residents and project managers and between the residents themselves, provided opportunities of mutual understanding, compromising, and hopefully solutions to specific aspects of leakage accounting on the ground. A good part of REDD+ project leakage actually took shape in local residents' life decisions and could be determined only in the negotiations over their decisions and over their involvement in the project.

It is revealing also to look into the moments of negotiation in the carbon market making at global level. The limited capacities of current technologies and hence the technical challenges in REDD+ carbon accounting could leave a space contested by competing knowledge claims and by associated political economic interests (Lohmann 2009). Chapter three of this dissertation has described in details the overall process of developing and validating the REDD+ carbon accounting methodology developed by the Juma Project experts. In brief, the methodology (draft version, FAS 2008) was submitted to the Voluntary Carbon Standard Association (VCS) for validation as a REDD+ carbon

accounting model for global use. The methodology was approved in July 2011 and, along with many changes to its contents, gained a new title "Approved VCS Methodology for Avoided Unplanned Deforestation" (FAS 2011), hereafter referred to as "the methodology" for short.

The rest of this section examines the negotiation between the methodology developers and validators on forest mapping standard, or more specifically, on the instrumental concept of Minimum Mapping Unit in the methodology. Some of the debates were recorded in the methodology assessment reports and others articulated by my personal interviews with them.

The determination of the Minimum Mapping Unit of a forest brought out interesting debates throughout the process of validating this methodology. The submitted version of the methodology actually did not set up a Minimum Mapping Unit. The validation team of Norwegian firm Bureau Veritas Certification (BV), one of the two validators, made a Corrective Action Request (CAR) to the methodology developers: "Forest – Please, make reference to the step which establishes the MMU." (BV 2010: 31) The methodology developers first made this response, "The CAR was solved by adding: The Minimum Mapping Unit (MMU) which shall be equal or above the minimum area threshold used for defining 'forest', but not above 5 times this value." (ibid) However, the BV validation team was not satisfied with this flexible threshold and insufficient accuracy, and thus did not accept the methodology developers' first response, by saying

> The assumption used to determine the minimum mapping unit (MMU) is incorrect because if the MMU is above the threshold used for

> defining “forest”, the accuracy and the map scale will change. For example: If the MMU is equal a 1ha (threshold) than the map scale is equal a 1:20,000 and the accuracy is equal 0.05 ha. If we use a value above of the threshold (1ha) such as 10ha the map scale is equal a 1:50,000 and the accuracy is equal 0.5ha. In this way the correct manner of expressing the MMU, would be like that: “The Minimum Mapping Unit (MMU), which shall be equal the minimum area threshold used for defining “forest”. CAR NOT CLOSED. (BV 2010: 31-32)

At this moment, the methodology developers brought up forest mapping experiences in tropical countries, especially their own in Brazil, as the reason for their proposal of the more flexible threshold. The major argument was that in practical terms, remote sensing technologies available at the moment may not be able to generate high resolution data that meet the MMU thresholds of UNFCCC forest definition.

> We have no problem in our project for establishing the MMU equal to the minimum area threshold used for defining “forest”. In Brazil this threshold is 1.0 ha and we can map and model our deforestation at this resolution. However, other countries have defined this threshold at 0.1 hectares or less (e.g. Dominican Republic), and mapping deforestation and modeling it at this resolution would be prohibitively costly in these countries. National GHG inventories reported to the UNFCCC by these countries were accepted with data at a coarser resolution than the minimum area threshold of

> the forest definition. Furthermore, finding high resolution data for the past may be impossible in many cases, implying that the MMU will be determined by the available RS data. In case of Landsat TM the minimum would be 0.08 ha (= 1 pixel) which is above the UNFCCC minimum of 0.05 ha. We therefore suggest BV to reconsider this CAR. Nevertheless, in the revised methodology we have stated: "The Minimum Mapping Unit (MMU), which shall be equal the minimum area threshold used for defining 'forest'." (ibid.)

Despite their practical argument based on the availability of affordable technologies and their request of the BV team to reconsider this CAR, the methodology developers agreed to revise the methodology exactly as advised by the BV team and the CAR was solved and closed. The eventual ruling of the methodology validators revealed that the debates between them and the methodology developers had been an unbalanced negotiation, given the established knowledge and institutional authority of institutions including Voluntary Carbon Standard Associatin, the global carbon firms, and the United Nations (UN) behind them.

Overall, in this case of making REDD+ carbon market, while negotiation yet appears promising to tackle some of the challenges, more often observed at this beginning stage of market making have been the lack of, unbalanced, or ineffective, negotiations. In his model of market making, Coase believed institutional framework would support negotiation and thus good market (1960, 1988). In the first years of the Juma Project when the Juma Residents' Association was not fully functioning yet, there had been no such institutional framework for negotiation, and project decisions were often made

unilaterally and turned out to be problematic. The Juma Residents' Association emerged as a venue promising for effective communication and negotiation between the various parties at local level. It certainly contributed to the specific decisions, such as migration, that would affect the project leakages on the ground. Institutional framework at global level had been much more established, yet deeply embedded in often unequal knowledge regime and vested with political economic interests. As in the process of methodology validation, negotiation turned out be unbalanced and ineffective, and bound to result in financial overflows back to the developed countries in the form of transaction costs from forest mapping technologies.

The Juma ferry boat as a vessel of leakage

The economic conception of leakage or externality, as reviewed earlier on in this chapter, opens up a much broadened framework to reengage the leakage issue and carbon market making on the ground. This section and next will explore some of the leakages or externalities not accounted in the Juma Project design. This section will focus on both the negative and positive social environmental externalities of the Juma Project as part of the Amazonas state policy of sustainable development.

The ferry boat depicted at the beginning of this chapter was not a random decision to spend the money from carbon trading; it was rather a small part of much bigger agenda of local sustainable development. Juma was one of the 15 state forest Reserves for Sustainable Development under the state program of payment for ecosystem services, called *Programa Bolsa Floresta*, or Forest Allowance Program. Swidden farming used to

be the major local economic activity, yet it had been considered as destructive in the new discourse of fighting global climate changes. Under the REDD+ Project, the Juma families were not allowed to deforest primary (virgin) forest for swidden farming. According to my field research, no individual or family intended to move out of the project area to continue or expand swidden farming, and almost all of them were physically unable to reclaim swidden farming land outside the project area far away from their homes (except those few live at the border of project area). Therefore, substantial relocation of deforestation and swidden farming to the project defined leakage belt was unlikely to happen. So was the prediction by the Juma project developers and the conclusion of no negative leakage (defined as deforestation to the leakage belt) in the Juma Project Design Document.

Giving up swidden farming, the Juma residents were encouraged to carry out "sustainable development." Sustainable development or sustainable economy was locally translated into sustainable agriculture, such as permaculture, and sustainable harvest of forest products, such as collecting brazil nuts, rubber and tree seeds. The ferry boat was intended to facilitate the transport of sustainable agricultural and forest products for sale and the regular purchase of food and grocery in the nearby cities, including the local staple foods, manioc starch, rice, bean, and coffee. It would be indeed a vessel of the transition to sustainable development.

However, the increased imports of foods would increase the pressure of deforestation for agriculture outside the reserve, not necessarily within the 10 km width surrounding zone, but more likely elsewhere in the Amazonas state or further away. In other words, deforestation in the Juma reserve would be relocated through the market mechanism as

far as the food market reaches. The Amazonas state's Secretariat of Sustainable Development and the Environment (SDS) believed that the food market shortfall would be taken up by industrial producers of manioc in the southern Brazilian state of Paran á (outside of Amazonia) (Fearnside 2009). However, the state government's Secretariat of Rural Production (SEPROR) had set up the goal to make the state of Amazonas self-sufficient in manioc flour production. The leakage through market mechanism as such might not be as conveniently measurable or attributable as deforestation relocated to the immediate leakage belt as defined in the Juma Project design (FAS 2008), but it is not entirely unexplored by scholars. Philip Fearnside has discussed such diffuse effect of forest carbon project and called it "economic leakage" (1995, 2009).

At the heart of the sustainable development agenda was to improve the living conditions of the Juma residents, as claimed by the project developers and managers. So after the ferry boat, provided were also school boats, motors for family canoes, power generators for community electricity supply, emergency boats and so on. The provision of these facilities in particular was results from negotiations between the Juma residents, community leaders and Juma project managers. The later section on negotiation in this chapter will further discuss such negotiations.

These fossil fuel-consuming facilities were practical to the Juma residents and increasingly used. Before the REDD+ project, many families had been using motors for their canoes and most communities had power generators provided by the municipal government about a decade before. However, the use of canoe motors was limited due to the substantial cost of the machine and fuel. The use of the community power generator was even more limited, one hour each day at its best performance, due to the substantial

fuel cost as well as the poor maintenance and worn-out condition of the machine. The Juma residents welcomed these facilities for their increased everyday needs, or "improved living conditions." As aforementioned, they increasingly relied on the ferry boat and family motored boats for food purchase and forest product sales outside the reserve. They also increased their river fishing activities by motored boats to make up the reduced food provision from swidden farming. In addition, the school boats were a new phenomenon along with the high school built under the REDD+ project (see below for more about this school), and they have been used at a daily base for the school students' commuting and other school activities.

Fossil fuel use in the Juma Project area increased substantially even just during my fieldwork period from 2009 to 2011 and could be expected to increase much more in the future towards 2050, the end year of the REDD+ project. Such increase is firstly thanks to the direct investment of REDD+ carbon money in the fossil fuel-consuming facilities as above. But in the long term, the more powerful and consistent drive would be the family income increase and living condition improvement which had been promoted through the sustainable development agenda behind the REDD+ project. The greenhouse gas emission from all these increasing fossil fuel consumptions could be significant if compared to that from deforestation of one or hectare per year per family, the target of the REDD+ project. I would argue this emission as negative environmental externality, or another kind of diffuse economic leakage.

However, this kind of economic leakage was not taken into consideration in leakage accounting either. Paulo Moutinho and his colleagues also argued in the REDD+ context that deforestation does not leak to other sectors such as energy and transport (Santilli et

al. 2005; Moutinho et al. 2011). Back to the Juma project in particular, it might be too early to tell if the amount of such leakage is significant enough. But it is not the amount of this leakage that matters, it is because the emission in this diffuse leakage is not the right kind to be included. The carbon accounting methodology developed based on the experiences of this project provided more details in this regard (FAS 2011). According to this methodology, leakage must be from displaced deforestation or "leakage prevention measures." Leakage prevention measures include "tree planting, agricultural intensification, fertilization, fodder production and/or other measures to enhance cropland and grazing land areas" (FAS 2011: 91-92). The sustainable development activities in the Juma reserve do not fit these kinds of leakage prevention measures, and are thus not considered as valid leakage in the Juma Project.

On the other hand, the Juma REDD+ Project had positive externalities as well, in the form of social cultural benefits to the Juma residents. As mentioned in the beginning of this chapter, the ferry boat provided for economic activities was well used for collective transports to social cultural activities among the communities. The ferry boat thus contributed to the improvement of local living conditions not only in economic terms, but also in social cultural terms. Although the social cultural benefits from the ferry boat were unexpected effects, the implementation of the Juma Project included a component specifically to promote local social welfare, called Social Forest Allowance (*Bolsa Floresta Social*) as introduced in the Introduction to this dissertation. The Social Forest Allowance component of the Juma Project had been focused on improvement of local education and medical services. It built up a high school and medical post (*Posto de*

Saude) next to the community of *Boa Frente* to serve all the residents in the Juma forest reserve.

The high school was built from scratch under the REDD+ project and was much valued by the Juma residents. The Juma residents used to send their children to the nearby cities for high school education. At least one of the adult members of the family would have to accompany their children by renting or building a house in the cities. Those families who could not afford the associated high costs often gave up their children's high school education. The new high school inside the forest reserve meant not only much reduced education costs, but also keeping their children away from the violence and drug problems in the cities. Moreover, this high school provided a specially designed environmental education curriculum which was mainly to disseminate climate change awareness and to promote sustainable agriculture and forestry. The forest residents used to be considered by others and also by themselves as "backward", "inferior", or "barrier to development" as in the arrogant developmentalist ideology. Out of this environmental education curriculum, many students and even some parents picked up new languages, such as forest conservation and value of forest. They re-interpreted these new languages with their own life experiences in the forest, such as the comfort blessed by forests' cooling effect, the calmness and safety in forest as away from drug and violence. With these new positive attitudes, they were having less feeling of inferiority or unconfidence, for example when communicating with people from outside or considering emigration to urban areas for schooling or living. The education component of the Juma Project would be a good example of positive social-cultural externality of REDD+ on the ground.

With the broadened framework of leakage or externality, this section explores the potential forms of REDD+ leakages in the particular case of the Juma Project. There had been and were expected to have more diffuse economic leakages, including relocation of deforestation though market mechanism and increase in fossil fuel consumption for economic and social cultural activities. There had been also positive leakages in social cultural terms as well, as the implementation of the Juma Project on the ground had expected and unexpected social cultural benefits to the local residents. The Juma Project design narrowly defined leakage as displacement of deforestation due to the REDD+ project or the associated leakage prevention measures. Yet all the alternative forms of leakages explored in this section are much beyond this narrow approach.

Carbon technologies as vessels of REDD+ leakage

Following the last one, this section continues exploring alternative forms of REDD+ leakage. It focuses on carbon trading knowledge and technologies as conduits of market overflows in the form of transaction costs back to the developed countries. As discussed in the Introduction to and the third chapter of this dissertation, the REDD+ carbon trading mechanism, together with other market and non-market emission reduction mechanisms, is supposed to transfer financial resources and advanced technologies from developed countries (Annex I countries in the Kyoto Protocol) to developing countries (Annex II countries) to encourage and compensate the conservational efforts in mitigating and adapting to global climate changes under the international climate policy regime led by the United Nations Framework Convention on Climate Change (UNFCCC). Yet, the realization of such transfer is bounded by the international knowledge regime and

ultimately by the global political economy (see more on this in chapter three of this dissertation). Available expertise and technologies for REDD+ carbon accounting are yet limited and premature, especially so in developing countries (Wunder 2008; GOFC-GOLD 2010; Moutinho et al. 2011). This section looks into how carbon knowledge and technologies might turn out to be conduits of financial overflows and generate unexpected externalities of the carbon market in the making.

Recalling the negotiation on forest mapping standard examined earlier on in this chapter, this section further explores the institutional contexts, technological implications and financial consequences of adopting the high standard in the focused REDD+ carbon accounting methodology. The concept of forest and the operationalization of this concept are fundamental to the methodology and to the REDD+ carbon market in the making. As the global carbon markets have been constructed under the auspice of the United Nations, this methodology, as do others not surprisingly, follows the UNFCCC definition of forest.

> Forest is a land with woody vegetation consistent with the thresholds used to define "forest land" in the country where the REDD project activity will be implemented. Where the country has adopted a forest definition for the Kyoto Protocol, the minimum thresholds of the vegetation indicators (minimum area, tree crown cover and height) used for defining "forests", as communicated by the Designated National Authority of Clean Development Mechanism consistent with decision 11/CP.7 and 19/CP.9, should be used. (FAS 2011: 127)

In technical terms, what is crucial in defining a forest is the minimum threshold of the vegetation indicators. In footnote 56 on the same page, the thresholds are specified:

> Forest is a *minimum area of land of 0.05 – 1.0 hectares* with tree crown cover (or equivalent stocking level) of more than 10 – 30 per cent with trees with the potential to reach a minimum height of 2 – 5 meters at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high portion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10 – 30 per cent or tree height of 2 – 5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily un-stocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest. (ibid; my italics)

In the step of defining the boundary of forest (step 1.1.3 on page 13 of the version for assessment and step 1.1.5 on page 29 of the final approved version of the methodology), the methodology indicated to set up a Minimum Mapping Unit (MMU) equal to the minimum area threshold used for UNFCCC definition of forest.

However, according to the table below cited from the appendix 2 of the methodology (FAS 2011:132), only developed countries had mature and commercially available satellite and remote sensing technologies to generate high resolution data needed by the

UNFCCC definition; developing countries such as Brazil had only experimental capacity, not even mentioning other less capable developing countries, such as Dominican Republic. This is why the methodology developers claimed that high resolution data required by the UNFCCC forest definition for modeling and accounting deforestation could be "prohibitively costly".

Table 2. Present availability of optical mid-resolution (10-60m) sensors
(GOFC-GOLD, 2008)

Nation	Satellite & sensor	Resolution & coverage	Cost (archive[62])	Feature
U.S.A.	Landsat-5 TM	30 m 180×180 km^2	600 US$/scene 0.02 US$/km^2	Images every 16 days to any satellite receiving station. Operating beyond expected lifetime.
U.S.A.	Landsat-7 ETM+	30 m 60×180 km^2	600 US$/scene 0.06 US$/km^2	On April 2003 the failure of the scan line corrector resulted in data gaps outside of the central portion of images, seriously compromising data quality
U.S.A./Japan	Terra ASTER	15 m 60×60 km^2	60 US$/scene 0.02 US$/km^2	Data is acquired on request and is not routinely collected for all areas
India	IRS-P2 LISS-III & AWIFS	23.5 & 56 m		Experimental craft shows promise, although images are hard to acquire
China/Brazil	CBERS-2 HRCCD	20 m		Experimental; Brazil uses on-demand images to bolster their coverage.
Algeria/China/Nigeria/Turkey/U.K.	DMC	32 m 160×660 km^2	3000 €/scene 0.03 €/km^2	Commercial; Brazil uses alongside Landsat data
France	SPOT-5 HRVIR	5-20 m 60×60 km^2	2000 €/scene 0.5 €/km^2	Commercial Indonesia & Thailand used alongside Landsat data

As demonstrated above, the subtleties in defining the very basic concept of forest in the validation of REDD+ methodology may eventually involve tangible economic interests of various parties in the international regime of climate change mitigation and carbon markets. As a result in this case, the high standard of data was ruled by VCS's validation process to be adopted in the approved methodology. The high standard of data in the methodology could entail high financial costs to the development of REDD+ projects in developing countries and thus compromise the actual volume of financial compensation from developed countries to developing countries through the REDD+

mechanism. More specifically, high resolution satellite technologies demanded by the high standard of data will increase substantially the transaction costs to the developing countries and thus become conduits of financial overflows back to the developed countries.

Overall, global institutions including Voluntary Carbon Standard Associatin, the global carbon firms, and the United Nations (UN) behind them, always have superior knowledge and institutional authorities over methodology developers. However, these global authorities on climate change and carbon market are neither free from politics and interests, as many policy critics have pointed out. From the beginning, not only UN advisory bodies such as the IPCC but also UN regulatory institutions such as the CDM Methodology Panel and Executive Board were peopled by figures with vested interests in lenient rule-setting, such as carbon consultants who stood to profit from high project volume and officials from credit-buying countries (Lohmann 2006:62; 2009:507). Carbon market-makers in the UN and elsewhere felt that an independent inspectorate would be impossible and pointless to insist on (ibid). “I don’t see us as police,” the chair of the CDM Executive board recently remarked (Nicholls, 2007:S42). A carbon investor of Lehmann Brothers expressed a wide consensus when he affirmed that “traders should be the ones designing and determining the standards” (Lohmann 2009:507; Reklev 2007:27). This consensus echoes with the fact that all the validators of REDD+ projects and methodologies are private firms and organizations from European and North American countries. While those countries and their traders are also potential buyers of carbon credits generated in developing countries such as Brazil, acquiring knowledge and

institutional authority has crucial political implications and potentially involves economic interests in carbon markets (Lohmann 2009:529).

In this section and the last, I explore various kinds of potential REDD+ leakages or externalities not accounted in the current practice of the emerging market. I describe elaborately the conduits of these alternative leakages in an ethnographic setting, including the food market to substitute the reduced family farming, the fossil fuel-consuming facilities to improve local living conditions, the social welfare facilities (especially the high school), and the satellite technologies for forest carbon mapping and measurement. The ethnographic exploration of these leakages reveals how REDD+ market making is embedded in and shaped by various social technological relations at both local and global levels. These social and technological relations are often unequal between the different stakeholders involved in a particular project or in the overall market making. The unequal relations are crucial to the decision making processes on the ground.

Conclusion: an ethnographic approach to market making

The unintended development of the Juma ferry boat is indicative of the experimental status of the project and of the REDD+ carbon market. This chapter demonstrates how anthropological study can contribute to the economic experimentation towards a good market by engaging the formulation of technical concepts, such as leakage in this case, in an ethnographic approach.

This chapter is informed and inspired by the technical debates on the challenging and controversial practice of REDD+ leakage accounting in this emerging carbon market. A review of the economic theory of market making, especially of the economic conception

of leakage and externality, provides a much broadened framework to think over these debates. In this new framework, leakage is but the new externalities generated by the process of making market to internalize the externalities of previous markets. Based on ethnographic studies, this chapter explores various potential forms of leakage in and beyond its technical definition in the Juma REDD+ project design.

As a result, this chapter maps out various socio-technological conduits of leakages at multiple levels. In doing so, it establishes the underlying observation that market making is heavily embedded in social technological relations. At local level, various forms of leakage are given shape by the negotiations between the different stakeholders, mainly the Juma community residents, the project managers mostly from FAS, and the local governmental authorities under the state agenda of sustainable development. At global level, the development of REDD+ carbon accounting methodology and the associated transference of financial overflows are ruled over by the global knowledge authorities which are vested with political economic interests. Thus, the social relations at both local and global levels are often unequal and unbalanced.

Moreover, the mapping of socio-technological conduits of leakages can facilitate more participatory and informed negotiations in the formulation and "maturing" of carbon markets. While Coase prescribed negotiation or bargaining for the model of market making, negotiation in such an experiment of market making is often absent, unbalanced or ineffective because the social relations between are unequal. The mapping of socio-technological conduits of leakages, being environmental or social cultural, negative or positive, can enable the various stakeholders, especially the unprivileged

ones, to keep track of their positions in the complex and multi-scalar process of carbon market making.

At last, this chapter speaks back to the economic model of market making. As observed above, the social technological relations that determine the leakage in carbon market are often unequal and unexpected. "It is this dynamic tension, in which constant unexpected concerns are expressed and ask to be heard and to be taken into consideration, that defines a 'good' market" (Law, 2004). I agree with Callon on his suggestion that a market can develop legitimately and efficiently only if it renders all these controversies and tensions visible and debatable, as a source of material for experimentation (2008). I think this is how other disciplines or expertise, such as (economic) anthropology, can enter in and contribute to the practice of market making, and the formation of concepts, and theories of economics at large.

Chapter 5:

Summary and conclusions

The actual use of the Juma ferry boat turned out to be a result of practical negotiation in which I, as an anthropologist, played a constructive role at the side accidentally. The project managers believed the boat was neither appropriately maintained nor sufficiently used because the Juma residents were "irresponsible and not well organized." However, the Juma residents had been well used the boat for social cultural activities more than economic ones as expected by the project managers. As an anthropologist in continuous collaboration with both sides for my own study, I happened to bridge the two sides' divergent approaches and contributed to their mutual understandings on the use of the boat. Indeed, this dissertation is a study of collaboration and negotiation between different modes of knowing in the evolution of REDD+ in Brazil, or rather, the financialization of the Brazilian Amazon.

Recalling the theoretical tenet of economic anthropology that economy is embedded in social relations (Polanyi 1957 [1944]; Granovetter 1985; Callon 1998a), this dissertation is an ethnographic study of the social-technological process of institutionalizing REDD+ carbon finance. The third chapter of this dissertation explores the development of a knowledge product as a market tool, the REDD+ carbon accounting methodology. In doing so, it actually provides for the whole dissertation a broad context of the global political economy of climate change and deforestation mitigation.

More specifically, this chapter juxtaposes the different approaches to the concept of environmental additionality of REDD+ by the various involved experts often in

collaboration with each other, including not only scientists, but also validators of global agencies, Brazilian lawyers as well as politicians and technocrats in Brazilian governments. The differences between their varied approaches bring forward the specific political economic contexts of the different fields of expertise in understanding and determining additionality. Moreover, the individual and organizational frustrations with the financial problems of REDD+ led to the reflections over of the financial additionality of REDD+ and the global carbon finance regime in general. From different perspectives, the collaborative experts started questioning the deeper issues of financial additionality, such as the transaction costs of REDD+ in technical terms and the political economic struggles in international negotiations. Their reflections help themselves to strategically contextualize and reshape accordingly their knowledge production practices in order to tackle the current challenges of financial additionality.

Here I would like to highlight some crucial characteristics of the political economy of knowledge production revealed in the third chapter. Firstly, knowledge production has been conducted in specific political economic contexts, for example the immediate context of the international knowledge authority regime in carbon finance and the broader context of post-colonial geopolitics imbued in carbon finance. Second, the political economic contexts pose challenges to their knowledge production, such as the bureaucratic barriers to the Brazilian scientists in their original contribution to the determination of (environmental) additionality, as well as the frustrations with the financial efficiency and the deficiency of financial additionality. Third, the collaborating and reflexive experts are not simply aware of the political economic contexts as such, but also strategically integrate such contexts in their knowledge production practices by

incorporating the bureaucratic international demands as well as by grounding their knowledge products in Third World reality. Forth, the conscious contextualization of knowledge production as such contributes to the advancement of knowledge production, not only in terms of the international political recognition of their knowledge products, such the FAS methodology of REDD+ carbon accounting, but also in terms of the applicability of their knowledge products to the Third World reality. At last, for the wide applicability of its knowledge products, such contextualized knowledge production in turn facilitates the achievement of financial additionality.

The scientists and experts involved with REDD+ in Brazil have been voluntarily reorganized themselves into collaborations as in the above case of producing more applied knowledge, a REDD+ methodology. This is also the case in more basic scientific research, or "hard science." The collaborative knowledge production as demonstrated in the second chapter represents an "epistemological turn" in science (Gibbons 1999). As in the case of building the Simamazonia model, the author scientists worked with each other for knowledge production. However, the particular modes of knowing of the collaborative scientists vary, with some of them more confined to the conventional neutral science, some others more attending to pragmatic aims, and others with the (carbon) market approach to scientific knowledge. The diverging modes of knowing enkindled critical discourses and reflections among the scientists. The constant reflexivity of the REDD+ scientists made themselves more conscious of their own approaches, more accountable to the collaborative relationship, and more daring to navigate in the uncertainties and unpredictable across the fields of science, policy and market.

The contextualization of knowledge production (Haraway 1988; Latour 1993; Gibbons 1999) is realized through the integration of the policy-market implications in building the Juma baseline and the Simamazonia model. In other words, the knowledge production process anticipated and integrated its potential and/or intended social implications, "before it leaves the laboratories" (Gibbons 1999: c83; Strathern 2004:474). Moreover, the knowledge products sought approval not only by the conventional science community by publication in the best science journals, but also by policymakers and the market world. Such contextualized collaboration did not compromise the conventional ethics of neutral science, but rather concretely identified and maintained the conventional ethical line in the particular work. The product of such contextualized, collaborative science is of a special kind, classically called "socially robust knowledge" (Gibbons 1999) or "Mode 2 knowledge" (Nowotny et al. 2001). Such knowledge is not less scientific or reliable, but rather it is more open, more regulated, and more accountable to an ever wide set of economic, social and ethical standards (Barbira-Freedman 2012:51). It is in this sense that such collaborative knowledge practice stands for an epistemological shift from conventional science confined to itself.

The reflexivity of collaborative scientists is thus essential to contemporary scientific knowledge production. Gibbons and Nowotny et al. proposed the "rethinking of science" earlier on out of the concern with the increasing uncertainties and complexity of all kinds of crises and disasters (Gibbons 1999; Nowotny et al. 2001). The conventional modern demarcation of science, state and market has been destabilized and this destabilization forces the scientists to reach out, but this does not guarantee the collaborative science, or in Gibbons's term "socially distributed knowledge production" (Gibbons 1999: c84). It is

primarily because the scientists yet need the reflexivity over the contextualization of their knowledge production (ibid).

While essential to increasing practice of collaborative knowledge production, scientists' reflexivity is yet largely informal or un-institutionalized and often not encouraged (ibid; Holmes and Marcus 2012). Anthropologists have observed scientists' in situ reflexivity over the integration of unpredictable implications of their knowledge production. And they called it "experiment ethos", of which a big part is the "curiosity" or even the necessity to understand the particular perspectives of their collaborators and other fields (e.g. Holmes 2009; Holmes and Marcus 2012). This curiosity elsewhere is shared in common by the reflexive scientists and an anthropologic ethnographer interested in study them, and thus it may open up the space in their knowledge production for a real or figurative ethnographer to fill in as fellow interlocutor or epistemic partner in their reflexivity (Holmes and Marcus 2012:139). In other words, the reflexivity of the collaborative scientists forms potentially an epistemological base for a new kind of ethnographic fieldwork, or tentatively "collaborative ethnography" (Lassiter 2005; Westbrook 2008; Holmes and Marcus 2012; Farquhar and Zhang 2012). My study thus makes contribution to this strong yet "experimental ethos" in anthropology of collaborative ethnography by closely examining its epistemological base in this robust knowledge arena, the REDD+ science in Brazil.

This dissertation is aimed to engage the technical debates on the challenging and controversial practice of institutionalizing REDD+ and to eventually speak back to them in a constructive way. This aim is especially elaborated in the forth chapter which is focused on the leakage accounting in the emerging REDD+ carbon market. This chapter

briefly reviews the economic theory of market making, especially of the economic conception of leakage and externality, and provides a much broadened framework to think over the debates on leakage. In this new framework, leakage is but the new externalities generated by the process of making market to internalize the externalities of previous markets. Based on ethnographic studies, this chapter explores various potential forms of leakage in and beyond its technical definition in the Juma REDD+ project design.

As a result, this chapter maps out various socio-technological conduits of leakages at multiple levels. In doing so, it establishes the underlying observation that market making is heavily embedded in social technological relations. At local level, various forms of leakage are given shape by the negotiations between the different stakeholders, mainly the Juma community residents, the project managers mostly from FAS, and the local governmental authorities under the state agenda of sustainable development. At global level, the development of REDD+ carbon accounting methodology and the associated transference of financial overflows are ruled over by the global knowledge authorities which are vested with political economic interests. Thus, the social relations at both local and global levels are often unequal and unbalanced.

Moreover, the mapping of socio-technological conduits of leakages can facilitate more participatory and informed negotiations in the formulation and "maturing" of carbon markets. While Coase (1960, 1988) prescribed negotiation or bargaining for the model of market making, negotiation in such an experiment of market making is often absent, unbalanced or ineffective because the social relations between are unequal. The mapping of socio-technological conduits of leakages, being environmental or social

cultural, negative or positive, can enable the various stakeholders, especially the unprivileged ones, to keep track of their positions in the complex and multi-scalar process of carbon market making.

At last, this chapter speaks back to the economic model of market making. As observed above, the social technological relations that determine the leakage in carbon market are often unequal and unexpected. "It is this dynamic tension, in which constant unexpected concerns are expressed and ask to be heard and to be taken into consideration, that defines a 'good' market" (Law, 2004). I agree with Callon on his suggestion that a market can develop legitimately and efficiently only if it renders all these controversies and tensions visible and debatable, as a source of material for experimentation (Callon 2008). I think this is how other disciplines or expertise, such as (economic) anthropology, can enter in and contribute to the practice of market making, and the formation of concepts, and theories of economics at large.

Based on such attempt to speak back to the collaborators in my field, I would conclude thinking of a more engaged anthropology. There has been a wide call for a more engaged anthropology in the field of environmental studies, and climate change studies in particular (West 2005; Batterbury 2008; Altman 2009; Fiske 2009; Rancoli, Crane and Orlove 2009; Crate 2011). This call also resonates with suggestions from related fields, such as sociology, STS and economics. For example, Elinor Ostrom, the Nobel Laureate, has recently suggested a polycentric approach at multiple scales and levels for coping with climate change (Ostrom 2009, 2012). Michel Callon has called for more participatory and informed negotiations in designing and institutionalizing carbon markets (Callon 1998, 2009).

Ethnographic research of carbon market making, as exemplified in this dissertation study, can contribute to the rethinking of technical concepts, such as baseline, additionality and leakage, in a more contextualized ways. As in the case of leakage accounting, ethnographic research can help to map out the various socio-technological conduits of leakage. It would not exactly solve the technical problems. But it will help to enable various stakeholders to keep track of their positions in the complex process of carbon market making, especially those unprivileged stakeholders, such as the forest community residents, and the "Third World scientists" as in their own words. It will thus enable them in the negotiation, either in formal policy events or in everyday practical terms, on the knowing, carbonizing and financializing of Amazonia.

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