ABUSING THE COMMONS?
AN INTEGRATED INSTITUTIONAL ANALYSIS OF COMMON - POOL RESOURCE GOVERNANCE IN CONFLICT SITUATIONS

Jampel dell'Angelo
September 2013

JOINT RESEARCH DOCTORAL DISSERTATION

PhD Programme in Sustainable Development and International Cooperation
at La Sapienza Università di Roma – Centro Interuniversitario di Ricerca per lo Sviluppo Sostenibile (CIRPS)
and
PhD Programme in Environmental Science and Technology
at the Universitat Autònoma de Barcelona – Institut de Ciència i Tecnologia Ambiental (ICTA)

Centro Interuniversitario di Ricerca Per lo Sviluppo sostenibile - CIRPS

Sapienza Università di Roma

Directors
Prof. Mario Giampietro
Dr. Katharine N. Farrell
Prof. Vincenzo Naso

icta Institut de Ciència i Tecnologia Ambientals • UAB

ABUSING THE COMMONS?

AN INTEGRATED INSTITUTIONAL ANALYSIS OF COMMON-POOL RESOURCE GOVERNANCE IN CONFLICT SITUATIONS

Jampel dell'Angelo

September 2013

JOINT RESEARCH DOCTORAL DISSERTATION

PhD programme in Sustainable Development and International Cooperation at La Sapienza Università di Roma – Centro Interuniversitario di Ricerca per lo Sviluppo Sostenibile (CIRPS)

and

PhD programme in Environmental Science and Technology at the Universitat Autònoma de Barcelona – Institut de Ciència i Tecnologia Ambiental (ICTA)

Directors:

Dr. Mario Giampietro

ICREA Research Professor, Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona.

Dr. Katharine N. Farrell

Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona; Department of Agricultural Economics, Humboldt University of Berlin.

Dr. Vincenzo Naso

Professor, Dipartimento di Ingegneria Meccanica e Aeronautica, La Sapienza Università di Roma.

CENTRO INTERUNIVERSITARIO DI RICERCA PER LO SVILUPPO SOSTENIBILE - CIRPS

SAPIENZA UNIVERSITÀ DI ROMA

icta Institut de Ciència i Tecnologia Ambientals • UAB

To Those Who Follow in Our Wake

. . .

And yet we knew:
Even the hatred of squalor
Distorts one's features.
Even anger against injustice
Makes the voice grow hoarse. We
Who wished to lay the foundation for gentleness
Could not ourselves be gentle.

But you, when at last the time comes
That man can aid his fellow man,
Should think upon us
With leniency.

–Bertolt Brecht, 1939

In *Gesammelte Werke* 4:722-25 (1967)
(trans. S.H.)

PREFACE

One of the first questions I usually receive on my work is how and why, with a degree in Environmental Economics, I arrived in the Tibetan Rangelands. The academic answer would be that the most important watersheds of Asia are contained in those regions and investigating their governance is scientifically crucial. A second question that soon follows is what geothermal energy production in Italy has to do with the Tibetan nomads. Also in this case, the formal answer is that, similar to the Tibetan case, the most important watershed in central Italy is in critical condition and its well-being depends on science-policy interactions.

These answers reflect the kind of "Western" positivistic scientific attitude that brings rigorous researchers to be emotionally and personally detached from what they study and to explain the relevance of their work as something intrinsic and impersonal. This is the price we pay for the sake of objectivity and neutrality.

However, after four years of research, and the guidance and supervisions of self-reflexive researchers, I realize how important it is to look into the real motivations of one's scientific production, which inevitably will reflect on how research is conducted. In particular, research on sustainability, where the complex human nature dialectic is often associated with uncertainty and unpredictability and its multiple dimensions inevitably create tradeoffs and conflicts between "losers and winners," or better "oppressed and oppressors," clashes with a narrow, deterministic, and detached research approach.

Therefore, upon (critical self)-reflection, and awareness of what it implies methodologically, I can say that what scientifically took me to Tibet and Mount Amiata is first of all my personal connections. Because of my parents work and interest in Tibet, I spent time with many Tibetan people; I also spent time on Mount Amiata, enjoying the magic of that mountain during my childhood holidays. In both cases, I knew the beauty and saw the injustices.

At ICTA – UAB, the political dimension of social-ecological research, the acknowledgment of the myriad of (often conflicting) perspectives and the importance of their integration, and the self-reflection of our role and responsibilities as people who conduct scientific research are particularly alive. Attracted by these perspectives, I joined the ICTA group and was able to alleviate a sort of epistemological restlessness that had started while I was working on my Bachelor degree and continued at the LSE in classes taught by well-respected neoclassical economists.

Finally, I found a way to systematize this creative scientific unease and translate it into a constructive critical methodological and theoretical proposal, as if I involuntarily followed a Hegelian thesis–antithesis–synthesis process. I integrated my approach and research with Elinor Ostrom's work and application of the Institutional Analysis and Development (IAD) Framework. The methodological openness of the framework and the epistemological pluralism of Elinor Ostrom represented a harbour where one could come and reunite the hope for a just world, the awareness of the importance of the integration of multiple perspectives, and the analytical rigour of scientific analysis.

I hope the modifications to the IAD Framework that I propose and illustrate through the Tibetan Rangelands and Mount Amiata cases will be of interest to the reader and contribute to discussions of how to conduct research on environmental governance in situations of conflict.

24th September 2013, Bloomington, IN, USA
Jampel dell'Angelo

ACKNOWLEDGMENTS

When I start to read a new book or a dissertation, I am always curious about the acknowledgments. My impression is that sometimes if you read carefully between their lines, you can understand a great deal about the author and his or her work. The people to whom I want to express my gratitude, after four years of research, residency in three research centres in three different countries, and two fieldwork trips are many, and I really want to do it thoroughly. As I think back, I realize my scientific journey is in great part the result of the life-changing encounters I was so lucky to have.

First of all, I want to express my gratitude to the three directors of this dissertation. If Vincenzo Naso had not invited me to apply for the doctoral position at CIRPS–UAB, this work probably would not have started. If Mario Giampietro had not welcomed me at ICTA–UAB with open arms (although my original background is in Economics!), supported and showed me the way to pursue my research, I would not have gone in this direction. If Kate Farrell had not walked with me, assisted me, guided me when the path became unclear, I would not be here now (scientifically speaking).

I also care particularly about expressing my sincere gratitude to the people I have interviewed and collaborated with, during the fieldworks in Qinghai and Mount Amiata. Moreover, I want to thank the staff of ASIA for their logistical and technical support in Qinghai. For the Amiata case, my particular gratitude goes to Andrea Borgia, who provided me with an invaluably precious quantity of information. I hope my research effort will somehow contribute and be beneficial for the people involved in the two studied issues.

While at CIRPS-Sapienza in Rome, I received valuable feedback and advice from several people in the PhD program, in particular Silvia Macchi, Marco Zupi, Stefano Grego, Francesca Farioli, Fabio Orecchini, and support and help from Katia Spitaleri, Luciano Spinelli, and the other members of the administration staff. Moreover, during the time at CIRPS the collaborations with the people of the International Society for Sustainability Science from Arizona State University and University of Tokyo have been a very rewarding learning experience.

After 18 months at CIRPS in Rome, I moved to ICTA in Barcelona. At this point my life drastically changed in scientific and human terms. I was almost confused by the extreme coincidence between how fascinating the research projects were and the exceptional human qualities of the people conducting them. During the years in Barcelona I met without doubt some of whom I now consider my best friends, and I had the luck to have them as colleagues.

In particular, I want to thank: Giacomo, I never went hungry or homesick on a Sunday thanks to him. Nevertheless, he somehow always reminded me, paraphrasing Brecht, that if we are lucky to eat and drink, we will always stay hungry for justice. Arnim, because he taught me that the combination of rigour and creativity can make science really beautiful—something like a gypsy violin played by a talented Austrian musician. Roberto, who showed me that what is most important is really to do what makes you happy. Johannes, with whom I wish that together we will be able to translate sustainability theory into action. Erik, “didbythewayoutosedown or vamosdespues?”

Along the lines of the powerful combination of friendship, ideals, and communion of scientific interest I have the possibility to express at once all my gratitude and esteem to Federica, Gonzalo, Violeta, Sara, Giuseppina, Jaime, Pere, Tarik, Nancy, Talía, Elena, members of the most wonderful and stimulating working group I ever been part of (www.ruralsystems.org) and the other members of our IASTE research group (http://iaste-researchgroup.org/) in particular Alev, Cristina, Zora, François, Sandra, Maria, Amaranta, Meera, Kozo Mayumi, and Jesús Ramos-Martin. As if this was not enough, at ICTA I had the possibility to share ideas, discuss, learn, receive feedback from, and drink with the members of the Research & Degrowth group: Giorgos, Federico, Viviana, Christian, Claudio, Christos, François, Filka, Marta, Iago, Beatriz, and Mariana. From the Ethnoecology Laboratory I want to thank Esteve, Ana, and Pablo. Pablo and I, influenced by our studies on pastoralism, both become nomads. I hope our transhumant life will bring us back to the same rangelands soon. Finally, I want to thank Joan Martinez–Alier; his work is a huge source of inspiration for me, and in the ICTA extended family, Marco Armiero (KTH) and Stefania Barca (from CES) with whom I hope to collaborate in the future.

A second PhD/life-changing moment, has been the Thor Heyerdahl Environmental Governance summer school organized by Arild Vatn. Sincere thanks to Arild, attending the Summer School was critical in the development of my work. Elinor (Lin) Ostrom was one of the lecturers there. During this course I started a collaboration with Patrick, Orleans and Hassan, later extended to Floriane that I hope will be long-lasting. I am very grateful also because they allowed me to include our co-authored paper in this dissertation. With no doubts I can say Floriane's research represents one of the cornerstones of my work. With some reverential anxiety and naïve enthusiasm, at the end of the Thor Heyerdahl course, I told Lin that I had some (at the time very disorganized) ideas on modifying the IAD Framework and asked if she thought they made sense. The answer was, "*Apply to the visiting scholar program at the Workshop, and we will speak more about it in Bloomington*" plus a very friendly blink of her eye. I will never forget that moment and will forever be grateful for the opportunity she gave me. Now, after more than a year at the Ostrom Workshop, first as a visiting scholar and then as Research Associate, I have filled the inevitable void that I felt leaving the people of ICTA. The absence of Lin and Vincent is pervasive, but their incredible intellectual legacies echo in every person at the Workshop. I am incredibly grateful to Tom Evans, who gave me the chance to start working on an extremely interesting water governance research project that he wrote together with Lin. I feel that the enthusiastic encouragement and the responsibilities that he gave me have made me grow a lot scientifically and professionally.

At the Ostrom Workshop, I really want to thank Dan Cole, Burney Fischer, Armando Razo, and Mike McGinnis. They all have been strongly supportive with guidance, feedbacks, and suggestions during seminars, and with comments on drafts of papers. I also want to thank the staff of the Ostrom Workshop, who made me feel at home very soon and offered help at any occasion: Gayle, Patty, David, Emily, Ray, and Julie. However without the fellow visiting scholars and PhD students, Bloomington would not be as great: Sergin, Irene, Timor, and Tiago – we were way too dangerous together. Irene's help has been fundamental for the statistical analysis. I also want to thank Keith, Yukun, Sanchayan, Josefien, Graham, Ursula, Pepe, CY, Sean, Cathryn, Seleste, and Luke, with the hope of developing further collaborations in the future. Paul, thank you very much. If you didn't already have a twin I would be a good candidate. I also need to thank Joanna at CIPEC, who helped on the editing close to the submission deadline, *deus ex machina*, and Emilio, who has been there since the beginning and I hope will continue to be.

Elyse, I hope I didn't stress you too much with my stress, you have been like water for a thirsty runner in the last sprint. Sghirra, Bubba, Paco, Fra, Giulia, Matz, Irene, Maki, Andy, Angela, Tashi, and Roma – every time I come back to Rome you make it really difficult to leave again and I miss you from wherever I am.

Finally, I take this occasion to thank the columns of my life: my parents and my Brother. My grandparents and my uncles and anties are also a great source of love. My infinite gratitude goes to Chogyal Namkhai Norbu for making me understand that there is nothing to worry about and my *vajra* brothers and sisters for sailing together in this existential ocean.

Funding: This research was mainly conducted with the financial support of the XXIV Cycle of the PhD program in *Sviluppo Sostenibile e Cooperazione Internazionale* scholarship of the Centro Interuniversitario di Ricerca Per lo Sviluppo Sostenibile – Sapienza Università di Roma. Minor additional funding is aknowledged separately in some of the specific essays in the manuscript.

DISSERTATION ABTRACT

Governance of natural Common-Pool Resources (CPRs) is a central area of sustainability theory and practice. This arena generally lies at the interface between policy and science. Nevertheless, the conflict nature of CPR governance is often not systematically acknowledged in analytical approaches developed for the study of Social-Ecological Systems (SES) and specifically common-pool resources.

This dissertation integrates three different bodies of scholarship—Institutional Analysis/Commons Theory, Political Ecology, and Societal Metabolism—and discusses the complementarities and potentials for bringing them together. Moreover, based on this theoretical discussion, it proposes an integrated and modified version of Elinor Ostrom's Institutional Analysis and Development (IAD) Framework.

The dissertation illustrates the integration of the proposed modified version of the IAD Framework and its application to two case studies, both related to the governance of CPRs in conflict situations but significantly different in terms of geographical and political-economic contexts, institutional arrangements, and kinds of actors involved. Both cases are related to the ecological condition of critically important watersheds, and in both cases government plays a central role; however, the types of conflict and controversy show distinct characteristics. The two cases are not addressed in a comparative way but the take part in the same iterative theoretical/methodological/empirical process.

In the first case, the resettlement programs in the Sanjiangyuan area (literally, three river heads) in Qinghai, People's Republic of China, are investigated. In order to preserve the Sanjiangyuan area, which contains the watersheds of the Yellow, Yangtze, and Mekong rivers, the Chinese central government has implemented since the year 2000 a program with the aim of resettling the total nomadic population and move them from the grasslands to new, semi-urban conglomerates, transforming their system of production from a predominantly self-subsistence pastoral mobile system to a sedentary system and promoting their integration into the market economy.

In the second case, the policy-science interplay behind the geothermal development plans on Mount Amiata in Tuscany Region, Italy, is investigated. Mount Amiata is one of the most important freshwater reserves of central Italy. It has an aquifer that serves over 700,000 people in southern Tuscany and northern Lazio. However, independent studies, local environmental groups, and citizens associations point out that the geothermal activity is depleting and contaminating the Mount Amiata watershed and increasing the rate of degenerative diseases, morbidity, and mortality in the geothermal areas.

This dissertation is presented as a hybrid between a "book format" and "collection of essays format." It is developed in three parts. In Part I, the methodological, meta-theoretical, and theoretical background are discussed. Part II contains five stand-alone essays that relate to the applications and elaboration of the proposed modified IAD approach. In Part III, a conclusive discussion is presented.

Keywords
Institutional Analysis/Commons Theory, Political Ecology, Societal Metabolism, Sustainability Research, SES, IAD, Environmental Conflicts, Watersheds, Sanjiangyuan, Tibetan nomads, Amiata, Geothermal plants

TABLE OF CONTENTS

List of Figures ..... *xii*
List of Tables ..... *xiii*
List of Boxes ..... *xiv*
Acronyms and Abbreviations ..... *xv*

PART I – THEORETICAL ELABORATION

CHAPTER 1: Introduction
1 Stepping out of the system 1
2 Structure of the dissertation 3
3 From the Tibetan Rangelands to Mount Amiata 4
4 Synthetic abstracts of the chapters 8

CHAPTER 2: Methodologies and Methods
1 Methodological overview 13
2 Rationale for the integration of the IAD Framework 17

CHAPTER 3 Metatheoretical reflections on quality domains ofr sustainability research
1 Introduction 20
2 From sustainable development to sustainability research 22
3 Research on Sustainability Issues 23
4 Approaching quality 25
5 Quality assurance in sustainability research 26
6 Discussion 35
7 Chapter's conclusions 37

CHAPTER 4: Theoretical Background And IAD Framework Integration
1 Introduction 40
Section 1: Theoretical Background
2 Sustainability and CPRs 43
3 Conventional Commons Theory/The Tragedy of The Commons 44
4 The "tragic" confusion between Open-Access and CPRs 46
5 Elinor Ostrom's contribution 48
6 Political Ecology 55
7 Societal Metabolism 58
Section 2: Integration of the Analytical Framework
8 The Institutional Analysis and Development (IAD) Framework 64
9 MuSIASEM 66

PART II – APPLICATIONS

II.A ”Politicizing” the IAD: Participation in different cases of NRM

CHAPTER 5: Discourse and practice in participatory conservation: exploring how it varies in different geo-political settings

1 Introduction 71
2 Participation and natural resources conservation 72
3 Methodology 76
4 Case Studies 77
4.1 Zambia....78
4.2 Kenya 81
4.3 U.S....84
4.4 Tibetan rangelands (People’s Republic of China)....88
5 Discusion 91
6 Conclusions....94

II.B Integrating the politicized version of IAD with Societal Metabolism: The Tibetan nomads’ resettlement case

CHAPTER 6: The sedentarization of Tibetan nomads: conservation or coercion?

1 The Sanjiangyuan environmental protection policy 97
2 Geographical and historical information....98
3 The general development policy context: “open up the west”....101
4 Tibetan Nomads 102
5 Consequences of the Sanjiangyuan environmental policy....103
6 NGO dilemma 112
7 Discussion 115

CHAPTER 7: Neoliberalism and metabolic patterns in the Tibetan rangelands: the resettlement transformation

1 Introduction....120
2 Case Study Background and Theoretical Approach....121
3 Methodology 125
4 Methods....129
5 Results....132
6 Discussion 115

CHAPTER 8: A great transformation: resettlement policies, institutions and metabolic patterns in the Tibetan rangelands

1 Introduction 142
2 Methodology and methods 143
3 Modified IAD Analysis 146
3.1 Action Arena 147
3.2 Political-economic context 147
3.3 Discourses 148
3.4 Rules in use 149
3.5 Attributes of the Community 154
3.6 Biophysical Conditions 155
3.7 Metabolic Patterns 157
3.8 Patterns of interaction & (Policy) Outcomes 158
3.9 Evaluative Criteria 159
4 Essay's conclusive discussion 160

II.C Using "IAD" to study possible bias in the use of science for governance – the case of geothermal power development on Mount Amiata

CHAPTER 9: Some politicians only drink bottled water? A case study on the policy-science dynamics of the Amiata geothermal power plants development

1 Introduction 167
2 Theoretical background 170
3 Data Collections Methods 173
4 Case Background 173
4.2 Socioeconomic characteristic of the area 176
4.3 Geothermal power development 177
4.4 Geothermal generation in Italy and on Monte Amiata 180
4.5 The Mount Amiata geothermal development plan 181
5 IAD integrated Analysis 184
6 Conclusive Discussion 195

PART III – FINALE

CHAPTER 10: CONCLUSIONS

1 Review of the chapters as stand-alone papers 201
2 Unifying and emerging characheristics 203
3 Conclusive final discussion on the integration of the IAD Framework 206

References *218*
Annex A *237*
Annex B *240*

LIST OF FIGURES

Fig. 2.1. Politicised IAD framework....17
Fig. 2.2. Integrated IAD Framework....18
Fig. 3.1. Research characterized by the motivations that inspire it....24
Fig. 3.2. Post-Normal Science....24
Fig. 3.3. Quality domains and strategic questioning approach....37
Fig. 4.1. Institutional Analysis Development Framework....65
Fig. 4.2 Politicised Institutional Analysis and Development Framework....66
Fig. 4.3. Integrated IAD Framework....67
Fig. 5.1. Politicised Institutional Analysis and Development Framework....77
Fig. 6.1. Map of Tibet Autonomous Region, Qinghai and surrounding regions in PRC....95
Fig. 6.2. Traditional pastoralist practices....103
Fig. 6.3. Transformations of the metabolic patterns and transport....108
Fig. 7.1. Map and fieldwork sites....127
Fig. 7.2. Resettlements....129
Fig. 7.3. Flow/fund representation of Household Averages for the Traditional Village Sample....134
Fig. 7.4. NFEA – herd size – productive total own land – correlations among monetary groups of the RES and TV....138
Fig. 8.1. Nomadic women during daily pastoral activity....141
Fig. 8.2. Resettlement site....143
Fig. 8.3. Integrated IAD framework....145
Fig. 8.4. Resettlement posters....148
Fig. 9.1. Amiata population trends....148
Fig. 9.2. Italy gross electricity generation by source in 2010....177
Fig. 9.3. Tuscany gross electricity generation by source in 2009....177
Fig. 9.4. Geothermal generation in Tuscany....178

LIST OF TABLES

Table 1.1. Synthetic description of main aspects of the cases studied 7
Table 1.2. An overview of the publication status of different chapters 12
Table 1.3. Summary of the methodological features for the singular parts of the dissertation 15
Table 1.4. Interviews 16
Table 4.1. Definitions of types of goods in mainstream economics 44
Table 5.1. Typologies of participation: how people participate in natural resource conservation 74
Table 7.1. Characteristics of sampled population 132
Table 7.2. Traditional village aggregated metabolic data 132
Table 7.3. Correlations among working family members, monetary flow per year, herd size, total peroductive owned land, and NFEA 136
Table 7.4. Average characteristics of the different household types calculated by the univariate clustering test and difference calculated with the Kruskal-Wallis test 137
Table 8.1. Posters discourses 149
Table 8.2. Historical reconstruction of institutional arrangements in the case study area 150
Table 8.3. Working rules in the traditional nomadic village and resettlement site 153
Table 9.1. Social actors 188

LIST OF BOXES

Box 4.1. Clarifying common-pool resources and common-property regimes.....47
Box 4.2. Institutional economics theoretical background synthetic review 49
Box 4.3. Microsituational variables 53
Box 4.4. Ostrom's design principles 54
Box 6.1. Traditional ecological knowledge 96
Box 6.2. Keystone species 106
Box 6.3. Complexity 108
Box 6.4. Environmental governance.....112
Box 9.1. Rebels and mystics onMount Amiata.....173
Box 9.2. Epidemiological transition, health, and environment.....180
Box 9.3. Highlights of the General Protocol on Geothermal Power 183
Box 9.4. Stances of the geothermal development "opposers" 189

ACRONYMS AND ABBREVIATIONS

ARPAT	Agenzia Regionale per la Protezione Ambientale della Toscana
ARS	Regional Health Agency
CCP	Chinese Communist Party
CEGL	Centro di Eccelenza per la Geotermia di Lardarello
CIRPS	Centro Interuniversitario di Ricerca per lo Sviluppo Sostenibile
CM	Comunità Montana
CMAVO	Comunità Montana Amiata Val d'Orcia
CPRs	common-pool resources
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization of the United Nations
GSE	Gestore Servizi Elettrici
IAD	Institutional Analysis and Development Framework
IASC	International Association for the Study of the Commons
ICTA	Institut de Ciència i Tecnologia Ambiental
IMF	International Monetary Fund
IRPET	Istituto Regional Programmazione Economica della Toscana
JFM	joint forest resources management
MEA	Millennium Ecosystem Assessment
MuSIASEM	multi-scale integrated assessment of social ecological metabolism
NFEA	non-farming economic activities
NGOs	non-government organizations
NIE	new institutional economics
NRM	natural resource management
PE	political ecology
PLA	People's Liberation Army
PRC	People's Republic of China
RES	Resettlement
SES	social-ecological systems
TAR	Tibetan Autonomous Region
TV	traditional village
UNDP	United Nations Development Programme

WB	World Bank
WCED	World Commission on Environment and Development

PART I – THEORETICAL ELABORATION

CHAPTER 1

INTRODUCTION

1 Stepping out of the system

Common-pool resources (CPRs) and natural resource management (NRM) are central parts of sustainability research and social-ecological systems (SES) analysis. The multi- and interdisciplinary epistemological and ontological features of SES research (Farrell et al. 2013) greatly amplify the range of possible methodologies, approaches, and epistemologies that can apply. The integration of different approaches, which could strengthen the potential to understand complex sustainability issues, inevitably leads to fundamental theoretical questions that can create disciplinary conflicts.

Moreover, sustainability research and SES analysis have a subversive nature, both in political and scientific terms. Dealing with sustainability issues in a world where the "tragedy of Anthropocene" is the greatest "success of reductionism" (Farrell et al. 2013, p.1) raises fundamental questions about the political responsibilities of science, the role of politics in the production of science, and the mutually embedded nature of the relationship between science and politics. This inevitably raises questions about the role of the scientist. As a "sustainability researcher," I have reflected on what it means to be part of, using the words of Jasanoff (1996), the system of production of knowledge and social order and what it means to be reflexive and critically step out of this dialectic, and thereby question its fundamental epistemological assumptions.

For this reason, although interdisciplinary SES studies and sustainability research are constantly expanding, there are basic questions that need to be addressed when dealing with sustainability issues in a critical way. According to the positivistic tradition, rigorous science is objective, and aims at providing truth. In this hegemonic and historically consolidated system of knowledge production, what it means to conduct rigorous scientific research is straightforward and follows clear criteria. Nevertheless, because of the irreducible complexity of the problems it addresses, and the political aspects of human-nature interrelations, sustainability research is unavoidably characterized by uncertainty and cannot be considered neutral. Funtowicz and Ravetz (1994b)

propose that "post-normal science" conditions, which characterize sustainability research problems, imply that the pursuit of "truth" should be replaced by the concept of procedural "quality." The meta-theoretical aspects of this debate and the practical sides of how I dealt with this conundrum are presented in **Chapter 3** *Meta-Theoretical Reflections on Sustainability Research.*

In an anthropogenic way, a core aspect of sustainability research is defined as governance of natural common-pool resources. Object of study since the work of the XVIII century classical political economist, the double exposure problem of resource scarcity and population pressure, represents an urgent matter due to its incremental speed. The definition of sustainability (in its different weak, strong, and very strong interpretations) focuses on the notion of natural capital, clearly addresses the issue of natural resources (as both sink and source) exploitation. Natural resources, for their specific ontological characteristics, often fall under the definition of *common-pool resources*.

This dissertation draws specifically on the seminal work of Elinor Ostrom (1933–2012) in CPRs, with particular attention to the elaboration and application of the Institutional Analysis and Development (IAD) framework. The work of Professor Ostrom is a guiding element of this dissertation, but following the critique developed by Clement (2010; Clement and Amezaga 2008), I integrate the IAD Framework with notions and concepts from political ecology and societal metabolism. Therefore, in **Chapter 4**, *Theoretical Background and IAD Framework Integration,* I first present the rationale and motivation for the integration of these three different bodies of scholarship: (1) Institutional Analysis/Commons Theory, (2) Political Ecology, and (3) Societal Metabolism. Second, I elaborate on the possibilities of modifying the IAD Framework with new building blocks that are instrumental to bring together potential complementarities of the three bodies of scholarship that have influenced my approach and work. With the intention of integrating the simultaneous consideration of human institutions and biophysical factors, my modified version of the IAD Framework is proposed as a possible option for CPR governance analysis in conflict contexts.

The proposed re-elaboration of the IAD Framework is the result of an iterative learning process that I followed during the course of my PhD work, which has been characterised by mutually influential deductive and inductive tensions. I have developed the theoretical elaboration under the influence of supervisors and colleagues in three different research institutions and by dealing with the necessity of dealing with complex empirical cases and looking for a way to tackle them. Likewise, the

empirical component of this work is informed theory but with a heuristic and self-reflexive attitude. Therefore the order of the discourse of the dissertation is not a representation of the chronological development of my work nor follows a linear consequentiality. I believe that, apart from the theoretical, methodological, and empirical outcomes of this work, the process itself is an important result.

2 Structure of the dissertation

This dissertation is presented as a hybrid between the 'book format' and the 'collection of essays format'. It is developed in three parts with a central part where three different subsections and four stand-alone essays relate to the applications and elaboration of the proposed approach. The four essays are stand-alone works but instrumentally connected because through a different design of the IAD Framework in the essays it is possible to discuss the limitations and the improvements of the proposed modification to the framework in the dissertation's conclusion.

In **Part I**, following this brief introduction, I illustrate the overview of methodologies and methods (Chapter 2). Then I introduce a meta-theoretical reflection on sustainability research and the post-normal science conditions that characterize this interdisciplinary field of inquiry (Chapter 3). A theoretical background chapter (Chapter 4) follows.

In **Part II,** I present in three subsections three different applications. First, in II.A I introduce the politicised version of the IAD Framework as proposed by Clement and Amezaga (2008) and with the joint effort of four other researchers, address the problem of participation in NRM and CPR governance in four different case studies in Kenya, Zambia, USA, and Tibet (China). (In this paper three case studies are borrowed from the co-authors of the paper). In this subsection I present the essay *Discourse and practice in participatory conservation: exploring how it varies in different geopolitical settings* (Chapter 5).

Second, in II.B I introduce the integration of the politicized version of IAD with societal metabolism, by referring to the Tibetan nomads' resettlement case in the Sanjiangyuan area of Qinghai, People's Republic of China. In this subsection I present three essays that relate to the different aspects of the IAD Framework elaboration and building blocks modification and to the theoretical complementarities between the three theoretical bodies that I draw on. The first essay is

The sedentarization of Tibetan nomads: conservation or coercion? (Chapter 6), which first introduces the background information for the Tibetan rangelands case study and overviews the political-economic context, relevant geographical and historical information, and the general policy context. Second, it introduces the Sanjiangyuan environmental policy with a focus on the resettlement programmes. The next essay of the subsection is *Neoliberalism and metabolic patterns in the Tibetan rangelands: the resettlement transformation* (Chapter 7), which specifically focuses on the relationship between metabolic patterns and politics. Last in the subsection is *A great transformation: resettlement policies, institutions and metabolic patterns in the Tibetan rangelands* (Chapter 8), which provides an integrated analysis of the resettlement and sedentarization programmes of the Tibetan nomads in the Sanjiangyuan using the IAD Framework.

The last subsection of Part II (II.C) illustrates the use of the IAD Framework to study possible bias in the use of science for governance with specific reference to the case of geothermal power development on Mount Amiata in Italy. I present the essay *Some politicians only drink bottled water? A case study on the policy-science dynamics of the Amiata geothermal power plants development* (Chapter 9), which investigates the policy-science interface of this complex and contested process of legislative activity and decision making. Therefore, this chapter deals with the expansion of the geothermal industrial power plant and the conflicts that arise with the preservation of the most important watershed of central Italy.

Finally, in **Part III,** I present the conclusions (Chapter 10) where I elaborate on the methodological, theoretical, and empirical aspects that emerged in this dissertation. In particular, I discuss the importance of an analytical framework for commons and conflicts that includes the fields of Institutional Analysis, Political Ecology, and Societal Metabolism. A final section includes the list of references cited in the whole dissertation and the appendix.

3 From the Tibetan Rangelands to Mount Amiata

When I first described the research project of this dissertation I had to answer several times the following questions: “What do the Tibetan Rangelands and the Tuscan Mount Amiata have in common?” “What justifies this research design?” and “How to conduct a comparative analysis between two contexts that are so different in terms of geographical, cultural, ecological, and political dimensions and have such different variables and problems to be addressed in the study?” I

must confess that I was not sure how to answer these formal questions. I had the insight that there were some characteristics in the issues that I was interested in that unified those two very different situations, but I was not able to express a clear comparative analysis research design.

In both cases, there was very little research and very few publications on the issues to be addressed. For this reason I opted for an exploratory approach (Nagy et al. 2011). Inspired by grounded theory (Glaser and Strauss 1967). I looked at the emergence of information rather than looking for confirmations of my theoretical preconceptions. In this way the research design has evolved and adapted to the analysis during the progress of the study. As a matter of fact, the two study cases have been since the beginning thought separately without a comparative design and for the sake of the PhD accomplishment, I initially intended to submit the different outcomes of the research as independent papers in the compilation of papers format.

However, by applying the same theoretical and methodological/analytical framework to these two different cases I started to appreciate certain unifying characteristics, in the words of Hukinnen (1999). Hukinnen (1999), studying four different cases of environmental management from Finland, Colorado, and China, deals with the same problem of addressing a multiplicity and diversity of contexts. He finds this to be an enriching process to contrast and compare his methodological and theoretical framework. He identifies uncertainty, complexity, and relatively large temporal and spatial scales as unifying characteristics of his cases. Hukinnen (1999) looks at very different cases of environmental management in different sociopolitical contexts, each with specific features, insights, discussions, and lessons learnt. However this heterogeneity of cases produces emergent outcomes on the importance and limits of institutional change. Moreover, he is able to identify a binding feature in such a diverse range of cases: an incompatibility between the short-term environmental managers' actions that are directly influenced by individual and organization professional credibility and legitimacy and long-term sustainability criteria.

In this dissertation, two cases are addressed not in a comparative way but as part of the same iterative empirical–methodological–theoretical process. The two cases are both related to the governance of CPRs in conflict situations. Significantly different in terms of geographical and political-economic context, institutional arrangements, and kinds of actors involved. Both cases are related to the ecological condition of critically important watersheds, and in both cases government plays a central role; however, the types of conflict and controversy show distinct characteristics.

In the first case, the resettlement programmes in the Sanjiangyuan area (literally “three river heads”) in Qinghai, People's Republic of China, are investigated. In order to preserve the Sanjiangyuan area, which contains the watersheds of the Yellow, Yangtze, and Mekong rivers, the Chinese central government has implemented since the year 2000 a program with the aim of resettling the whole nomadic population and moving them from the grasslands to new, semi-urban conglomerates, transforming their system of production from a predominantly self-subsistence pastoral mobile system, to a sedentary system and promoting their integration in the market economy.

The fundamental initial justification for this massive program, that extended its objectives to the resettlement and sedentarization of every Tibetan nomad in Qinghai (about 160,000 people), was based on a simple equation (reminiscent of Hardin's famous discourse of 1968): “pastoral herders seeking the maximization of their personal utility increase their herds, which leads to overgrazing, which produces land degradation. Land degradation is considered the main threat to the ecological health of the Sanjiangyuan's watersheds, which is the cause of the hydrological instability (violent alternation of droughts and flooding) of the main rivers of China.”

Therefore, the proposed solution is to remove the nomads from the grasslands. Very little independent research has been conducted on this narrative and there is no scientific evidence that the resettlement policies are beneficial for the ecological integrity of Qinghai. Moreover, the targeted population manifests discontent and international Tibet support groups denounce that the resettlement policies can also be interpreted as a system of cultural eradication and eviction.

In a second case, I investigate the geothermal development plans on Mount Amiata in Tuscany Region of Italy. Mount Amiata is one of the most important freshwater reserves of central Italy. It has an aquifer that serves over 700,000 people in southern Tuscany and northern Lazio. However, since 1958 a program of geothermal electric energy production has been developed in the watershed areas of Mount Amiata. In 2007, a programmatic agreement between the Tuscan Regional Government and ENEL Spa (the largest Italian power company, which has the Italian Ministry of Economy and Finance as the majority shareholder with 31.24% of the shares) stated that the installed power of geothermal power plants on Mount Amiata would rise from 60 MWp to 200 MWp by 2020. The agreement recognizes considerable funding and compensations for the municipalities located in the territory of interest and declares that the program has to be conducted with no contamination of the ecosystem or negative consequences for the health of the local

population. However, independent studies, local environmental groups, and citizen associations point out that the geothermal activity is depleting and contaminating the Amiata watershed and increasing the rate of degenerative diseases, morbidity, and mortality in the geothermal areas.

Table 1.1. Synthetic description of main aspects of the cases studied

	AMIATA	**SANJIANGYUAN**
Problem addressed	Geothermal electric energy power plants expansion and conflict with the Amiata watershed preservation and local population	Resettlement of the overall Tibetan Nomadic population in the Yangtze, Mekong and Lacan Rivers watersheds area (Sanjiangyuan)
Ecological issues	Depletion and Pollution of the Amiata Aquifer and Fiora watersheds. Atmospheric and soil contamination with heavy metals and toxic elements	Increase hydrological instability of the Yangtze, Mekong and Lacan Rivers. Rangelands degradation
Social issues	Water provision for 700 thousand people. Epidemiological concern with local population.	Drastic transformation of the life, system of production and culture of over 160 thousand nomads. Increasing discontent.
Political broad context	Parliamentary Republic	Centralized Authoritarian Government
Institutional Arrangements for the natural resource considered	Mix of private-public hybrid institutional arrangements varying according to specific issues.	Tendency of transformation of pastures institutional arrangements from a common-property regime system to a private ownership (50 years right use) to an open access
Driving Discourses	Opposing discourses of: Geothermal Electric Energy production as clean, natural and renewable and as dirty, polluting, cancerous, watershed depleting	Developmental Discourse, Tibetan nomads as "backward", Public (Chinese) Education as mean of social advancement, Tibetan pastoral system threat to the environment and watersheds stability.

	AMIATA	SANJIANGYUAN
Scale of Analysis	1.Institutional Arrangements analysis at: ▪ communal level ▪ regional level ▪ national level 2. Policy Analysis at: ▪ communal level ▪ regional level ▪ national level ▪ EU level 3. Policy-science interface analysis: ▪ regional level ▪ national level ▪ international level	1. Resettlement VS Traditional village institutional arrangements and metabolic comparison at the: ▪ household level ▪ village level 2. Policy and Discourse analysis at the: ▪ village level ▪ provincial level national level
Demographic issues	Aging of the overall Italian population. Specific for Mount Amiata: strong demographic reduction in the last 60 years – the population reduced by 1/3 from 1950 to 2006 (CMAVO 2009).	One Child Policy for the Han population, 2 Child Policy for the Minorities (between the Tibetan nomads this rule is often breached)
Conflict and Controversies	Local groups, independent studies and environmental activists denounce the contamination of the Mount Amiata, depletion of the Aquifer, increase in mortality and morbidity rates and that the scientific and authorization process has been biased	Tibetan nomads manifest discontent for the resettlements. International organization and Tibetan support groups accuse the Chinese government of cultural eradication and eviction.
Level of Participation	Participation by consultation	Manipulative participation
Current situation	October 2012, the Environmental Impact Office of Regione Toscana has approved the enlargement of the main power plant with prescriptions	In 2011 the Chinese central government claims to have resettlement 100 thousand nomads over 160 thousand

4 Synthetic abstracts of the chapters

Chapter 2 *Methodologies*

This chapter illustrates the different methodologies and methods mentioned or used in the various parts of the dissertation and briefly presents general methodological issues.

Chapter 3 *Meta-theoretical reflections on sustainability research*

This chapter illustrates some meta-theoretical reflection on sustainability research and the problem of quality assurance in SES and interdisciplinary fields of enquiry. Conducting research on sustainability issues often has to deal with "post-normal" scientific conditions (i.e. facts are uncertain, values are in dispute, stakes are high, and decisions are urgent; Funtowicz and Ravetz, 1991). Moreover, sustainability research requires a high degree of transdisciplinarity for the different dimensions that address it at the same time. For these two reasons, traditional standards of quality criteria do not hold and it seems useful to make transparent and explicit the methodological pre-assumptions. In this chapter, eight heuristic quality domains for sustainability research are proposed and discussed.

Chapter 4 *Theoretical background*

This chapter is the theoretical backbone of this dissertation. In the first section, Commons Theory and Institutional Analysis, Political Ecology, and Societal Metabolism are reviewed and the potential complementarities discussed. Then, in the second section, drawing on this theoretical review and elaboration, a modification of the IAD Framework is proposed. It is modified with new building blocks that are elaborated in order to integrate tools from political ecology (i.e. discourse analysis) and connect to the possibility of operationalizing notions derived from societal metabolism (i.e. MuSIASEM).

Chapter 5 *Discourse and practice in participatory conservation: exploring how it varies in different geopolitical settings*

This essay explores through institutional analysis how and why participation in natural conservation programmes varies substantially in different geopolitical settings. The same IAD Framework is applied to characterize four case studies from four different continents. The analysis is based on the original version of the IAD Framework (Kiser and Ostrom 1982; Ostrom 1994, 2011) and on the contribution of Clement and Amezaga (2009) and Clement (2010) that integrates the political ecology (PE) perspective with the IAD Framework.

Chapter 6 *The sedentarization of Tibetan Nomads: conservation or coercion?*

This essay introduces background information for the Tibetan rangelands case study. It overviews the political-economic context, relevant geographical and historical information, and the general policy context. Second, it introduces the Sanjiangyuan environmental policy with a focus on the resettlement programmes.

Chapter 7 *Neoliberism and metabolic patterns in the Tibetan rangelands: the resettlement transformation*

This essay specifically addresses the resettlement and sedentarization policies in the Sanjiangyuan area. The text elaborates specifically on the relation between metabolic patterns (land-use change, human activity, herd size), the funds and flows, and the political change. In this chapter political transformation is interpreted following Harvey's (2007) definition of *neoliberalism* with Chinese characteristics.

Chapter 8 *A great transformation: resettlement policies, institutions, and metabolic patterns in the Tibetan rangelands*

This essay introduces a modified version of the IAD Framework applied to conduct an "integrated" institutional analysis that merges the traditional IAD Framework with a version of developed by Clement and Amezaga (2009). Moreover, this application adds the metabolic patterns component. The objective of this essay is to analyse and describe the major transformations that are occurring in the case of the Tibetan nomads' resettlement policies through an institutional analysis – societal metabolism – political ecology perspective.

Chapter 9 *Some politicians only drink bottled water? A case study on the policy-science dynamics of the Amiata geothermal power plants development*

This chapter first introduces background information for Mount Amiata Geothermal

Energy/Water case presenting information about the historical background, the socioeconomical characteristics of the area, specific aspects about geothermal development, and the Italian energy context. Second, it presents an institutional analysis based on a modified IAD Framework, of the policy-science dynamics that rule the geothermal power exploitation on Mount Amiata and the connected risk of watershed deterioration and the consequent conflict with the local communities and environmental organizations.

Chapter 10 *Conclusive discussion*

The conclusions provide a review of the major findings of the dissertation referring to the different cases and discuss the methodological and theoretical values contribution. In particular, the pros and cons of the integration of the fields of Institutional Analysis/Commons Theory, Political Ecology, and Societal Metabolism are discussed. This last chapter also aims at laying the groundwork for the development of an integrated approach for the study of commons and conflicts.

Table 1.2 An overview of the publication status of different chapters

Chapter	Title	Chapter's co-authorship	Current publication status or presentation
3	*Meta-theoretical reflections on sustainability research*		A different version of this chapter will be submitted with the co-authorship of Katharine N. Farrell and Arnim Scheidel
5	*Discourse and practice in participatory conservation: exploring how it varies in different geopolitical settings*	Co-authored by J. Dell'Angelo, O. Mfune, H. Roba, P. Bixler, F. Clement	Published in *Proceedings of the Thor Heyerdal Summer School of Environmental Governance, Aas, Norway, 20 June -1st July 2012*
6	*The sedentarization of Tibetan nomads: conservation or coercion?*		Published in *Ecological Economics from the Ground Up*, ed. H. Healy, J. Martinez-Alier, L. Temper, M. Walter, J.F. Gerber. Routledge, London, 2012
7	*Neoliberalism and metabolic patterns in the Tibetan rangelands: the resettlement transformation*		A different version of this chapter, in co-authorship with Katharine N. Farrell and Irene Iniesta, has been accepted for the special issue of *Environment, Development and Sustainability* "Pathways of rural change: an integrated assessment of the metabolic patterns of emerging ruralities" (forthcoming).
8	*A great transformation: resettlement policies, institutions, and metabolic patterns in the Tibetan rangelands*		Work presented at The Vincent and Elinor Ostrom Workshop in Political Theory and Policy Analysis Colloquia 2012. To be submitted in co-authorship with Katharine N. Farrell and Mario Giampietro
9	*Some politicians only drink bottled water? A case study on the policy-science dynamics of the Amiata geothermal power plants development*		A reduced version of this chapter has been published in The Vincent and Elinor Ostrom Workshop in Political Theory and Policy Analysis Mini Conference 2012 proceedings, Bloomington, IN, USA.

CHAPTER 2
METHODOLOGIES AND METHODS

1 Methodological overview

This dissertation has been developed as a hybrid between a monographic manuscript and a collection of essays. The hybrid choice of this format is due to several reasons.

The itinerary of my PhD has been characterized by high mobility. Excluding my fieldwork on the Tibetan Rangelands in Qinghai and on Mount Amiata in Tuscany, I spent the time of my PhD time almost evenly distributed between: (1) CIRPS Sapienza in Rome, Italy; (2) ICTA – UAB in Barcelona, Spain; and (3) The Vincent and Elinor Ostrom Workshop in Political Theory and Policy Analysis in Bloomington, Indiana, USA. This "delocalized" pattern of activity gave me the chance to collaborate with a large number of researchers and to be influenced by different perspectives.

Concepts such as multidisciplinarity and transdisciplinarity essential for social-ecological systems and sustainability analysis (Munda 2004; Max-Neef 2005) started to reflect in a very practical way on my work. I have been supervised by scholars and collaborated with other fellow PhD students with very different scientific backgrounds (most of them with multidisciplinary training themselves). For example, referring to my close supervisors, their academic backgrounds range from political science and economics to engineering and chemistry. But in referring to the scholars from research groups, working groups, and colleagues I have collaborated with, the list of disciplines would be way too long, including some degree of experience in most of the humanities and hard sciences. In such a multiperspective and multidisciplinary scientific working environment, the importance of "Working Together" (Poteete et al. 2010) becomes a methodological necessity. Therefore, one of the practical consequences of working together in the sustainability arena can be to focus on the production of papers rather than an individual effort on a manuscript.

However, because I propose a conceptual modification to an analytical framework, I believe the four essays that I present should be tied together in an organic manuscript that has as a final conclusion with a methodological discussion of the proposed IAD Framework modification. The

work of Hukkinen (1999) in *Institutions in Environmental Management* is organized in a similar way, and I have found that to be a useful model for organizing my dissertation. His book is divided into three parts. In the first part he introduces some of the theoretical background for institutions and their analysis, while in the central part he presents four chapters (that were previously partially published as stand-alone scientific papers) on four different case studies of environmental management from Colorado, California, Finland, and China, and finally in the third part he addresses a discussion on principles of institutional reform. Therefore, the structure of this dissertation is similar to Hukinnen's book structure. As in Hukinnen (1999), this dissertation addresses two cases from different geographic areas: Europe and Asia (in my case, Italy and China). This is done without a cross-national comparative intent. However, the heterogeneity of the case studies is interesting for the application of the same theoretical and methodological background. The structure of the dissertation that has already been illustrated in the previous chapter is built on three parts plus conclusions.

The methodological component of this dissertation is central. This work proposes an integration of the analytical IAD Framework (Kiser and Ostrom 1982; Ostrom 2010), which is modified and integrated with "building blocks" (Ostrom 2010: 646), or in other words, analytical categories, that draw from political ecology and societal metabolism. This re-elaboration of the IAD Framework brings together different streams of scientific literature that I believe are complementary for understanding CPR issues, with particular attention to contested and conflict contexts. Chapter 4 describes the theoretical background in which the second section specifically refers to my modification of the IAD Framework.

The underlying methodological assumptions of this dissertation refer to three main points. First, the dissertation draws on the concept of post-normal science (Funtowicz and Ravetz 1992, 1993,1994b) with particular attention to the boundary between ethics and epistemology (Farrell 2009). Second, it aspires to inter- and intradisciplinary methodological pluralism by bringing together different theoretical backgrounds for the development of an integrated analytical framework. Third, it is predominantly based on a heuristic, deductive (theoretically informed), and self-reflexive approach rather than on an inductive positivistic one.

However, the methods that are applied in this work, and their justifications, vary according to the different levels and parts/chapters of the dissertation. In particular in Part 3, the stand-alone essays/papers have their specific methodological sections where the methods used are illustrated.

Table 1.3 Summary of the methodological features for the singular parts of the dissertation.

Chapter	Training and methods applied	Analytical framework
3. Meta-theoretical reflections on sustainability research	▪ Literature review ▪ Discussion with co-authors of the text ▪ Methodological workshop with 15 sustainability researchers	
4. Theoretical background	▪ Literature review ▪ Discussion with supervisors ▪ Discussion with fellow PhD students at three different research institutions ▪ Participation to the Thor Heyerdahl 'Environmental Governance: Institutions for Sustainable Development'. ▪ Participation to the Ostrom Workshop course in Institutional Analysis and Development	
5. "Discourse and practice in participatory conservation . . ."	▪ Literature review and grey literature review ▪ Fieldwork ▪ In-depth interviews with relevant stakeholders and Tibetan nomads ▪ Focus groups ▪ Posters discourse analysis	Clement's (2010) modified version of the Institutional Analysis and Development Framework
6. The sedentarization of Tibetan nomads: conservation or coercion?	▪ Literature review and grey literature review ▪ Fieldwork ▪ In-depth interviews with relevant stakeholders and Tibetan nomads	

Chapter	Training and methods applied	Analytical framework
7. Neoliberalism and metabolic patterns in the Tibetan rangelands: the resettlement transformation	▪ Literature review and grey literature review ▪ Fieldwork ▪ In-depth interviews with policy makers and stakeholders ▪ Focus groups ▪ Descriptive statistics ▪ Flow-fund analysis	▪ MuSIASEM
8. A great transformation: resettlement policies, institutions, and metabolic patterns in the Tibetan rangelands	▪ Literature review and grey literature review ▪ Fieldwork ▪ In-depth interviews with policy makers and stakeholders ▪ Focus groups ▪ Posters discourse analysis	▪ Proposed modified version of the Institutional Analysis Development Framework
9. Some politicians only drink bottled water? A case study on the policy-science dynamics of the Amiata geothermal power plants development	▪ Literature review and grey literature review ▪ Fieldwork ▪ In-depth interviews with policy makers and stakeholders ▪ Focus groups ▪ Participatory methods	▪ Proposed modified version of the Institutional Analysis Development Framework

Table 1.4, instead, describes the number of interviews and fieldwork duration for the two different case studies.

Table 1.4. Interviews

Case studies:	Fieldwork duration	In-depth interviews	Focus groups
Sanjiangyuan	September-October 2011	75	3
Amiata	March, August, and September 2011 (with followups via skype, telephone, mail throughout 2013)	29	2

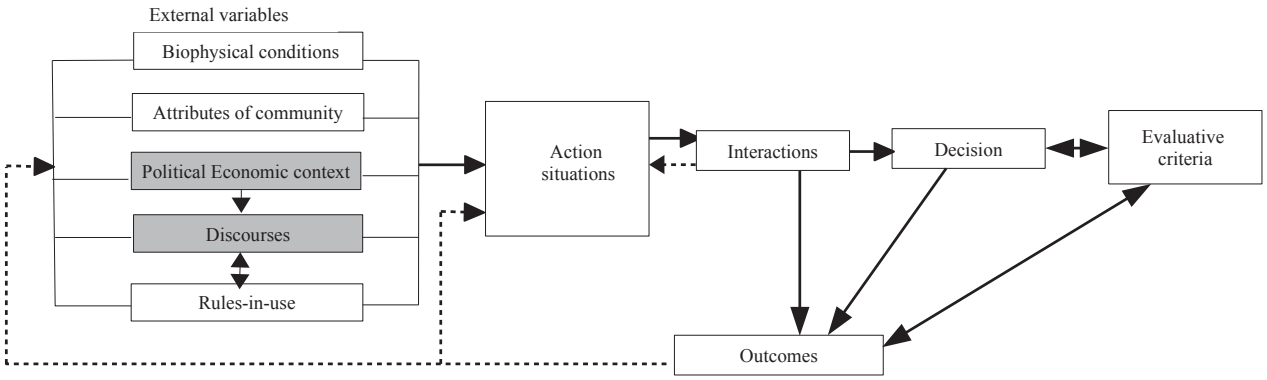
The methods vary according to the different parts of the dissertation. However, the methodological approach has been consistent in this work, a degree of epistemological openness and inclination towards the integration of different methodologies has been a red line in the work. Qualitative

methods cover an important role in this work. However, the metabolic patterns analysis has involved quantitative analysis and basic statistical methods.

2 Rationale for the integration of the IAD Framework

This dissertation applies the IAD Framework (described in detail in Chapter 4) to two case studies and explores the possibilities to modify and integrate the framework. The modification/integration of the framework is theoretically justified at the beginning of the dissertation, in Chapter 4. However, this elaboration has been produced in the course of the analysis of the case studies and not preconceived inductively. For this reason, the essays part of the dissertation (Part III) is a representation of the evolution of the integration/modification of the framework, which is presented as a starting point but should be considered mostly as an outcome of the research.

In the first essay (Chapter 8), the Amiata case is addressed applying the modified version of the IAD Framework as proposed by Clement (2010).



Source: adapted from Clement 2010:139 and E. Ostrom 2010:646

Fig 2.1. Politicised IAD framework

The second essay is a collaborative work of multiple authors to bring together an array of different cases (Zambia, USA, Kenya) with the analysis of the Amiata and Tibetan Rangelands. The IAD Framework used is the modified version produced by Clement (2010).

In the third essay, the IAD Framework is not applied. The work specifically focuses on the

Flow/Fund Model of Georgescu-Roegen (1971) and the societal metabolism and metabolic patterns concepts operationalization (Giampietro et al. 2000; 2012) and the political dimension.

It is in the last essay where the previous modifications to the IAD Framework and the metabolic patterns analysis are brought together in the integrated version of the framework that I propose:

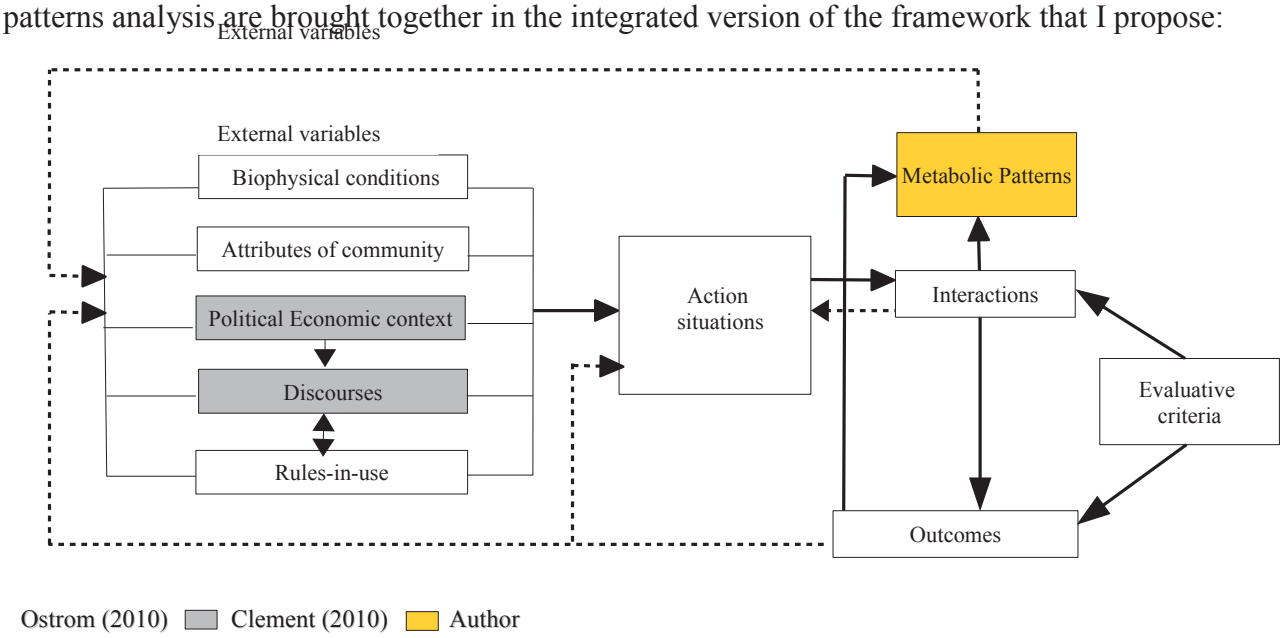


Fig 2.2. Integrated IAD Framework

The justification, and rational for this proposed revision of the IAD Framework that builds on Clement's (2010) critique is based on both a theoretical discussion addressed in Chapter 4 and the result of the empirical analysis. For this reason, in Chapter 4, the modified version of the IAD Framework that I propose is "anticipated." This might give the reader the impression that the modification of the framework was preconceived based only on a theoretical discussion and then inductively applied in the different essays in Part III. In reality, the illustration of the work follows this order: (1). methodology, (2) theory, (3) case studies analysis, and (4) conclusions. This sequence seems to reflect an inductivist approach but is presented in this way only for the sake of providing a linear logic. As a matter of fact, the presentation of this work does not correspond to the non-consequential evolution that is produced when going back and forth and from the case studies to theory and expanding the understanding of a case through theory and at the same time modifying the analytical framework both because of theory and because of the case studies analysis.

In the next chapter, I present some meta-theoretical reflections that are preparatory to the analysis and lay the groundwork of the epistemological presumptions of this dissertation. This is done by addressing the issue of self-reflexive quality assurance in sustainability research as an alternative to the positivistic quest for truth and objectivity. The next chapter is presented before the theoretical chapter in order to keep separate the specific theoretical discussion on which the IAD integration and analyses of cases are based.

CHAPTER 3

META-THEORETICAL REFLECTIONS ON QUALITY DOMAINS FOR SUSTAINABILITY RESEARCH

1 Introduction

Over the past four decades, starting with the United Nations Conference on the Human Environment held in Stockholm in 1972, terms such as "sustainable development" (WCED 1987) and "sustainability" have received considerable attention, within both science and politics. While the variety of research topics and approaches in this area is substantial, due to the many dimensions of sustainability, all the related research has one thing in common: it deals with issues that may significantly affect the medium- and long-term future viability of local societies and of the whole of humanity. Quality assurance in sustainability research is therefore of utmost importance.

This quality assurance is, however, a difficult task. The theory of "sustainability" and "sustainable development" is developed at the science–policy interface and associated research concerns a nearly endless number of issues, each having different properties, which inevitably involves multiple disciplines and their cooperation. While "normal science" has struggled in dealing with sustainability issues (Funtowicz and Ravetz 1993, 1994b), new epistemologies and methodologies have emerged, which in turn require new approaches to quality (Wickson et al. 2006).

This chapter is the result of the reasoning on what *rigorous scientific activity* means when dealing with sustainability issues in highly contested contexts. In this chapter, the Sanjiangyuan case of Tibetan nomads resettlement is referred to as the main example. The very high level of uncertainty and contrasting perspectives that characterize the case study on the resettlement of the Tibetan nomads in Qinghai leads to the necessity of developing a reflexive procedural approach to sustainability research in relation to the task of conducting quality assurance control.

In order to develop an approach for quality assurance, three main questions are addressed. First, what are the main theoretical implications for "quality" that can be derived from the fundamental epistemological characteristics of sustainability research? Second, how can "quality" be

adequately conceptualized within the broad field of sustainability research? And third, what may be useful approaches that can help to ensure quality when doing sustainability research?

Various authors have addressed different aspect of quality assurance within the study field of sustainability. For example whereas Farrell (2008; 2011a; 2011b), following Funtowicz and Ravetz (1990; 1991; 1992; 1994b; Ravetz, 1971; 1990), has focused on the question of how epistemological robustness and political legitimacy can be simultaneously retained, Kasemir et al. (2003), Norgaard (2004), and Max-Neef (2005) have focused on ensuring that scientific results are both relevant and robust. Others, such as Cash et al. (2003), Pereira and Funtowicz (2005) and Wickson et al. (2006) address the problem of how to apply quality control in complex transdisciplinary research settings. Wickson et al. (2006) have suggested the use of "strategic questioning."[1] Strategic questioning is an iterative and heuristic method, intended to improve researchers' understanding of both the objects and subjects of their studies, by inducing reflection on a given issue. This is an important contribution to the discussion on quality assurance in sustainability research, as it expands the focus of quality control from reliance solely on traditional epistemologically closed approaches, (i.e. research has to meet pre-defined and fixed criteria, e.g. repeatability or statistical significance) to more open procedural approaches, in which quality is understood to be enhanced through continuous reflection and reframing of the studied issue.

While the general principle of procedural quality control is widely accepted and applied within social research its use in sustainability research is potentially problematic because criteria for measuring procedural quality are inevitably both subjective and case specific.

Since, in the transdisciplinary arena of sustainability research (Hirsch Hadorn et al. 2006; Baumgärtner et al. 2008), both physical and social sciences as well as policy making are involved, there is a need for concrete ways to evaluate dispersed sets of related but differently configured research outputs. This, in turn, requires that we use some form of quality control standardisation that can be extended above and beyond the case study level.

In this chapter, based on literature review, discussion with supervisors, and a methodological workshop with other sustainability researchers, eight "quality domains" are identified, each delimited by a set of common methodological and epistemological characteristics that provide information useful for managing the quality of sustainability research activities. The definition of

quality domains used here draws in particular from the literature on sustainability science, ecological economics, and post-normal science. Nevertheless, the more general term *sustainability research* (Hirsch Hadorn et al. 2006; Baumgärtner et al. 2008) can be used to refer to this entire corpus of literature.

Section 2 of this chapter introduces the main epistemological issues relevant to a discussion of quality assurance in sustainability research. Section 3 introduces a possible approach to quality assurance. Section 4 describes the concept of "quality domains" and sets out an illustration of the approach. Section 5 discusses the implications and usefulness of this approach for different audiences. In the last section, a brief summary and conclusions are presented.

2 From sustainable development to sustainability research

It is common that students interested in sustainability issues discover, at the beginning of their studies, that *sustainable* means "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987:5). This definition has been widely accepted in academic and policy circles and "sustainable development" has become a buzz phrase, often accepted as a neutral, universal truth. However, the concept of sustainable development has had a strongly debated and politically contested genealogy. Failure to keep in mind these sociopolitical circumstances, which are a constitutive part of all scientific knowledge production, represents a potential epistemological problem for sustainability research (Jasanoff 1996).

In 1987, the Brundtland Commission prepared its report *Our Common Future* (WCED 1987) in a moment with comparatively minor global political and ideological contrapositions (Sneddon et al., 2006) but with a prevalent hegemonic neoliberal economic ideology. Criticism of this hegemonic view of sustainable development, as manifest in the Brundtland Report, came, at that time, only from so-called "post-development thinkers," such as Escobar (1995), who associated the idea of sustainable development with the death of nature and the rise of a managerial attitude to environment that advances a "Western, white discourse for sustaining growth (read: capitalistic market expansion) and not the environment" (Ibid., p. 195). While the advent of the idea of sustainable development reflects an important turning point in the global discourse

concerning human environment relations, it is clearly not a neutral, objective concept and so needs to be handled with care, at all times.

3 Research on Sustainability Issues: Ecological Economics, Sustainability Science, and Post-normal Science

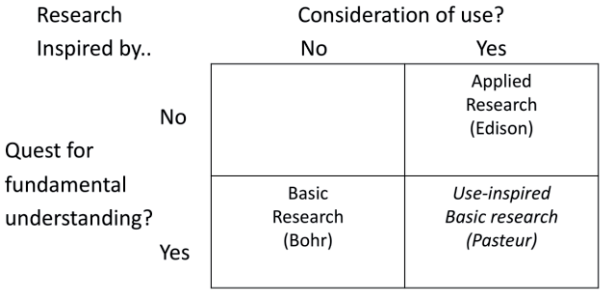
What sustainable development means in theory and in practice is a question that has been strongly discussed within a Western cultural frame. The relationship between human activity and natural resources has been central since from the beginning of the political-economy debate (sic, Malthus, 1798; Ricardo, 2004[1817]; Mill, 1862; Jevons, 1865). On the practical side, the 18th-century German custom of *Nachhaltigkeit* in forestry has been identified as a first realization of the concept (Neumayer, 2003). In the contemporary scientific arena, the most important discussion on the definition of sustainability can be related to the "strong versus weak" sustainability definition (Ecological Economics special issue, Daly 1997; Martinez-Alier et al., 1998; Neumayer 2003).

Discussion on sustainability issues has led to the establishment of entirely new fields of inquiry, two of which are ecological economics and sustainability science.[2] Ecological economics formally started between 1987 and 1989 with the foundation of the International Society for Ecological Economics and the publication of the first issue of the journal *Ecological Economics.* The foundations of sustainability science, instead, were laid during the Freibergh Workshop on Sustainability Science in 2000 (Kates et al., 2001) and consolidated with the publication of the journal *Sustainability Science* in 2006 and the launch, in that same year, of a new section of the *Proceedings of the National Academy of Sciences of the USA* (Clark, 2007) called "Sustainability Science" .

The great variety and heterogeneity of studied objects, arguments, approaches, methodologies and intellectual positions within these two research arenas make it very difficult to synthetically define the differences and similarities between them. Both sustainability science and ecological economics address complex social-ecological issues that go beyond basic and applied scientific research and have strong and explicit policy implications. On the epistemological and methodological level, albeit with different emphases, they both challenge the traditional normal

scientific paradigm, based on a segmented, mono-disciplinary model of research design, in an effort to understand and resolve complex, practical, policy-relevant sustainability problems.

However, an interesting epistemological difference between Sustainability Science and Ecological Economics can be understood by looking at how Funtowicz and Ravetz and Clark refer to the contribution of Louis Pasteur. In Sustainability Science, Clark (2007), referring to Stoke's quadrant (figure 3.1), emphasizes the positive role that use-inspired basic research can play in solving sustainability problems. On the contrary, Funtowicz and Ravetz (1993; 1994b), recalling Latour (1993a), argue that available scientific methodologies, including those of Pasteur, which have helped to create contemporary (sustainability) problems, cannot represent the solution. Instead, there is a need for new scientific methods that move beyond the presumptions that all problems can eventually be solved, to a post-normal science (figure 3.2), which would involve new scientific methodologies. They propose that sustainability problems have special social and epistemological characteristics, with high 'decision stakes' and high 'system uncertainties,' that make it unreasonable to expect the value neutrality and epistemological certainty that are typically associated with traditional, so-called (sic Kuhn, 1970) 'normal' science results.



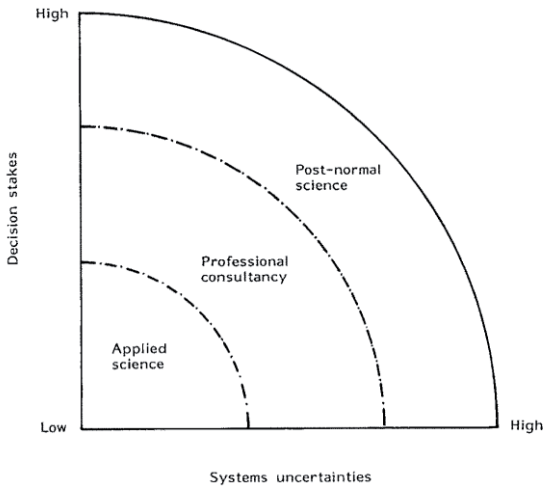


Figure 3.1. Research characterized by the motivations that inspire it (redrawn from Clark 2007)

Figure 3.2. Post-Normal Science (from Funtowicz and Ravetz, 1993, p. 745)

On one hand, sustainability research plays an important role in providing problem-solving strategies for policy and decision makers – it has become political (sic Farrell, 2008). On the other hand, because of the irreducible complexity of the problems addressed, sustainability research results are always fundamentally uncertain. In the face of this conundrum Funtowicz and Ravetz propose that post-normal science should not be guided by the pursuit of 'truth' but should follow an organizing principle geared toward generating 'quality' research results, fit for the social purpose(s) for which they have been generated (Funtowicz and Ravetz, 1994b). This would, they propose, entail a democratization of knowledge production and the extension of peer review, from closed processes restricted to a community of experts, to open processes taking place within broad communities of concerned and interested individuals from all walks of life. While the NUSAP (Numeral, Unit, Spread, Assessment, Pedigree) method proposed by Funtowicz and Ravetz (1990) and later developed by van der Sluijs (van der Sluijs et al. 2003; 2005) offers one concrete strategy for monitoring the quality of post-normal science research, there are still no general standards or guiding measures available that sustainability researchers can readily pick up and apply to their own cases and studies.[3] This is not without reason, since taking up the challenge of 'knowing that' something is true or false is more straightforward and familiar to the sustainability research community than addressing the procedural challenge of "knowing how" to make something of quality (sic Funtowicz and O'Connor, 1999).

4 Approaching quality

The term "quality" has various meanings. On one hand it refers to "*a distinctive attribute or characteristic possessed by someone or something"* (Oxford English Dictionary 2010), such as the colour of a flower. On the other hand it can be understood as *"the standard of something as measured against other things of a similar kind; the degree of excellence of something"* (Oxford English Dictionary 2010), such as the quality of an exam, which entails a value judgment of "better" or "worse" quality. When talking about enhancing research quality, obviously we are referring to the latter: in the sense of a degree of excellence. However, the "quality" of a sustainability research result, which focuses on any of a multitude of real-life problems, becomes

impossible to assess independently by comparing it to "*other things of similar kind"*. These research problems are complex, involving many academic disciplines and local stakeholder knowledge, and are in most cases non-comparable. Moreover, since the unique social context of each research project determines its relevance, this also has to be considered an important component of its quality. Therefore "quality" in sustainability research can be understood as always being context dependent. The scientific paradigms involved in the research may set the "rules of the game," in the sense of defining what is best scientific practice, but the social-ecological context defines "what games are to be played" in the sense of determining what research may be relevant or useful. Quality in itself then becomes a complex issue in that its characteristics cannot be reduced to a single description (Rosen 1991; Funtowicz and Ravetz, 1994b; 1997; Giampietro 2004: 15). Instead, it has multiple identities, depending on (i) the needs and preferences of different actors regarding the problem to be researched, (ii) the various academic disciplines involved, and (iii) the overall interpretative context.

While the multiple identity of quality makes it impossible to define universally applicable quality criteria, we do not believe that this means it is impossible to address quality in a general way. By adopting a procedural approach to quality assessment, one that allows for reflection upon and enhancement of quality as part of the research process, it is possible to propose general rules of practice that can be applied in diverse research settings. Following on from this reflection on the general aims of sustainability research, as outlined above, quality in sustainability research could be understood as the attainment of a level of excellence that is expected to arise from the combined presence of awareness of research context, explicitness, and clear justification of the adequacy of the research properties with respect to the research objectives and appreciation for the interpretative context within which the research results would be applied.

5 Quality assurance in sustainability research: quality domains

Quality domains elaboration

In this chapter the term quality domains refers to an open and revisable set of research aspect, with each domain having certain characteristic that are relevant to the sustainability research in general or to a particularly important part of the specific problem at hand**.** Based on literature

review analysis, reflection on the cases study, and discussions with other researchers, 8 quality domains have been identified.

In particular, a methodological workshop has been organized as an experimental consultative workshop on a fictitious, archetypical sustainability research case study address in issues similar to those arising in my case studies and SES research: resource conflict, environmental degradation, responsibility, diverging ethical values, democratic and power issues, complex relation between scientific opinion and governance.[5] In this methodological workshop 15 sustainability researchers with different training backgrounds and with different levels of experience ranging from Ph.D students to post-doctoral and senior researchers were asked to comment on a proposed list of quality domains and to give suggestions for additions and deletions. Finally, based on inputs from the workshop the final framework of quality domains was revised and elaborated.

These domains represent an useful basis for reasoning on the process of quality assurance of sustainability research. The eight different quality domains (illustrated in Figure 3.3) are: 1. Normativity; 2. Descriptivity; 3. Orchestration of Science; 4. Transparency; 5. Participation; 6. Political Bias; 7. Problem Orientation; 8. Review and Feedback.

Without any specific meaning being assigned to the order in which they are presented, characteristics of these domains are considered here below and key aspects of the research that emerged in referring these domains to our case study are presented. The domains are not meant to serve as a predefined or closed set of criteria. Instead, they reflect a working list of quality management issues that have emerged over and again within the discourse on sustainability research. On that basis, they can be considered as a valid starting point for developing a heuristic self reflexive quality assurance procedure.

Normativity: One of the first issues that emerge in sustainability research is that sustainable development and sustainability are inherently normative, since they implicitly presume 1. that there are right and a wrong ways to manage the project of development and 2. that those ways that preserve ecosystem functioning for use by future generations are superior (Becker and Jahn, 1999). At the same time, both political and scientific actors wishing to advance sustainable development are faced with “the impossibility to define in absolute terms the optimal way to sustainability” (Giampietro 2004). Sustainability is much more than just determining the “right”

mix of reliance upon human-made and natural capital. Questions such as "Sustainability of what?", "…for whom?", "…for who long?", "…at what cost?" (Munda 2004; B. Walker 2005) are answered differently depending on which perspective is given weight. Since there is no "single" perspective that can provide a universal answer to these questions the main epistemological characteristic of sustainability research is multidimensional complexity. Moreover the issues under investigation are themselves ontologically complex. The complexity of sustainability issues does not lie only in the multidimensional dynamics of human / non-human nature interactions. It is also related to the inescapable normativity of any definition of sustainability, which places ethical and political issues directly alongside the more familiar ontological and epistemological issues that are typically addressed in research designs (Farrell 2011a). Munda (2004) summarises this as the problem of "social incommensurability,", where in the face of a multiplicity of legitimate values, deciding which ones are the "right" ones becomes a matter of power relations. The importance of this special, normative component of sustainability research is widely acknowledged (e.g., NRC, 1999; Kates et al., 2001; Clark and Dickson, 2003; Clark et al., 2005; Komiyama and Takeuchi, 2006; Clark, 2007; Burns et al., 2006; Kajikawa, 2008; Ostrom, 2007; Kastenhofer et al., 2011; B. Walker 2005), and has many implications. The one in which we are most interested here is related by Farrell (2008; 2011a; 2011b), following Funtowicz and Ravetz (1991; Funtowicz and O'Conner, 1999) to the question of how extended peer review processes are designed: for sustainability researchers facts and values are sometimes irrevocably intertwined, regardless of what evasive manoeuvres the research might employ. This domain indicated that normativity plays a role in determining problem specification. While acknowledging the inevitable normativity of any clear position taken within the complex domain of sustainability research is surely not enough to ensure that work is of good quality, w failure to explicitly take this normative factor into account is more than sufficient to ensure poor quality results.

In the study on the resettlement of the Tibetan nomads in Qinghai for example I have encountered situations where I was inclined to mix together the descriptive task of recording the impacts on families with a normative view that the nomadic way of life is a valid and honourable one. Acknowledging the presence of a normative quality domain should make it possible to begin monitoring how personal values and ethical positions are helping to shape the content of our research on this issue. This will, in turn, help to ensure that results are more transparent and

assessments more readily expose to critique

Descriptivity:

The description and the representation, in scientific terms, of a sustainability issue, implies bringing together data, numbers, indicators, analyses and assessments, all based on a range of different analytical frameworks and numerous different, often non-comparable, units and dimension of measurement. It is not possible to meaningfully reduce this heterogeneous array of information to a single data point (Giampietro 2005, 2011), this is what Munda (2004) defines as 'technical incommensurability'.

Nevertheless, in spite of the impossibility of aggregating data and analysis drawn from different discursive and descriptive domains, it is still necessary to ensure that all the individual descriptions contributing to a larger sustainability research result are of good quality. This means that the work of sustainability research needs to be measured not only with respect to how well it addresses complex, interdisciplinary research questions but also with respect to how its constituent parts meet the expectations and quality criteria of their respective disciplines. Difficulties associated with simultaneously fulfilling the expectations of both disciplinary and interdisciplinary evaluators appear repeatedly in the small but growing number of studies specifically addressing interdisciplinary methodology (i.e. see Birnbaum-More et al., 1990; Boix Mansilla and Gardner, 2003; Boix Mansilla et al. 2006; Rhoten and Parker, 2004; Klein, 2008) and we do not propose to resolve that issue here. Within this domain it would important to define strategies for ensuring the quality of both the discipline specific and the interdisciplinary aspects of the descriptions being generated. As a basic criterion it is possible to say that ensuring the descriptive quality of an interdisciplinary sustainability research result requires that the research makes reference to the quality of both the component descriptions, as independent works, and of their mosaic (sic Giampietro, 2004) composition.

In the Tibetan case study I have encountered several problems of 'technical incommensurability'. In order to develop a picture of overall effects of the Chinese government's resettlement policy I had to take in consideration a number of completely different indicators: on the hand there are socioeconomic effects on the local nomadic population, which play out over a time frame measurable in decades, on the other, there are soil erosion impacts being produced that will play out over a time frame of hundreds of years. And finally, understanding the long term impacts of

either of these individual factors requires that we also understand how they are impacting upon each other.

Orchestration of Sciences

In considering how to deal with the problem of technical incommensurability one confronts another quality assurance problem: that of composition. Here, Munda (2003) suggests recourse to what Neurath (1973) has called the "orchestration of sciences". The appropriateness of moving beyond disciplinary boundaries has long been debated within philosophy of science. However in sustainability research this is not just an epistemological issue but also an operational necessity. As Max-Neef (2005:14) put it: in order to understand the relation between a "complex world" and a "complex nature" "we need a complex thought." Similarly, Farrell et al. (forthcoming) propose that that inter- as opposed to multidisciplinarity is necessary for Social-Ecological Sytems Research because combinations of different understandings are required if we are to understand the relationships between different aspects of sustainability problems. In the emergent arena of "Sustainability Science" transdisciplinarity is often advocated as the necessary way to proceed (Komiyama et al. 2006; Burns et al. 2006).

In ecological economics, Max-Neef (2005), writes that transdisciplinarity addresses complexity coordinating simultaneously the empirical, the pragmatical, the normative, and the value levels of different scientific disciplines. The transdisciplinary approach of sustainability research, in contrast to a disciplinary one, is not concerned with only one level of reality but extends the investigation over different levels of reality, including extending the work of problem and solution identification to include various stakeholders (sic Funtowicz and Ravetz, 1994a; Burns et al., 2006). Within this domain we are looking for the research to include explicit attention to how the various independent components of the interdisciplinary research are fitted together, to generate the whole.

In our study there are a number of different problems to address, ranging all the way from the ecological to the psychological impacts of forcing nomads to settle. While this project is too small to be faced with the challenges of coordinating an interdisciplinary research team, this study, nonetheless, confronts the challenge of bringing together insights drawn from studies derived from a range of different scientific discourses.

Political Bias

The presence of a plurality of legitimate but often contrasting perspectives implies that policy decisions on sustainability issues can be, in favour or against, the interests of a certain person or group, which leads to the question "who is making the decisions?" (Munda, 2003:666). The link between the epistemological dimension of politics and the effect of domination has been described by Foucault (1980: 104) as follows: "The exercise of power perpetually creates knowledge and, conversely, knowledge constantly induces effects of power." This relationship between knowledge and power is a recurrent theme in environmental sciences. If we carefully open this Pandora's Box we can find two important philosophical questions "what is scientific truth?", which is beyond the scope of this paper, and "does what is deemed to be scientific truth depends on power relations?", which is fundamental to the argument presented here. Various authors in the field sustainability research have describe the manifestation of knowledge/science as power using terms such as "orthodoxies" (Leach and Mearns, 1996), "myths" (Lambin et al., 2001), "narratives" (Roe, 1991, 1994) and "storylines" (Hajer, 1997), to describe a tendency for descriptions of environmental problems to be based not only on ontological and epistemological but also political framing. The identification of this domain looks at the acknowledgment of the role that political bias plays in shaping the discourses that are being used to frame and discuss the topics of the research.

The presence of political bias in The Tibetan case study is very strong, as Sino-Tibetan relations are a controversial political issue both within the region and world wide. Keeping a neutral position concerning this case is impossible. At the same time making ones personal political views explicit could create serious problems in the field, perhaps leading to prohibitions to access to the research area and to further problems for people who have consented to be interviewed. While there is no clear rule or thumb available for guiding choices about how to deal with the politically charged nature of our case study, it is possible, nonetheless, to factor this aspect of the problem into self-reflexive assessments, making its influence on the structure of data and results explicit.

Problem Orientation

Sustainability research is, by definition, concerned with applied problems. While this is related to some of the issues raised above in terms of normativity, it is, , a distinct issue that merits its

own Quality Domain. While all research, regardless of discipline or topic, is guided by the investigation of specified problems, the role of problem specification in sustainability research is special for two key reasons: 1. here problems are often specified, in the first instance, through political rather than scientific channels and are always mediated through reference to political and social concerns, even when scientists have the final say and 2. whereas adoption of their results in real world applied settings is of interest to most scientists, for the sustainability researcher, as for scientists working in commercial or military research and development departments, the practical applicability of research results is one of the criteria against which their quality must be measured (sic Berkhout et al., 2003; Norgaard, 2004). Within this domain it is important to look for attention to the research's relationship with its policy context and to the degree to which the results have been thought all the way through to the stage of application.

In my case study problem orientation centres around the potential that resettlement policies may have for improving the socioeconomic and ecological conditions of both resettled and non-resettled nomads. However, in this case there are various actors with conflicting objectives, so it is difficult to identify a single policy objective giving the research its problem orientation. Instead of asking ourselves how close to we keep to the problem at hand, we must also keep in mind, who's problem is it that we are studying.

Participation

It has been proposed from many corners and for some time now (Dryzek, 1987; Funtowicz and Ravetz, 1990; Wynne, 1996) that public participation in the development and the execution of sustainability research should be formalised. Today participatory science approaches are widely employed by sustainability researchers working on topics ranging from monetary valuation of ecological phenomena (Wilson and Howarth, 2002) to participatory modelling of fisheries management (Videira et al, 2003) and climate change (Kasemir et al, 2003) scenarios. In their ground breaking text concerning the challenge of ensuring quality in science for policy Funtowicz and Ravetz (1990:210) referred to this opening up of scientific work to participatory engagement as the "democratization of expertise." Similar propositions, regarding the potential epistemological benefits associated with consulting affected communities were made in education studies as early as the 1920's by Dewey (1966[1916]) and later by Freire (1970), in the 1960s and 1970s as part of a major shift in the principles of guiding ethnographic and

sociological research (Garfinkel, 1967; Ladner, 1971; Geertz, 1973), in the 1980s, with the adoption of a new approach to development studies, which helped to coin the term 'action research' (Hall, 1985) and finally, more recently, in environmental studies (e,g, Wynne's, 1996). While many questions still remain, regarding how this participation might best be organised, to benefit both the research and the participants, the question as to whether or not such participation can improve the epistemological quality of sustainability research seems now to have been answered with a strong affirmative. Within this domain it would be important to look for the presence of participation and for some formalisation of procedures for monitoring its usefulness both for the researchers and for the other participants.

In our case study participation will be solicited through focus group discussions. However, we expect that rich participation will be very difficult to achieve, due to lack of time, linguistic barriers and the political sensitivity of the case study issue. In addition, due to the political context, it is unreasonable to expect any extension of the decision making process to include the wishes of the local population. Here the best can be done is to take note of the fact that it is very difficult to produce a participatory research setting when dealing with people who are not used to having a voice in the policies and decisions that affect them.

Transparency[4]

Presence of clear documentation is a typical measure of the quality of a research report, since it is required to ensure that results can be verified by other researchers. However, in sustainability research such documentation takes on a different of role: first because the applied and case specific character of the work means that reported results are unlikely to be strictly repeatable and second because documentation needs to be detailed enough to be useful to experts in the field and also general enough to be intelligible to non-expert laypersons and policy makers. In addition, since there are inevitably a range of analytical and descriptive domains contributing toward a sustainability research result, this documentation must gather together information concerning a range contributions into a coherent report. Finally, since the quality of these results depends in large part on the quality of the interdisciplinary dialogues and participatory consultations that have contributed to the research, information regarding how these were carried out and why also needs to be included, along with information regarding how the results were reported to affected communities, in a format that they are able to interpret and judge without

difficulty. Within this domain it would be important to look for simultaneous attention to both the scientific and the political reporting obligations that sustainability researchers have.

Ensuring transparency in the Tibetan nomads resettlement case study is complicated, since, regardless of which perspective or problem orientation wee adopt, some of the concerned actors will see the research as political. To deal with this the reflection goes on my own work and considers the impact and role of researchers. In this case study descriptions I make clear the ontological, epistemological and methodological approaches and what are the operating constraints. I try to locate my personal views of the topic in relation to the more normative conflicts present among our study subjects and we reflect, in an iterative way, on the worked we have produced.

Review and feedback (The semiotic process)

This domain has traditionally (i.e. within normal science) been associated with quality control and quality assurance. However, whereas traditional peer-review and feedback methods rely on systems of assessment that reference back to specialized communities of discipline specific experts, the nature of inherently complex and politically entailed nature of sustainability research problem means that the knowledge we are creating is not strictly disciplinary or even exclusively scientific. Overcoming the limits imposed by traditional academic peer review in such situations is one of the motivations behind the post-normal science discourse on extended peer review and the issue has been discussed in a range of contexts (sic Ravetz, 1971; Funtowicz and Ravetz, 1990; O'Connor, 2000; Rhoten and Parker, 2004; Farrell, 2011a).

The general point common to all these discussions is that there is a need to achieve some kind of extension of the evaluation process that reaches beyond the academic Ivory Tower. When problems are complex and politically entailed, people from the community involved in the problem, reporters, technical experts all become relevant actors in the process of quality assessment evaluation phenomena (Funtowicz 1990). Here the extended peer review community can be understood in a similar light to other extensions of the franchise in the past, such as with trade unions placing worker rights into business decision contexts, of the women's suffrage movement (Pereira and Funtowicz, 2005). Within this domain we are looking for attention and sensitivity to understandings and critiques of research approaches and results that deriving from outside of the scientific community, especially to those coming from affected and locally

embedded communities and perspectives.

The peer review process for this case study results will follow the normal journal peer review process, on the one hand, but I am also aiming to receive feedback from at least some members of the extended peer community concerned with our case. For example, I am informally collaborating with two different NGOs working in the region and will receive comments from them on research plans and outcomes, in an effort to see how it might be possible to produce changes in the region through cooperation with them. However, due to the sensitivity of this case study, I have decided not to pursue an extended peer review process that would integrate feedback from other more locally active actors, such as community representatives and local activist.

I do not presume that the quality domains we present here are the only possible or indeed even the most relevant ones, nor that the number three holds some special importance. Instead, the quality domains I provide here are intended to be understood as part of an open, iterative, reflexive procedure. I expect that they would be reframed and even rewritten in a different research situation and that they will be iteratively developed in any research situation in a more or less participatory manner. The proposal here is that these quality domains should be seen as an heuristic method that, can provide a simple, systematic and repeatable quality assurance procedure for sustainability research that can also be extended to include the participation of non academic actors.

6 Discussion

The quality domains proposed here above represent a conceptual framing that is intended to produce important methodological consequences. While I do not mean to force these conceptual categories as rigid taxonomical boxes, I do propose that distinguishing between different domains of sustainability research work provides a good basis for addressing persistent epistemological problems in this field of study. Giampietro et al. (2011), for example, argue that in many cases in research on climate change, decisions related normative and descriptive aspects of the work are mixed together, making it impossible to conducting a proper quality control of the results. That is to say, we propose that it is useful to work with the categorization of quality

domains for methodological reasons.

For example, as it has been pointed out above, a certain feature of a research situation may have characteristics that can be associated with more then one domain. Depending upon how these relationships are construed, we may produce one or another set of quality “meta-domains”. Since, within a procedural logic, it is not be necessary to define all the possible sets of possible meta-domain ahead of time, they are free to serve as an additional heuristic tools, that can be created to address specific issues and concerns, in response to the different research conditions and circumstances. Three meta-domains for 8 quality domains (figure 3.3) could, for example, be assigned following Farrell's (2009:104; 2011a) categorisation of first order (within the *adcademe*) and second order (between science and society) extended peer review processes, by adding to that list a third category of universal (pertaining to both first and second order situations). In this case the first order meta-domain might include 'Descriptivity' and 'Orchestration of Science', the second order 'Participation', 'Problem Orientation' and 'Political Bias' and the universal meta-domain 'Normativity', 'Transparency' and 'Review and Feed-back' domains. Similarly, it might be possible to choose to develop meta-domain categories compatible with Munda’s distinction between technical and social imcommensurabilities or with Ravetz (1971) distinction between quality assessments based on criteria of adequacy vs value criteria.

Following Munda's (2003; 2004) distinction between social incommensurability (i.e: a multiplicity of different and often contrasting values in the society) and technical incommensurability (i.e. the problem of representation of multiple identities of complex systems in descriptive models) the eight quality domains could be grouped as follows: within the technical incommensurability “meta-domain” 'Descriptivity', 'Orchestration of Science', 'Review and Feed-back', within the social incommensurability “meta-domain” 'Normativity', 'Problem Orientation', 'Political Bias', 'Participation' and at the boundary between them, ‘Transparency’.

Figure 3.3. Quality domains and strategic questioning approach. Source: Own elaboration

In spite of widespread acceptance that the complexity of sustainability research topics demands similarly complex methodologies, sustainability issues are still often researched from a single perspective. Keeping in mind the different domains where quality has to be checked can help to ensure the quality of the overall sustainability research project and its results. The quality domains presented here aim at producing three main outcomes that move us in that direction: 1. to increase the researcher's level of reflection and their awareness on the completeness (or indeed the incompleteness) of their work; 2. to provide a means for checking on the completeness and therefore the quality of other researchers' work; 3. to support the process of extended peer review by giving non academic readers a conceptual instrument and an assessment guide that clarifies the different components that are important to consider in evaluating research concerned with sustainability issues.

7 Chapter's conclusions

In this chapter I have presented work and reflections responding to the challenge of creating a procedural heuristic approach for quality assurance of sustainability research. I considered

how the concept of sustainability is understood from within the epistemological frames of Ecological Economics, Sustainability Science and Post-normal Science and identified a series of key aspects of sustainability research that are relevant for discussing its quality. This allowed us to develop a broad definition of quality in sustainability research and to elaborate a list of 8 quality domains which I found to be particularly relevant for assessing the quality of my case study research on nomad resettlement policies in Tibet.

Having applied this approach to my case study work, concerning the resettlement of Tibetan nomads in Qinghai, it has proved useful for identifying weak points in my research design and has helped to reflect constructively on the quality of my own work. I believe that this approach could prove useful for a wide range of researchers interested in ensuring and reflecting upon the quality of their contributions to sustainability research. While we have applied it here on a very small scale, this approach could be developed in a number of directions, for example, within a large interdisciplinary research project, it could be used to provide comparative evaluations of the procedural quality of different contributing research projects and even with respect to the overall project as a whole. In addition, a guide to rigorous, but open, theoretical conceptualization of quality assessment domains for sustainability research seems a promising candidate for facilitating the extension of the peer-review community, allowing people without an academic background, to deal in a more comprehensive and thorough going way with the knowledge production processes that inform decisions being made every day about sustainability issues and problems that affect their lives and their environments.

---

[1] a method first introduced by Peavey (1995)

[2] It is taken here as given that other fields of research contribute to the theorization on sustainability and sustainable development. For example Political Ecology and “Development as Freedom” literature as described by Sneddon et al. (2006), other inter-disciplines such as Technology Assessment and Science and Technology Studies (Kastenhofer et al., 2011). Often the borders of the different fields are not clearly defined and there is continuity in their mutual epistemic development. Clark (2007) for example, in his description of Sustainability Science

as an independent field of inquiry, also makes it clear how sustainability scientist draws from a number of different fields of enquiry, from complex system theory to cultural and political ecology.

[3] For more information about NUSAP see Funtowicz and Ravetz, 1990 and www.nusap.net

[4] This domain has emerged not from the literature review but from discussion in the methodological workshop.

[5] The case was set in an imaginary world, in order to loosen possible prejudices that might accompany discussion of an already well known research case.

CHAPTER 4
THEORETICAL BACKGROUND AND IAD FRAMEWORK INTEGRATION

Abstract

In this chapter, I propose a methodological re-elaboration of the Institutional Analysis Development Framework, IAD, (Kiser and Ostrom 1982; Ostrom 1994, 2011) by taking into account the methodological development suggested by Clement (2010) and integrating it with the Societal Metabolism dimension. I follow Clement's (2010) approach in bringing together Institutional Analysis/Commons Theory with Political Ecology and then discuss the possibility of adding to this theoretical integration, analytical perspectives that draw from Post-Normal Science and Societal Metabolism. This theoretical review eventually conducts to the proposal for a further methodological integration of Clement's version of the IAD that enhances the biophysical component of the framework. Therefore, in the last section of this chapter a new re-adapted version of the IAD is proposed. Moreover, the evolution and integration of this proposed re-elaboration of the IAD is discussed and applied in the following parts of the dissertation and finally discussed in the Conclusions chapter.

1 Introduction

The study of the interrelations between "human" activity and "nature" has been, and continues to be, a central object in science. The exponential increases in the human population in the XVIII century, raised the fundamental question, debated by classical authors such as Malthus and Ricardo, of the anthropic pressure on natural resources and its consequences in social, political and economical terms. A similar focus was at the center of the debate started by the Club of Rome and the publication *The Limits to Growth* (Meadows et al. 1972). The infinite energy and material possibilities of the earth were questioned by the so-called "prophets of doom". In the 1970s, authors such as Nicholas Georgescu-Roegen, Paul Ehlrich and Kenneth Boulding raised the doubt that a finite world could not serve an infinite demand for materials and energy which was implied by economic growth. In 1987 then, the famous Brundtland Report (WCED 1987), produced a fundamental concept which fast became one of the most quoted buzz words and

which doesn't seem to loose appeal yet in scientific and policy arenas: Sustainable Development.

If, according to international policy reports and politicians' declarations of intents, the fact that Sustainable Development is the target to achieve has become very clear, what is not clear is neither its definition nor how to measure it or achieve it. "*The development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* poses several questions, which escape the traditional modern scientific fragmentation. Economist find themselves with the necessity to consider resources scarcity in terms of intergenerational equity, with a proliferation of intellectual exercises about the possibility of interchanging different forms of capital (natural versus human-made) in order to maximize the utility function for keeping constant *the ability to meet needs,* present and future. A synthesis of this central debate in the sustainability discussion, proposed in the economics literature is the identification of weak and strong paradigmatic definitions of sustainability (Daly and Cobb 1989, Pearce and Atkinson 1993, Ayres et al. 1998, Neumayer 2005).

However, a fragmented and mono-disciplinary scientific system struggles in representing and analysing the multiple dimensions entailed in the concept of sustainability. The study of the relationship between human activity and nature, implied by the definition of sustainability, clashes against disciplinary boundaries and reductionist approaches. It is in this context that a call for multi-inter and trans-disciplinary approaches to sustainability has emerged (Kates et al. 2001, Max-Neef 2005, Clark 2007).

Sustainability not only deals with the representation and analysis of complex and multidimensional problems but it also involves implementation on the ground, which includes aspects such as governance, management and policymaking. This inevitably connects the theory and practice of sustainability to power and politics.

It is then possible to observe how academic and scientific approaches to sustainability studies, in particular in economics, have been strongly influenced by political agendas and hegemonic worldviews. In particular, I am concerned with the study of what, with a very anthropocentric perspective, has been defined as the governance of natural CPRs. From a sustainability perspective, natural CPRs represent one of the core spaces of human-nature interaction. For example, forests, oceans, rangelands, mountains, biodiversity, are all categories that have been studied under the umbrella of natural CPRs or Commons Theory. In this chapter, commons

theory, political ecology and societal metabolism are reviewed by looking at the limitations and potential complementarities that can be enhanced in order to produce a theoretically supported analysis of natural CPR governance with particular attention to conflict contexts. The underlying assumption is that in a world subject to the double exposure of increasing human population and the resultant expansion of natural resource scarcity, natural CPR governance in conflict contexts is a central dimension of the sustainability debate.

This chapter is developed in two main sections. The first section looks at fundamental elements of the Commons Theory reviewing central theoretical aspects of the debate and evolution of this scientific and policy-making arena. In the first section, the conventional approach to the commons ("The Tragedy of the Commons," Hardin 1968) is illustrated and Ostrom's (1990) critique is proposed as a clarification to some analytical flaws and way forward. Ostrom's institutional analysis approach to CPRs is synthesized and a synthetic review of the different streams in the Institutional Economics arena presented. At this point two bodies of scholarship Political Ecology (with a reference to the complementarities with Post-Normal Science) and Societal Metabolism are presented as complements for an integrated CPRs analysis. Therefore the first section of the chapter concludes with a review of both Political Ecology and Societal Metabolism.

The second section of the chapter instead, focuses on the methodological development of the Analytical framework. In this section the IAD framework as developed by Ostrom and colleagues is reviewed. Then the politicized version developed by Clement (2010) is discussed and finally a further integration that includes metabolic patterns in order to strengthen the biophysical component of the integrated IAD is proposed. The inclusion of the metabolic patterns component draws from the work developed by Giampietro and colleagues in the development of the MuSIASEM approach, which is described. A conclusive discussion on the adequacy of this methodological integration is postponed to the final chapter of the dissertation.

In more detail, the structure is as follows: in the first section, as a theoretical background, first, the link between the definition of the sustainability concept and the definition of CPRs is illustrated. Second, the "Conventional Theory of Commons" with particular reference to the work of Hardin (1968) is criticized by referring to Ostrom's 1990 critique. Third, the theoretical background of the work of Elinor Ostrom and the different streams of the Institutional

Economics arena reviewed. Fourth following Clement's (2010) work it is discussed the option of integrating institutional analysis with Political Ecology. Therefore a synthetic review of the Political Ecology scholarship presented. Last, bringing forward the integration of the IAD framework, the weakness of the biophysical component highlighted and Societal Metabolism is proposed as a complimentary field of research that could be compatible with an integrated version of the IAD.

The second section structure, focused on the methodological integration of the IAD, first reviews the IAD in its original form. Second, it presents Clement's politicized version. Third it illustrates the MuSIASEM approach from which the concept of metabolic patterns is drawn. Finally it presents the integrated IAD version that I propose.

Section 1: Theoretical Background

2 Sustainability and CPRs

The strong sustainability paradigm which mainly questions the possibility of perfect substitutability between natural capital and human-made capital has to deal with the fundamental question of the maintenance and preservation of 'natural funds' (Daly 1997, Neumayer 2005). In the words of Georgescu-Roegen (1971) what has to be preserved are 'natural funds' – self-reproducing elements that must preserve their identity through the duration of the analysis. stocks can be depleted – e.g. mines of coals, whereas rivers must be maintained therefore they are funds. Forests, fisheries, water systems, rangelands, are all cases of natural resources that have been analysed in the literature on sustainability. Their unifying characteristic is that they have high costs of exclusion but the appropriation/use of one person or of a group subtracts it from the appropriation/use of another person or group.

These kinds of natural resources have been classified in an anthropocentric way as a specific category of goods defined as CPRs. These two attributes, exclusion and subtractability have been largely used in economics and natural resources literature as distinctive intrinsic features for the definition of the four main types of goods (Ostrom 2005). Exclusion indicates the difficulty to limit or restrict the appropriation or use of the people that benefit from a service or good. Subtractability, that is perfect synonym of rivalry, refers to the extent to which the

consumption/appropriation/use of a person or a group of a specific good or service reduces the possibilities of another person or group to benefit from that good or service.

A theoretical distinction to keep in mind at this point is the definition between stocks of resources and fund resources as explained by Georgescu-Roegen (1971). In fact it is different if you are exploiting a "pool of resources" which is a stock (e.g gold mines, oil fields, a cow to butcher) or a fund (e.g prairies, rivers or a cow to milk).

According to these two attributes the definition of the type of good is then defined by the nature of the good. Four types of goods can be broadly defined in this way (Ostrom 2005):

Table 4.1. Definitions of types of goods in orthodox economics

		Subtractability	
		Low	*High*
Difficulty to Exclude	*Low*	Toll/Club Goods	Private Goods
	High	Public Goods	Common-Pool Resources

3 Conventional Commons Theory/The Tragedy of The Commons

An influential narrative in science and policy on the management of natural CPRs has been that the resources that escaped market or state institutional arrangements are doomed to overexploitation and eventual exhaustion. The milestone of this theorem was posed by Hardin's famous "The Tragedy of the Commons," published in *Science* in 1968. The main message evoked by Hardin's depiction of a "pasture open to all" where it is "expected that each herdsman will try to keep as many cattle as possible on the commons" was that it is "rational" for natural resource users to seek maximization only for their personal gain and utility (p. 1244). According to Hardin's 1968 description, "freedom in a commons brings ruin to all" because, as in the case of grazing, "each man is locked into a system that compels him to increase his herd without

limit—in a world that is limited" (p. 1244). According to Hardin's article, the solution to natural resources overexploitation relies on only two possible institutional arrangements: privatization or governmental forms of property and control.

Hardin's (1968) argument was in line with the arguments developed by Gordon (1954), Scott (1995) and Olson (1965) and supported empirically by a large number of examples where natural CPRs were depleted and overharvested. Olson (1965) work on the logic of collective action mainly asserted that rational individuals would act for the benefit of their group only under specific circumstances such as coercion, incentives or special devises. Moreover Hardin's argument has been formalized as *The Prisoner Dilemma game* (Dawes 1973, 1975 in Ostrom 1990).

The Prisoner Dilemma based on the assumptions of perfect information of the players implied that the rational solution for each single player does not provide a Pareto-optimal outcome (Axelrod and Hamilton 1981). Hardin's argument, the prisoner dilemma and Olson's logic of collective action shared the belief that rational individual behavior would not provide an efficient collective outcome because collective actions situations would always be affected by free riding problems (Ostrom 1990).

This assumption is at the base of the so called conventional theory of the commons which has been highly influential at the policy making level. As Ostrom (1990) critiques, within this perspective the only possibility for natural resource management in a world with increasing population and resource scarcity was a Hobbesian solution. According to this interpretation an external powerful coercive authority is necessary to correct the distortions produced by individual rational action and obtain an efficient outcome, in other words a "sustainable use" of resources. The "Leviathan" in polarized Cold War historical era was represented, either as Governmental Control/Socialism or as extension of property rights/privatization (Hardin 1978). Other authors such as Ophals (1973 in Ostrom 1990) and Carruthers and Stoner (1981in Ostrom 1990) diffused the argument that government intervention is a necessity for avoiding the tragedy of the commons. However, the argument for the creation of property rights systems and for the extension of privatization models, as the only solution for the tragedy of the commons, become central in scientific and policy arenas. The theorem of private property as the *only way* for natural resources sustainability (Ostrom 1990) is based on works such as of Demsetz (1967)

Johnon (1972), Smith (1981), Sinn (1984).

The privatization theoretical argument for natural resources sustainability corresponded perfectly with the rising of the Neoliberal doctrine promulgated by the Washington Consensus at the end of the 70s. The Washington Consensus, affirmed at the end of the 70s with the election of Ronald Reagan and Margaret Thatcher was defined, by different authors with slightly different interpretations, as an hegemonic global economic model based on neoliberal theories and implemented on the large scale by the World Bank and the International Monetary Fund (O'Rourke and Williamson 1999, Chomsky 1999, Stiglitz 2002). The three core tenets of the Washington Consensus were austerity, liberalization and privatization (Vercelli and Borghesi 2004).

It is not surprising then how Hardin's discourse was mainly interpreted as a scientific sound response that neoliberal policies could provide for the governance of natural resources (Caffentzis 2004). This to a certain extent has been a manipulation of Hardin's (1968) argument as he was not indicating privatization as the only way but both privatization and governmental control (socialism). However, apart from the opinion that Hardin's discourse might had been manipulated and used to support neoliberal political views of economic and policy models, his 1968 paper was analytically flawed.

4 The "tragic" confusion between open-access and common-property regimes

Hardin's famous 1968 paper, that has been criticized by Hardin himself in a later paper (1998), incurred in two elements of confusion that have been largely debated in the commons literature (*The Drama of the Commons*, NRC 2002) and that still can produce some misunderstanding. The first famous mistake is that Hardin did not recognize the existence of common-property regimes in 1968. In "The Tragedy of the Commons," he wrongly depicted that all natural CPRs, unless governed by the state or privatized would be "open to all". This is only true according to the definition of *Res Nullius*[1] or "Open Access" but false in the case of common-property regimes. Hardin mistake is striking because he is considering the world only in terms of western

1 This according to the Romans Law tradition had a slightly different interpretation as it was considered as "not yet property" which implied the potentiality to be appropriated. This is different than the contemporary interpretation of open access where the possibility to exclude and appropriate are extremely reduced (Dan Cole, persona communication 2 November 2012).

categories completely overshadowing the fact that a large share of the global rural population has been developing institutional arrangements for managing resources in the course of their history and this not necessarily fell in the government or privatization categories.

The second mistake, which is still easy to encounter when dealing with natural resources management and governance issues, consists in the exercise of categorizing a resource without being clear if its definition depends on its institutional arrangements or on its ontological attributes. In the following box I introduce a tentative to clarify this frequent point of confusion.

Box 4.1. Clarifying common-pool resources and common-property regimes

A system of definition for goods and services that has been largely used in natural resources is the one previously mentioned that looks at the degree of the attributes excludability and subtractability (see tab 4.2). According to this system it is possible to define a natural resource as a CPR, because of its ontological attributes of high subtractability and difficulty to exclude, and at the same time identify the specific institutional arrangement that is related in the specific context.

On the other side, a categorical definition of institutional arrangements typically identifies four categories: 1. Private Property System; 2. Governmental Control; 3. Common-Property Regimes; 4. Absence of Institutional Arrangements or Open Access. These are broad abstract categories that synthesize a large variety of situations that often can have not clearly defined or mix features such as cases of *de iure* governmental control but *de facto* open access. Or hybrid private-public systems such as the public water management system in Italy. Moreover the institutional arrangements that relate to a specific resource in a specific context can be defined differently according to the scale of analysis for example in the case of a pasture that is managed according to local community arrangements but that is legally owned by the government such as in the case of the Tibetan nomads common grazing areas.

In the following table is possible to observe a simplistic and reductionist description of the relation between the definition of a type of good according to its attributes and the possible institutional arrangements that can be applied according to different contexts and circumstances.

The red arrows are an example of how the degree (low – high) of the attribute (in this case exclusion) of the specific good, can correspond to a potential institutional arrangement. In the example it refers to how some specific goods can fall in the categories of ‘no institutional/open access.

Difficulty to Exclude	Subtractability: *Low*	Subtractability: *High*
Low	Toll/Club Goods	Private Goods
High	Public Goods	Common Pool Resources

TYPE OF GOODS	Privatization	Governmental Control	Common Property Regimes	No Institutional Arrangement/ Open Access
Private Goods - examples:				
Food	YES	YES	YES	NO
Car	YES	YES	YES	NO
Clothing	YES	YES	YES	NO
Toll/Club Goods - examples:				
Cinema	YES	YES	YES	NO
Golf Club	YES	YES	YES	NO
Rowing Club	YES	YES	YES	NO
Public Goods - examples:				
Sunlight	NO	NO	NO	YES
Air (in open air)	NO	NO	NO	YES
Common Pool Resources examples:				
Forest	YES	YES	YES	YES
Rangelands	YES	YES	YES	YES
Fisheries	YES	YES	YES	YES

5 Elinor Ostrom's contribution: pushing forward the Theory of Collective Action and the Commons

Synthesizing Elinor's Ostrom contribution is a very difficult task. It is clear that her *Governing the Commons: The Evolution of Institutions for Collective Action* (1990) has catalyzed a

fundamental shift in the conventional commons theory. As recognized during the 2009 Sveriges Riksbank Price in Economic Sciences in Memory of Alfred Nobel celebration, "her analysis of economic governance, especially the commons" has "challenged the conventional wisdom by demonstrating how local property can be successfully managed by local commons without any regulation by central authorities or privatization"[2].

The Theory of Collective Actions and the Commons, through the application of multiple research methods (field work case studies, field and laboratory experiments, agent based models and game theory), has observed and in certain cases demonstrated the individuals possibility to act collectively to manage natural CPRs without prejudicing their sustainable rate of maintenance and reproduction.

Box 4.2. Institutional Economics theoretical background synthetic review

Ostrom clearly demonstrated the evident difference between open-access and common-property regimes and the role that common institutional arrangements play in the sustainable use of natural resources (Agrawal 2001). In her study *Governing the Commons*, Ostrom (1990) introduced an institutional approach to the study of CPRs. Her work on CPRs and analysis of social-ecological systems has been developed in the stream of institutional economics and institutional analysis. This extended family of scholars is brought together by the acknowledgment of the centrality of institutions in the socioeconomic processes (for an exhaustive review see Rutherford 1996; Vatn 2005).

However the definitions of institutions and their explanation varies according to different epistemological and theoretical positions that have been reflected in different currents of institutional analysis. Vatn (2005) has synthesized the different souls of Institutional Analysis referring to three main traditions that are generally acknowledged: 1. classical institutional economics (old and new), 2. new institutional economics and the institutions-as-equilibria tradition.

Classical institutional economics since its beginning challenged the core of the neoclassical economic theory assumptions. A milestone of this critique has been Veblen's (1898) paper "Why is Economics not an evolutionary science." One of the main points of Veblen's criticism was the possibility of the economic system to reach an equilibrium based on rational individuals fixed preferences. According to Veblen (1919 in Vatn 2005) Institutions are "settled habits of thought common to the generality of man"

2 From: http://www.nobelprize.org/nobel_prizes/economics/laureates/2009/ostrom.html?print=1 (accessed 2 Nov. 12)

(p. 239). Together with Veblen other scholars, mainly Americans, focused on the role of institutions criticizing the fundamental assumptions of the neoclassical core. Between these authors appear JR Commons, WC Mitchell and CE Ayres. However some important differences can be highlighted also among these scholars, for example Veblen considered that institutions are conservative restrictions rather than liberating capacities while Commons described institutions as supports in dealing with conflict and sustaining interests (Vatn 2005). As Krugman (2009) described in a caricature version, institutional economics was very influential before World War II, but with the great depression "*institutional economics, asked for advice about what to do, replied that well, it's all very complicated, and has deep historical roots, and ... Meanwhile, Keynesian economists, using very simple mathematical models, basically said "Push this button — we need more G* ".

However the insights and critiques produced by the institutional economist didn't go extinct. In the 60s a resurgence of these ideas took shape different currents. One current corresponded to the authors that developed their work coherently with the Classical Institutional Economist criticism, challenging the neoclassical theorem fundamental core and applications. These authors are considered as the Contemporary Classical Institutional Economists. Works such as the ones from Schmid (1987), Bromley (1989, 1991), Tool (1995) Samuels et al (1997), Vatn (2005) contribute to this tradition. The main features of this tradition in contraposition with neoclassical economics are synthesized by Vatn (2005) as: first, the critique to the description of the individual as a rational individualistic utility maximizer; second importance of the context and social structure in preferences formation; third, understanding the socio economic system in evolutionary terms rather than as subject to a natural tendency to equilibrium. Last which is very interesting for the work developed in this dissertation, the fact that contemporary classical economist explicitly relate institutions such as hierarchies and command structures to the role of power and interests protections (Bromley 1989).

Very differently from the Classical tradition, the New Institutional Economics (NIE), which took the scene from the 60s, while developing critical explanations did not negate the basis of the Neoclassical core assumptions. Opposite to the Classical Institutional Economics, and close to the Neoclassical position, a central assumption for NIE scholars was the possibility of theory building based on paradigmatic axioms rather than deductively from empirical studies. NIE recognizes the fundamental axioms implied by the theoretical core of neoclassical economics. However some important differences can be depicted among NIE scholars. Vatn (2005) classifies NIE in three sub-branches: First, the property right school, which relates to the work of Coase (1960), Alchian (1996[1961]), Demsetz (1967) and Posner (1977). The main critical element among these authors is not the validity of the neoclassical assumptions but the fact that the economic neoclassical theory actually is inconsistent with these

assumptions. A central element of debate here is the role of governmental regulation when it comes to public goods and externalities. Second, the transaction cost school which is represented by the work of Douglass C. North. According to North (1991, p. 97), institutions are "the humanly devised constraints that structure political, economic and social interaction". They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights). Or also, as often quoted, institutions are "the rules of the game" (Ostrom 1990, p. 3). The central tenet of this sub-branch is the role that positive transaction costs, (which is a case in contraposition with one of the assumptions of the Neoclassical core), play in resource allocation problems. An important consequence is that if there are transaction costs, market might not be the less expensive solution. The third sub-branch of NIE, is represented by the Williamson tradition. Williamson develops his work including the concept of bounded rationality. Drawing on the work of Simon (1979) he describes the individual as a hybrid between the neoclassical *homo economicus* and the "institutional men" as explained in social constructivism (Vatn 2005).

The last branch of institutional economics following Vatn's (2005) categorization is "institutions-as-equilibria". This position is developed in relation to the work of authors such as Hayek (1988), Sugden (1986) and Aoki (2001). According to this approach institutions are the "*equilibrium strategies of the players in a game"* (Vatn 2005, p. 95). This position that builds on assumptions of neoclassical rationality, considers that institutions emerge spontaneously. Aoki (2001, p. 185) describes institutions as the "invariant features of an equilibrium path". Individualism is one of the main tenets of this approach where there is no acknowledgment of collective and intentional institutions creation.

Specifically the contribution of Elinor Ostrom and colleagues in the advancement of the frontiers in the Theory of Collective Action and the Commons beyond the conventional theory is related to three different levels of theoretical development, as described by Poteete, Janssen and Ostrom (2010): (I) individual human behaviour; (II) the Microsituational Context; (III) the broader social ecological context.

(I) The first area of theoretical development refers to a broader theory of human action. This relates to the overcoming of the reductionist model diffused by the rational-choice theory that explains individuals as economically rational beings that act because of individualistic payoff functions. The main criticism to the rational-choice theory is that its assumptions hold and its predictive power works only in very specific and highly structured competitive situations. A

broader theory of human action instead understands the action of individuals as dependent on the specific attributes of the situation in which the individuals find themselves to interact (Poteete et al. 2010). In the words of Orbell et al. (2004) the contextual variables are more important than the rational behaviour assumption that individual payoffs involve dilemma situations.

A broader behavioural theory understands humans as adaptive to the constraints and opportunities of the circumstances (Jones 2001; Simon 1999), capable of self-reflection, learning, imagination, and possibility of designing new institutions or other mechanisms in order to achieve their purposes. The broader behavioural theory to which Poteete, Janssen and Ostrom (2010) refer, in the specific decision making dilemma settings, builds on three main assumptions: (i) actors do not have complete information about the situation in which they interact but they can increase their level of information over time; (ii) actors preferences for net benefits and consequent decisions and actions are not independent from norms and other-regarding preferences; (iii) a variety of heuristics are used by actors in decision making, competitive or cooperative actions can take place in different contexts in order to approximate to maximization of net benefits, for self or for others. In synthesis, according to the broader behavioural theory, decision-making relies on adaptation and learning, norms and other-regarding preferences.

(II) However in Ostrom's work, also a broader assumption of Behavioural Theory is not enough alone in order to explain cooperation and social dilemmas. This has to go together with the understanding of the specific characteristics of the micro-situations embedded in the broader social ecological context (Poteete et al. 2010). In the development of this theoretical interpretation a central role is played by trust (Ostrom and Walker 2005). This is very different from the conventional theory of collective action where the importance of trust and reciprocity are underestimated. According to different studies on natural common-pool resources over-harvesting is more likely to happen when there is no trust and reciprocity (Ostrom and Walker 2005; Poteete et al. 2010). Experiments show that actors associated with common-pool resources problems overharvest when there is lack of communication, absence of feedback and ignorance about the members in the group. According to Poteete et al. (2010) in social dilemmas, trust and positive outcomes increase with the presence of specific micro-situational variables. Experiments that use microsituational variables in the design in relation to the broader behavioural theory of human action point at some variables that can be connected with joint and individual higher

payoffs when dealing with natural resources social dilemmas. Trust results as the central issue that needs to be addressed in order to create the cooperation that avoids free riding and that can reduce the chances of over-harvesting. Ten micro-situational variables have been related to the possibility of increasing positive outcomes and trust in multiple experimental social dilemmas (see Box 4.3).

Box 4.3 Micro-situational variables (Poteete et al. 2010, pp. 229-231)

- *1. High marginal per capita return of cooperation.*
- *2. Security that contributions will be returned is not sufficient*
- *3. The reputations of participants are known.*
- *4. Longer time horizon.*
- *5. Capability to choose to enter or exit from a group.*
- *6. Communication is feasible with the full set of participants.*
- *7. Size of a group.*
- *8. Information about the average contributions is made available.*
- *9. Sanctioning capabilities.*
- *10. Heterogeneity in benefits and costs.*

In the specific case of natural CPRs Ostrom (1990) has observed 8 design principles that characterize successful cases of common-property regimes management. For design principle Ostrom means "*an essential element or condition that helps to account for the success of these institutions in sustaining the Common Pool Resources and gaining the compliance of generation after generation of appropriators to the rules in use"* (1990, p. 90).

Cox et al. (2010) analyzed 91 case studies of community based natural resource management in order to conduct an empirical evaluation of Ostrom's design principles and they find them empirically well supported. Cox et al. (2010) reiterate what already said by Ostrom (Dietz et al. 2002) that these design principles do not represent a normative blueprint for successful resource management that can be implemented, but is more likely that in the cases in which they are present the resource is likely to be managed successfully for the local community perspective.

Box 4.4 **Ostrom Design Principles** (Ostrom 1990, p. 90 ; Cox et al. 2010, p.37)

- 1A. *Clearly defined boundaries: Individuals or households who have rights to withdraw resource units from the common-pool resource (CPR) must be clearly defined.*
- *1B. Clearly defined boundaries: The boundaries of the CPR must be well defined.*
- *2A. Congruence between appropriation and provision rules and local conditions: Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions.*
- *2B. Congruence between appropriation and provision rules and local conditions: The benefits obtained by users from a CPR, as determined by appropriation rules, are proportional to the amount of inputs required in the form of labor, material, or money, as determined by provision rules.*
- *3. Collective-choice arrangements: Most individuals affected by the operational rules can participate in modifying the operational rules.*
- *4A. Monitoring: Monitors are present and actively audit CPR conditions and appropriator behavior.*
- *4B. Monitoring: Monitors are accountable to or are the appropriators.*
- *5. Graduated sanctions: Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, officials accountable to these appropriators, or both.*
- *6. Conflict-resolution mechanisms: Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.*
- *7. Minimal recognition of rights to organize: The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.*
- *8. Nested enterprises: Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.*

(III) Social and ecological dynamics and systems has been at the center of the analysis of different body of scholarships. In economics the classical authors have placed a great deal of attention on the relationship between societal patterns and the environmental external conditions. However the fragmentation and specialization of science strongly narrowed the focus of

contemporary economics especially in the hegemonic form of neoclassical economics.

Institutional analysis has been criticized for not giving adequate a central role to power. Following this line of criticism, Clement (2010) proposes a politicized version of the IAD. Clement combines the contribution of Ostrom and colleagues with political ecology. I find this approach as interesting and enriching for the study of social ecological systems in particular when conflicting interests and perspectives clash. In the next section a review of some of the relevant trends in political ecology is presented.

6 Political Ecology

Political ecology is an heterogeneous and "generous" (Robbins 2011) body of scholarship that does not coincide with a univocal definition. Authors such as Bryant (1998) Forsyth (2002) and Robbins (2011) have made the effort to describe the different school of thoughts and epistemologies that converge under the Political Ecology umbrella in order to bring some clarification on the epistemological and conceptual differences of the different trends of this discipline. A broad understanding of Political Ecology refers to the social and political conditions that relate to environmental problems (Blaikie and Brookfield 1987; Zimmerer 2000). Some authors instead prefer to use the plural term "political ecologies" emphasizing the importance of different local and geographical contexts (Walker 2003, Bebbington and Batterbury).

According to Forsyth (2002) review there are five main trends in political ecology that can be identified by the meaning that "ecology" assumes in the definition of "political ecology". Also if with some limitations, (see Farrell 2004) I find his review very useful.

According to Forsyth the first trend in political ecology is represented by the authors that bring together issues of ecology together with a broad interpretation of political economy. Under this perspective environmental problems are explained as the result of the interaction between biophysical processes, human needs and the political dimension. The second trend relates to the "politics of ecology" (Forsyth 2002, p.3), this interpretation relates to the Deep Green environmentalism political activity present in different social and political movements. Third, is the interpretation of "political ecology" as presented by Russtt's (1975) *International Regions*

and the International System: A study in Political Ecology.

The term ecology is referred to the dynamics and interconnections of the political relations. Fourth, is the political economy stream of analysis of nature and society where the Marxian or Marxist interpretation of the process of environmental degradation as consequence of capitalistic modes of production is predominant (Cockburn and Ridgeway 1979; Pearce and Atkinson 1993; Bryant 1997b; Bryant and Bailey 1997; Wells and Lynch 2000). The fifth interpretation identified by Forsyth relates to the analysis and discussion of the politics of environmental problems without a specific meaning for ecology. Forsyth instead produces his own interpretation, which he names *critical political ecology* and defines as "the politics of ecology as a scientific legitimatization of environmental policy" (2002, p.4).

Moreover, Forsyth (2002) identifies some central themes that have influenced transversally the different trends in political ecology. The first theme is related to the emergence of ecology as a "subversive" discipline. The seminal work of Odum *Fundamentals of Ecology* (1953) extends the focus of analysis of level of organizations that go beyond the individual or the specific specie. This involved the necessity of going beyond the mono-disciplinary approach and above all it gave centrality to the question of interdependence and connection between the human sphere and all the infinite dimensions of nature. Forsyth points that the consequences of this question have been made more explicit by Sears' 1964 paper "Ecology – a subversive subject." Sears questions the fact that Ecology if taken seriously would endanger threaten the fundamental assumptions of modern societies whatever their political and doctrinal positions.

A second fundamental theme according to Forsyth is - the issue of domination of nature -, this theme finds its roots in the work of authors of the Frankfurt School of Critical Theory, in particular Habermas and Marcuse. Marcuse critique in relation to the simultaneous domination of "man" and "nature" produced by the modern economic system of industrial production has been connected to emergence of the postnormal science approach (Farrell 2008).

A third theme is related to the issue of - social justice and the so called developing world - in relation to this theme Forsyth recognizes two different approaches, the first applies a structuralist explanation of environmental degradation and local communities oppression, as consequence of either state oppressive policies or capitalistic expansion (e.g. Blaikie and Brookfield 1987; Bryant and Bailey 1997), the second approach instead is related to a poststructuralist perspective

that focuses on the importance of discourses and creation of paradigms and narratives in the "making" of the third world in a process in which discourse can become a powerful vehicle for subjection and oppression of people in poor countries. This approach (e.g. Rocheleau 1995, Leach and Mearns 1996) draws on the work of authors such as Michel Foucault and Edward Said and is tightly connected with the anti-development school of thought (Escobar 1996, 1998; Ferguson 1994).

A fourth and final theme is - the separation of science and politics – Forsyth critique here, is about the underlying assumption of some political ecology contributions, that science and politics can be kept separated. This perspective relates to a positivistic interpretation of the process of scientific production which mainly assumes objectivity, neutrality and truth as fundamental pillars of the scientific enterprises, in particular in the hard sciences. This approach according to Forsyth falls in the limitation of not recognizing the mutual embeddedness between politics and science. This clear separation between nature and science overshadows the role that politics plays in the production of science. According to Latour (1993b; 2004) the separation between '*non-human nature*' and '*humans culture*' or between nature and society, is the result of an artificial process of '*purification*' that consists in creating two different and separate ontological dimensions. However this process, through a simplistic dualism, creates the epistemological ground for inaccurate attempts to establish rational explanatory relationships as it overlooks the interrelation between nature and society.

This position raises concerns about the possibility of producing objective, neutral, and constructive truths in science and in particular in social sciences. Jasanoff, writing about relativistic concerns in one of her essays on sociology of scientific knowledge asks "*If we grant the sociologist of science the right to undermine 'true' scientific belief, then upon what basis can we accept the sociological account itself as authoritative*?" (1996, p.398). Her detailed and articulated answer is related to the interpretation that the scientific process is better understood as a system of co-production between knowledge and social order.

Therefore, according to Jasanoff, a relativizing position with respect to certain assumptions of scientific knowledge, does not deny the possibility for science to be normative and explanatory. On the contrary it "*adds to the repertoire of possible explanations, and illuminates new pathways for intervening in the production of both knowledge and power*" (Jasanoff 1996, p. 412). This

position is very close to the one described by Forsyth (2003) as the founding epistemological characteristic of his definition of Critical Political Ecology. Forsyth states that an accurate scientific representation of reality and environmental issues can be achieved but has to follow a critical approach that acknowledges that there cannot be a separation of (environmental) science and politics.

Both Jasanoff and Forysth challenge the 'political neutrality' of scientist. Forsyth points that environmental policies based on orthodox "*unproblematized universal truths*" (2003: 268), can produce socially undesirable supported by inadequate scientific explanations. These insights as Jasanoff (1996) notices have been recognized, (in very different ways I would add) in the stream of institutional analysis, and related to the capacity that institutions, and also scientist do not escape from them, have in creating meaning and social and symbolic orders.

7 Societal Metabolism

The Neoclassical economics hegemonic paradigm not only has been simplistic in the representation and interpretation of human behavior (i.e. *Homo economicus*), which has been widely criticized in different forms in the stream of institutional economics (see previous section), but also failed in representing the biophysical component of the economic and humans productive activities. The absence of the integration of the biophysical component in the neoclassical economic analysis is clear when looking at how the input factors are treated in Neoclassical Welfare Economics. Neoclassical Welfare Economics simply does not consider the physical component and the transformation of nature, including human labor, as central in the concept of production.

This brought several Post-Keynesians economists to consider that a Neoclassical theory of production just does not exist (Gowdy et al. 2009). On the contrary the Classical Economist, such as Smith, Ricardo, Malthus, Jevons and Marx and Engels placed production in a central position in their analysis. These authors well described the importance of the biophysical component in the production system. For example, one of Ricardo's main theoretical highlights is that the marginal productivity decline is related to the production factors including, labor, capital, land, and technology (2004[1817]).

Malthus (1798), instead famously described the collision in the economic system produced by the two different speeds, of population growth (geometric ratio) on one side and of the means of subsistence (arithmetic ratio) on the other. Jevons (1865) specifically addressed the issue of resource scarcity looking at the coal question in the UK and explained the role of technological advancement in dealing with resource scarcity, which explains how major efficiency due to technological progress 'paradoxically' and counter intuitively increases rather than decreases the aggregate consumption of the used natural resource. Marx's definition of the 'societal relation of humanity to nature' is a core question of the dialectic between use value and exchange value of labour, production and commodities (Burkett 2009).

However, after the 1870 the 'Marginalist revolution' overshadowed the importance of the biophysical component in the analysis of production systems and shifted the attention to the mathematical analysis of individuals utility functions (Gowdy et al. 2009). Within the neoclassical paradigm the whole issue of resource scarcity and biophysical limits has been treated as a problem that can be resolved through technological innovations and market price mechanisms. This belief has been part of the cornucopians world vision and is still very diffuse in certain economics and policy circles. A simplified description of the neoclassical view is that technology should be able to expand productivity without limits, and a fully rational individual informed and in a market system of perfect competition would be able to maximize its utility by manifesting its preferences about goods and services with a perfect substitutability of natural and artificial capital. As a matter of fact, this interpretation of human-nature interrelations is partial and simplistic.

According to Gowdy et al. (2010) when the neoclassical function of production is applied to environmental and social the results are sterile. Moreover, this is particularly striking when it comes to the definition of the different (weak, strong and very strong) paradigmatic definitions of sustainability that relate to the different degrees of substitutability of natural and artificial capital (Neumayer 2010). A hardcore neoclassical view based on the work of Solow (1974) and Solow and Wan (1976) define that an economy is sustainable when natural resources exploitation is counterbalanced by an increase in artificial and infrastructural capital.

This relates to the Neoclassical interpretation that the problem of scarcity is only related to relative scarcity (efficient allocation of resources) rather than with absolute scarcity. This

produces the Neoclassical assumption that in the production function it is only the total sum of the inputs that matters and not their qualitative difference. However this is particularly limited when taking into consideration inputs such as energy and labour that are fundamental for the economic and production process (Georgescu-Roegen et al. 1999, Mayumi 2002, Gowdy et al. 2009,).

A review of the authors that criticized the theoretical assumptions of Neoclassical economics is beyond the scope of this review. What is my interest is pointing at the fact that apart from some approaches developed in Ecological Economics, frameworks that takes into account the economic, the biophysical, the institutional and political components of society have not been consolidated yet. However, Georgescu-Roegen (1971, 1984, 1986) has posed the basis for a more integrated and less reductionist analysis of economic systems and human nature interrelations. Georgescu-Roegen work *The Entropy Law and The Economic Process* has been one of the most important efforts to bring the analysis of economic processes and production under the consideration of biophysical limits, energy resource and matter constraints and thermodynamic laws.

One of the useful distinctions of Georgescu-Roegen (1971) that have been applied by many of the authors that followed on his line of analysis (special issue of *Population and Environment* 2001) is the distinction between fund and flow coordinates. Fund coordinates refer to the Capital, People and Ricardian Land. They are factors that enter and exit the economic process and that transform input flows into output flows. Flow coordinates instead are factors that either only enter or only exit the economic process. According to this description factors such as Labour and Energy regain their central importance in the explanation of how societies produce and reproduce themselves looking at their metabolism in terms of economic production-nature (supply and sink functions).

Human activity, economic production and societies reproduction are studied according to this approach as a complex system with specific metabolic functions. This approach has been thoroughly developed in the Societal Metabolism[3] stream of analysis. This approach, introduced in two Special Issues edited by Giampietro and Mayumi (2000a; 2001) defined as 'Multiple-Scale Integrated Assessment of Societal Metabolism' and is proposed as a framework for the

3 Some Authors prefer to refer to Social Metabolism or Society's Metabolism

analysis of sustainability issues. The MuSIASEM approach has been later on further developed and its applications illustrated in three books: Giampietro et al. 2011; 2012; in press. MuSIASEM has been applied to different areas of analysis across different countries such as rural systems (Gomiero et al. 2006; Scheidel et al. 2013); in multiscale land use analysis (Tovar-Serrano and Giampietro, 2014), garbage management (D'Alisa et al. 2012), development studies (Ramos-Martin et al. 2007); and water metabolism (Madrid et al. 2013).

This approach builds on the integration of Complex Thinking and Hierarchy Theory and the old insights of the biophysical analyses of economic processes. This definition of Societal Metabolism takes into account three pillars that make it valuable for the analysis of sustainability issues. Following Hierarchy Theory (Allen and Starr 1982; Giampietro et al. 2000) this approach looks at societies as organized in nested hierarchies on multiple scales. This implies that non-equivalent representations of the system have to be used simultaneously depending on the hierarchical level considered (e.g individual, household, village, region, nation, etc). Acknowledging the existence of nested hierarchies on multiple scales involves that the analysis of the socioeconomic systems is conducted through the parallel use of variables and models not directly reducible to each other (addressing the issue of "technical incommensurability" proposed by Munda (2004) and discussed in Chapter 2).

The necessity of an integrated assessment that takes into account the multidimensionality of sustainability issues is a direct consequence of the special nature of social-ecological systems (SES), that cannot be represented into a single quantitative representation because refer to processes requiring two distinct scales of analysis (Madrid et al. 2012). Therefore integrated assessment means providing a simultaneous representation of incommensurable systems quality through multiple criteria. Last, this approach follows the old insights of the biophysical analyses of economic processes.

The main aspect here is that integrating biophysical analysis with economic analysis emphasise the direct relation between assessments of economic performance and of environmental pressure. Following the work done by Lotka (1956) and Georgescu- Roegen (1974), a central distinction in Societal Metabolism is the one between endosomatic and exosomatic metabolism. Endosomatic and exosomatic metabolism refer to the material inputs and energy flows transformed 'inside' or 'outside' of the body of the physical members involved in the

socioeconomic process of a given society or population group (Giampietro et al. 2009). The concept of metabolism implies that societies and economic systems depend for their reproduction on the ability of stabilizing a continuous flow of energy and material in their interaction with the environment.

This dependence implies that the characteristics of this interaction do affect the structural characteristics of a society. For example, Podolinsky in 1880 studying the constraints affecting an agricultural economy concluded that it can be sustainable only if the agricultural labor productivity (the food produced per unit of labour) at the local scale is higher than the efficiency of the transformation of food into work at the scale of the whole society (Giampietro et al. 2000). Other key authors in the historical theoretical evolution of the concept of societal metabolism are Schrödinger with his work on necessary conditions for living systems (ability of getting negative entropy) and the development of the concept of dissipative systems elaborated by the Prigogine's school. According to Prigogine's and colleagues work human societies are self-organizing dissipative systems that need a constant flow of energy and matter from the environment to stabilize their functions, and that at the same time produce a flow of waste towards the environment. Finally, Giampietro et al. (2011) in tracing the theoretical backbones of Societal Metabolism point at the work of authors such as Cottrell (1955), Odum (1971, 1996), Pimentel and Pimentel (1979), Smil (1991) for their energetic analysis of human systems and at other such as Leontief (1982) for his input/output analysis of the different economic sectors and at Zipf (1941) for his work on the profile of investments as fundamental features of socioeconomic systems.

Section 2: Integration of the Analytical Framework

In this section I will introduce the analytical framework that I elaborate on. The proposed framework is a modified version of the Institutional Analysis Development framework - IAD (Kiser and Ostrom 1982; Ostrom 1994, 2011). The term 'framework' in this dissertation is used in the specific way in which Ostrom (2011) has used it along her work on the IAD. Ostrom clarifies the terminological distinction that she applies (and that can be different from other common interpretations in science) between frameworks, theories and models.

To be consistent with her work I will apply the same definitions. According to Ostrom, "Frameworks identify the elements and general relationships among these elements that one needs to consider for institutional analysis and they organize diagnostic and prescriptive inquiry. Frameworks provide a metatheoretical language that can be used to compare theories" (2011, p. 8). In this interpretation, several theories are compatible and can be included in the same framework. Theories are understood in a pragmatical way as useful for making broad working assumptions about the scientific analysis and in "generating predictions about expected patterns of relationship" (Ostrom 2005, p. 28). Finally, models are explained as a way to "make precise assumptions about a limited set of parameters and variables" (Ostrom 2005, p. 28). Models are used to explore what outcomes are produced by the theoretical and multiple models can be compatible with the different theories. However models are not a necessary part of the framework and if they are used depends also on what Theories are included in the framework. Moreover models have to be used carefully because if they are applied to situations that do not fit precisely the assumptions of the model itself they reveal misleading (Ostrom 2005).

Understanding a framework in this way, which is semantically open, has the advantage of being able to: (i) reproduce an analytical approach; (ii) integrate diverse disciplinary backgrounds; (iii) apply different methods and tools according to the case study characteristics; (iv) have a heuristic potential; (v) imply a prescriptive capacity; (vi) develop diagnoses.

For this reason the IAD has been used in a extremely diverse variety of cases and tailored to specific research questions and circumstances. Moreover, some authors have pointed out that the IAD might be complemented adding other dimensions or variables. Clement (2010) for example proposes a politicised version of the IAD adding 'discourses' and 'political-economic context' as endogenous categories of the analysis. Hagedorn instead, supported by his 2008 work, criticize the framing of the IAD for not giving enough attention to the physical transactions that stimulate the action situation.

However, the integration of the biophysical dimension in the institutional analysis is something that is at the center of Ostrom's recent work, together with other colleagues, on the development of the Social-Ecological Systems (SES) framework (Anderies et al. 2004; Poteete et al. 2005; Ostrom 2009). Following the line suggested by Gowdy et al. (2010) of integrating in the analysis of sustainability issues both biophysical inputs and human institutions I still find that an

integrated version of the IAD is more useful in my research than the application of the SES.

The IAD is more semantically open then the SES. The SES represents a valid attempt to reproduce an ontological framework of Social-Ecological Systems (Poteete et al. 2005). However the identification of second tier variables specific for resource-human interactions make the frameworks more defined. In the opinion of several scholars this is not a problem and the SES could be applied to a large variety of cases and not necessarily only to the social-ecological systems dynamics. My opinion here is that this is somehow in contradiction with the way in which the SES evolved from the work on the IAD on natural resources governance.

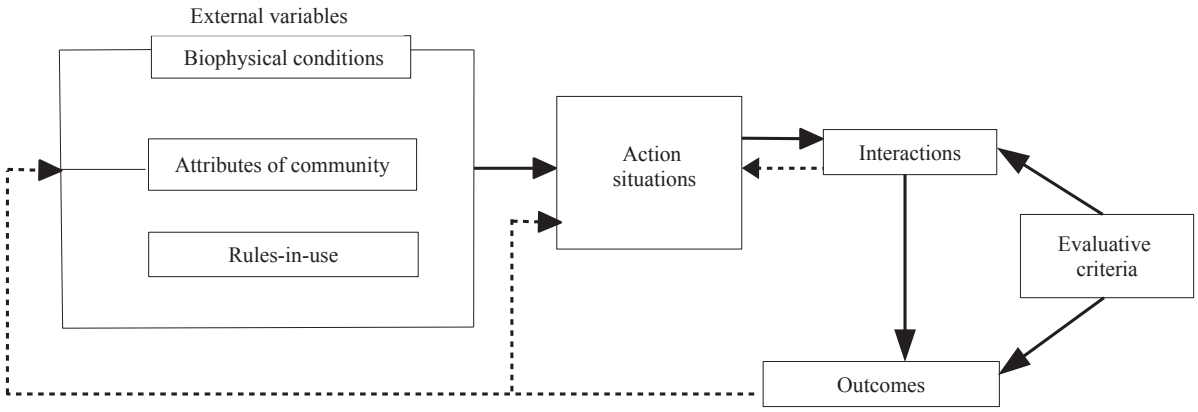
However the SES is still at its early stages and has a huge potential and possibilities of evolution. For these reasons I think that the IAD gives the possibilities to integrate institutional analysis and biophysical inputs for an integrated analysis of sustainability issues and social-ecological systems. This perspective derives from the three theoretical background reviewed in the previous section, institutional analysis, political ecology and societal metabolism. From these theoretical backgrounds IAD, MuSIASEM and discourse analysis are brought together in a modified integrated version of the IAD that I apply as analytical approach in the investigation of my two case studies. I will now briefly review the IAD, the MuSIASEM and the integration of discourse analysis and finally graphically present the approach that I apply.

8 The Institutional Analysis and Development (IAD) Framework

The Institutional Analysis and Development (IAD) framework (Kiser and Ostrom 1982; Ostrom 1994, 2011) is based on a set of broad variables, themselves decomposable into sub-variables, whose organizing and analytical capacity has proved useful in describing and explaining complex phenomena of policy change. For an accurate review and operational guidance of the use of the IAD Framework, see the *Policy Studies Journal* special issue on the Design and Promise of the Institutional Analysis and Development Framework (Ostrom 2011). The IAD has been used as a diagnostic tool for the analysis of a wide range of issues where humans interact within norms and rules that influence their choices, behaviors and decisions (Hess and Ostrom, 2007).

The framework has notably been used to identify drivers of collective action in natural resource

management. Its typology of rules provides a sound basis for understanding the role of institutions across multiple decision-making levels. The (IAD) has been extensively used for the study of CPRs and common-property regimes in the field of natural resource management (Oakerson 1992; Agrawal 1999; Ostrom et al. 1994; Ostrom 2000, 2005) but also for other complex interdisciplinary research tasks, for example the study of government incentives, the analysis of institutional impacts on monitoring and evaluation in development projects (Gordillo and Andersson, 2004) and institutional analysis of reforestation policies (Clement and Amezaga 2008). The IAD framework is used in such a large variety of empirical settings because it is helpful for identifying and rigorously analyzing the structure of a situation, in particular the influence of the rules, the essential characteristics of the actions and events taking place and the main actors, subjects, and communities involved (Ostrom, 2005).

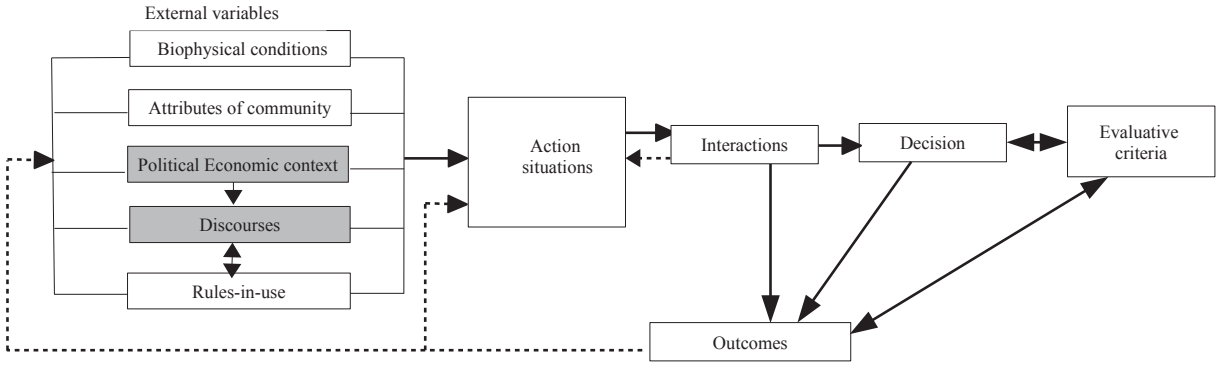


Source: Adapted from E. Ostrom 2010: 646

Figure 4.1. Institutional Analysis Development Framework

However, a recurrent critique of institutional analysis is that does not highlight the role of power and politics. To address this limitation, Clement (2010) proposes a modified "politicised" version of the IAD that takes into account the assessment of policy change and policy impacts, across multiple levels of governance (Clement 2010). Here in this case study a further modified version of Clement's IAD framework is used, which makes it possible to integrate analysis of multiple

governance levels (IAD) and to include political aspects of the structuring (Clement 2010) transmitted through discursive practices (Hajer and Versteeg 2005).



Source: adapted from Clement 2010:139 and E. Ostrom 2010:646

Figure 4.2 Politicised Institutional Analysis and Development Framework

9 MuSIASEM

In order to take into account the biophysical aspects of the case studied, drawing from the literature on Societal and Ecosystem Metabolism (Giampietro 2004, Giampietro et al., 2011; 2014) the dimension "Metabolic patterns" was added to the framework. The analysis of the metabolic patterns is conducted drawing on the MuSIASEM approach. The MuSIASEM 'Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism' is the result of a work started in 1997 in order to produce a framework that is able to represent the performances and dynamics of a multidimensional system that relates to non equivalent domains. This refers to the possibility of analytically representing problems that can require different representations according to the perspectives involved. This framework represents a possible way of dealing with Post-normal science situations such as in complex or sustainability issues where a plurality of legitimate different perspectives and different scales coexist.

The basic rational of MuSIASEM, which builds extensively on the work of Georgescu-Roegen for the accounting methodology can (i) analyse energy and material flows applying the concept of exosomatic and endosomatic metabolism within the metabolic pattern of society; (ii) analyse

the interface between the society and embedding ecosystem looking at the characteristics of the two specific metabolic patterns (described on different scales); (iii) establish a relation between the socioeconomic view - when mapping flows against the fund element "human activity" - and the ecological view – when mapping flows against the fund element "managed land". Within this analytical framework land use changes and damages to ecological funds represent a fundamental consequence of metabolic transformations involved in economic and modes of production transformations.

The MuSIASEM framework operationalize Georgescu-Roegen bioeconomic approach by explicitly including in the analysis biophysical capacities and limits. This is done by including in the analysis: *(i) socioeconomic factors required for both the production and consumption of goods and services, (ii) energy and material transformation processes, (iii) demographic changes, (iv) the profiles of human time allocation and land uses in various economic sectors, and (v) the impact on ecosystem health resulting from the compatibility of the flows of energy and matter metabolized by society and the supply and sink capacity of the ecosystems embedding the society.* (Giampietro et al. 2008, p.4)

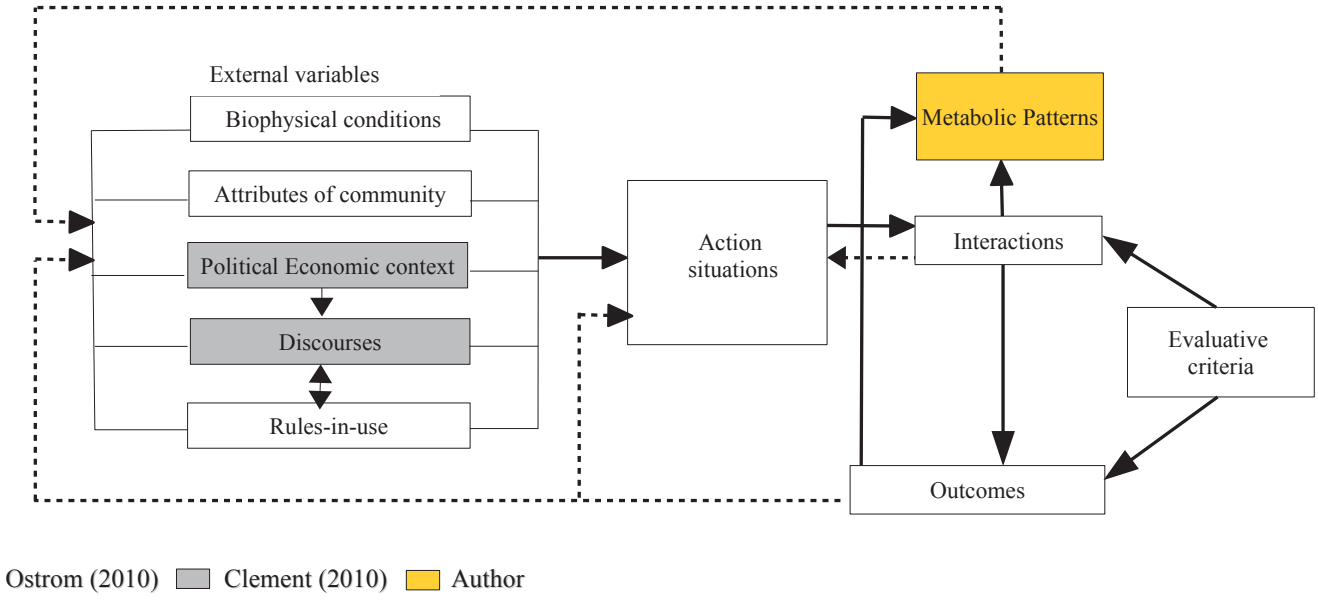


Figure 4.3. Integrated IAD Framework

In the next Part (II) of this dissertation three different appliactions of the Integrated IAD framework will be presented in five different essays.

PART II: APPLICATIONS

CHAPTER 5

DISCOURSE AND PRACTICE IN PARTICIPATORY CONSERVATION: EXPLORING HOW IT VARIES IN DIFFERENT GEO-POLITICAL SETTINGS

Authors: Jampel Dell’Angelo, Orleans Mfune, Patrick Bixler, Hassan Roba, Floriane Clement

Abstract:

Natural resource conservation programs and projects commonly refer to participation and local community involvement as one of the necessary prerequisites for sustainable resource management. All across the world, government and conservation agencies are implementing conservation programs that carry the label of participation. While the theory of participation has recently dominated conservation discourse, we observe that participation assumes different features depending on the specific context where it is applied. Often this has resulted in significant gaps between theory and practice. This paper argues that social, geographical, and political factors shape participatory discourse into different participatory practices depending on the context. To illustrate this, we compare four case studies of natural resource conservation to first describe what is the gap between participatory discourse and practice in the specific case studies and further to analytically consider how and why participation in different conservation programs varies across geo-political contexts?

In order to answer these questions, we apply a modified version of the Institutional Analysis Development (IAD) framework, including a political ecology perspective to provide a critical edge to assess power dynamics. Such a comparative analysis increases our understanding of how institutional dynamics are strongly influenced by discourse and political economy of the context in which they occur. The results of this research indicate that all four case studies posit a strong rhetoric of participatory resource governance ideals. However, in at least three of the four cases, there are important gaps between this rhetoric and practice. These results show that although large international donors and multi-national accords strongly tout participation as a

panacea for more sustainable natural resource management, in practice it assumes different characteristics which vary with context. The gap between participatory rhetoric and practice is often wide and leads to negative consequences for both local livelihoods and natural resource conservation efforts.

1 Introduction

Participation is a buzz word in development programs and projects all across the world (Cornwall and Brock 2005). Despite the discourse of participation illustrating uniformity globally, its application on the ground has taken different forms as different actors (including NGOs, governments, and international agencies) with different agendas implement it. These actors often interpret the notion of participation differently, which influences the way participation is translated into practice. The field of natural resource conservation is no exception. This paper explores this contradiction between participatory discourse and implementation outcomes on three different continents. We apply a cross-country analysis tracking the determinants of differential outcomes in four cases of participatory natural resource conservation in Kenya, Zambia, United States, and Tibetan rangelands (People's Republic of China).

In many instances, the comparability of cases is made more difficult by spatial differences in factor conditions, such as pre-existing power relationships, land tenure structures, the nature of poverty, and challenges of researcher access to concrete processes and outcomes. This point illustrates the problem of data commensurability with regard to studying natural resource conservation through the lens of livelihood generation, poverty reduction, and in relation to the practice of decentralization. Because of these challenges, multi-country critical comparisons are rare in the literature. This is unfortunate, because such analysis can provide rich insights into the localized forms of global discourses, such as participation and environmental conservation.

In order to restrict the analytic space of our exploratory study we have defined two guiding research questions: "What is the gap between discourse and practice on the level of participation in the specific case studies?" and "How and why does participation in different conservation programs vary in different geo-political contexts?" The Institutional Analysis Development

(IAD) framework (Kiser and Ostrom 1982; Ostrom, 1994, 2011) is useful for organizing the great quantity of information deriving from four different cases and for discussing these research questions. Moreover, because of the social, geographical, and political heterogeneity of our cases, we find particularly useful to include a political ecology perspective to the IAD framework. We do this following the approach developed by (Clement and Amezaga 2009; Clement 2010). Additionally, we draw on a typology of participation that characterizes the outcomes of each case study.

Our combined analytical approach provides a sound basis for understanding the role of institutions across multiple decision-making levels, while simultaneously examining how a similar global conservation discourse is differentially translated in local contexts. The results provide valuable insights to inform policy and practice at the intersection of conservation and livelihoods across a spectrum of geo-political and cultural boundaries.

2 Participation and natural resources conservation

For most of the past century, natural resource conservation was characterised by centralised modes of environmental decision making that placed natural resources under the control of state bureaucracies and marginalised local actors who were often dependant on the same resources for survival (see Adisu and Croll, 1994) or their livelihoods. This was the case in many parts of the world where CPRs were appropriated from local actors and designated as protected areas where human activities were excluded (Sullivan and Homewood, 2004; Hulme and Murphree, 1999; Campbell, 2000; Siurua, 2006). These exclusionary modes of environmental governance were often backed by scientific narratives that represented natural resources as threatened by the activities of local actors in proximity to these resources. In particular, equilibrium thinking in ecological theory was instrumental in forging a conservation approach that favoured exclusive control of natural resources by state experts (Hurley et al., 2002; Gillson, 2004; Lankford and Beale 2007; Forsyth 2003; Forsyth et al. 1998).

In the 1960s, narratives that represented local actor's exploitation of CPRs as 'tragic' bolstered this state-centric approach. This view gained ascendancy in institutional theory with Hardin's (1968) influential paper 'Tragedy of the commons'. In this work, CPRs were characterised by inefficient institutional arrangements where the consequences of free riding were resource over-exploitation and environmental degradation. Although many authors have noted that Hardin's

theory was significantly flawed, in the sense that what he was describing was a tragedy of 'open-access regimes' and not a tragedy of the 'commons', this paper was nonetheless influential in legitimising the view that CPRs required either the state or the market to avoid tragedy (see Ostrom, 1990; Sullivan and Homewood, 2004; Bryant and Bailey, 1997). It served to reinforce the importance of the protected area approach, as well as encouraged policy reforms that sought to dissolve common-property systems in favour of state and private property systems.

However, over the past 20 years, a combination of factors has been instrumental in weakening the hegemony of centralised natural resource management models. Many studies have demonstrated the failure of this approach to protect natural resources (Rinzin et al. 2009; Grimble and Laidlaw, 2002; Hulme and Murphree, 1999). Studies from institutional theorists such as Ostrom (1990) also offered mounting evidence on the inherent capacity of local actors to act collectively in order to solve environmental problems (also Roe et al., 2009; Scherr, 2000; Xu et al., 2008; Stringer, 2009).

In addition, Banerjee (2001) notes that in some parts of the world, local people rose to challenge the state and forced it to yield ground (e.g hugging of trees movement in India and the resistance movement against logging in Borneo). This period also witnessed a political movement towards decentralisation which filtered through the conservation arena. Lastly, participation, as a construct for natural resource management was also endorsed by the international environmental community at the Rio conference and gained legitimacy as a style of managing the environment when it was unveiled as one of the key principles of sustainable development. The 1990s saw a new conservation paradigm emerging.

Participatory forms of resource management have been presented as win-win solutions to a host of environmental challenges such as deforestation, watershed degradation and depletion of rangelands on the ground that various actors are involved in defining the goals and means of natural resources conservation (Mery and IUFRO 2005). Conservation theorists and development practitioners have advanced a discourse where participation is related to good governance in the form of transparent and accountable institutions (Mery and IUFRO 2005).

However, while there is still much euphoria surrounding the notion of participation, the outcomes of so-called participatory natural resource management initiatives have not met expectations (Blaikie, 2006). In many instances, governments have been reluctant to devolve

power to bodies that are accountable to and representative of local people and have recentralised power through other means (Ribot et al., 2005). Whereas discourses of participation at the global level are appealing and relatively uniform, their translation at the national or local level has taken multiple forms and meanings (Blaikie, 2006, Cornwall and Brock 2005). *Participation* is indeed such an imprecise and ambiguous concept that participatory resource management has often been used as a catch-it-all construct to cover many different resource management arrangements (Sullivan and Homewood, 2004) and serve multiple interests. For instance, participatory development has offered a convenient way for the State to maintain existing power relationships and ensure the silence of the poor (Botes and van Rensburg, 2000). Under the same denomination, participation has taken multiple forms, ranging from mere manipulation with little or no power devolved to local actors, passive participation, where local actors are just told what others have decided, to self-mobilisation where local actors take themselves initiatives to manage the resource (Hobley 1996).

Table 5.1. Typologies of participation: how people participate in natural resource conservation

Typology	**Characteristics of each type**
Manipulative Participation	Participation is a pretence (people's representatives on official boards but unelected and have no power).
Passive Participation	People participate by being told what has been decided or what has happened
Participation by Consultation	People participate by being consulted or by answering questions
Participation For Material Incentives	People participate by contributing material resources (e.g. contribute labour)
Functional Participation	Participation seen by external agents as a means to achieve programme goals. In this case, people are only co-opted to serve external objectives while all major decisions have already been made by external actors

Typology	Characteristics of each type
Interactive Participation	People participate in joint analysis, development of action plans, formation or strengthening of local institutions. Groups take control over local decisions and determine use of available resources
Self-mobilisation	People take initiatives independently to change systems and develop contacts with external actors for resources and technical advise

Source: Hobley 1996:8

The conceptual imprecision that characterises the notion of participation, and the wide range of interests pushing it on the development and conservation agendas, raise several questions surrounding its translation into natural resource policy and practice. With so many resource management programmes across the world wearing the tag of participation, this study considers it important to understand how the global discourse of participation is captured, particularised and contextualised for use in a variety of socio-geopolitical contexts.

Furthermore, many scholars have highlighted the depoliticisation of participation both as a discourse and process (Hickey and Mohan, 2005, Cornwall and Brock 2005) and the influence of broader political forces (Blaikie, 2006) as key drivers for outcomes. Whereas institutional theorists have extensively explored the rules, community attributes and local biophysical conditions driving community participation, few studies have linked these factors with the broader discursive and political-economic context in which participation projects are embedded. Development and conservation studies have interrogated the discourse of participation, but often using a single country or single case context. While producing rich in-depth analysis, these studies have often lacked a comparative analysis of how participation is framed and used in different contexts. As a point of departure, this study uses four cases from three different continents to do this. In each case, the study examines the context in which participation takes place, the way participation is framed and translated into practice, the resource being contested, the actors involved and the outcomes of the conservation programme. Such an endeavour requires a blend multiple analytical lenses. The simultaneous use of analytical tools from institutional analysis and political ecology proved particularly useful to shed fresh insights on the drivers of participation.

3 Methodology

Institutional analysis, and in particular the IAD framework (Kiser and Ostrom 1982; Ostrom 1994, 2011), offers a solid analytical frame for comparative studies. The IAD framework is based on a set of broad variables, themselves decomposable into sub-variables, whose organizing and analytical capacity has proved useful in describing and explaining complex phenomena of policy change. The IAD has been used as a diagnostic tool for the analysis of a wide range of issues where humans interact within norms and rules that influence their choices, behaviours and decisions (Hess and Ostrom, 2007). The framework has notably been used to identify drivers of collective action in natural resource management and the outcomes of participatory conservation programmes. Its typology of rules provides a sound basis for understanding the role of institutions across multiple decision-making levels in participation outcomes In addition, political ecology (PE) is well suited to the analysis of participatory discourses and of the politics of participatory practices in resource management. Political ecology has gained ground in social-ecological research as a mode of analysing society-environment relationships (Evans, 2002; Zimmerer, 2006; Kepe et al., 2008; Robbins, 2004). According to Simsik (2002), political ecology articulates the motivations, interests and actions of various actors vying for access to and control of resource management. Epistemologically, we identify with Forsyth's term *critical political ecology*, an approach that questions the neutral validity of scientific explanations in politically charged contexts, such as the socioenvironmental field, but does not negate the existence of a "real world out there" (2003:11). Such an approach enables this research to focus on the way the discourses of participation are framed in various socio-cultural contexts and the role of power and social relations in determining the right to access and management of natural resources (Brown, 2003; Berkes, 2004).

We base our analysis on a 'politicised' version of the IAD framework, as proposed by Clement and Amezaga (2009) and Clement (2010).

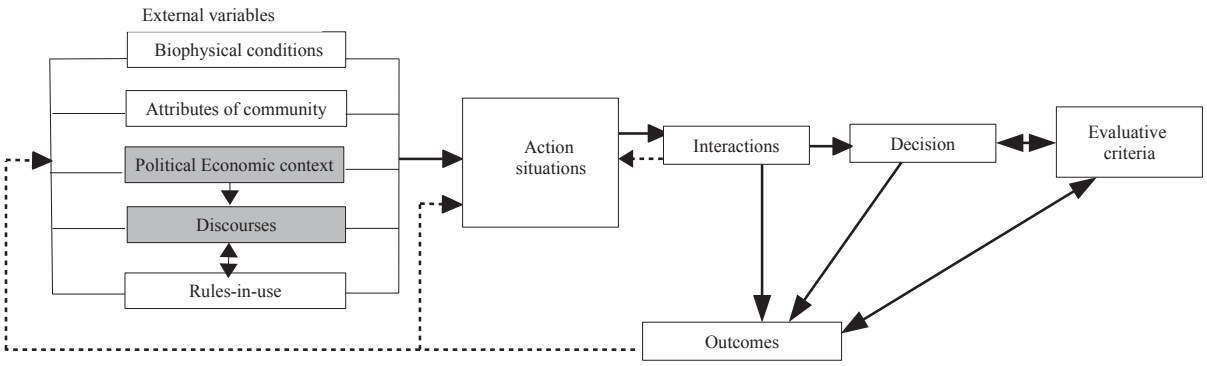


Fig 5.1. Politicised' version of the IAD framework adapted from Ostrom 2010: 646 and from Clement 2010: 139

Two variables were added to the original IAD framework: the [Political-economic context] and [Discourses]. [PB1] The addition of the [Political–economic context] aims at drawing attention to broader political structures and to the influence of the political economy on actors' power, interests and incentives. Considering the political-economic context also allows us to locate the relationship between the rules-in-use and the variability of levels of participation in different geo-political contexts. The analysis of discourses informs how the prevailing beliefs and values affect actors decisions and how dominant narratives include or exclude specific actors and views. Discourses also hold an important role by (de)legitimising institutional change (Hajer 1997), such as participatory conservation programmes.

The element that pulls together the four different case studies is the [evaluative criteria] based on Hobley's typology of participation (1996). It allows comparing what form of participation is produced in the different case studies. The specific methods of the different cases are described individually in the case study section as different data gathering strategies have been used according to the different research contexts.

4 Case Studies

The four cases in this study were selected on the basis that they present us with different socio-geopolitical contexts within which the notion of participation is seen as being at the core of their respective natural resource conservation policies or programmes. Moreover, each case

concentrates on a different type of natural resource. This not only shows how participation has been widely accepted and deployed in different geo-political contexts, but also in different resource types.

4.1 Zambia

The problem:

Conservation of natural resources in Zambia has historically been dominated by use of the fortress conservation model (DEFINITION?). However, over the past few decades, a shift in policy has seen the state embrace a discourse of participation which has triggered a process of regime change in protected areas. The process of regime change is characterised by contestations between the actors involved in it. This is well illustrated in the case of Munyeta reserve (located in central Zambia) where the state has begun the process of transforming a protected forest into a joint forest resources management (JFM) area to allow local participation in the process. The purpose of instituting such reforms is to halt the degradation of forest resources in the reserve by involving local actors in natural resource governance. The livelihoods of these local actors are seen as being at the centre of the degradation occurring in the reserve. To examine this process of change, we carried out 36 interviews with local actors (in the reserve and outside it) and 34 interviews with policy makers and conservation practitioners. Apart from interviews with local participants, focus groups discussions, examination of archival data and contemporary policy documents were carried out in order to understand the shift in these policies and to determine the fit between policy discourse and practice.

Biophysical conditions:

Munyeta reserve is part of the Miombo eco-region and is dominated by tree species belonging to the Brachystegia, Jubernardia and Isoberlina genera. Its range of hills and hydrological characteristics makes it an area of outstanding scenery. It was designated a protected forest in 1980 for the purpose of protecting its rich biological resources, its range of hills and water catchment area. Although the state adopted an exclusionary approach (i.e. fortress conservation), the size of the reserve (with an area extent of 12, 000 hectares and a land surface boundary of 42 km) and the complications involved in enforcement of forest rules and monitoring exploitation made restrictions to the reserve problematic. The costs of restricting access to the reserve are

quite high. Moreover, as a resource that is subtractable, forest degradation is inevitable in a situation where the state is unable to enforce forest regulation. In this regard, over the past 30 years, the reserve has been characterised by extensive deforestation resulting from human activities such as illegal settlements, charcoal production, livestock grazing and crop cultivation. The state of the reserve has prompted a shift in natural resource management strategies from the fortress conservation model towards participatory natural resource management.

The political-economic context:

With Zambia just emerging from an economic downturn in the 1990s that saw the country undergo biting economic reforms in form of structural adjustment programmes, the political-economic context creates challenges for the establishment of a participatory natural resource regime in the reserve. Some of the actors who have settled in the reserve are those who either lost their jobs during this period or were retrenched as part of the economic reforms. In this regard, they have become highly dependant on exploitation of the reserve's resources for agriculture and other extractive activities. In addition, some of the local political leaders (e.g the chief and headmen) are not supportive of participatory natural resource governance as they are seeking to have the area converted to an agricultural resettlement area.

Discourses:

In the 1980s, a discourse of an 'untouched' environment was used to advance conservation in the area. Munyeta was constructed as an untouched and fragile environment that required state protection. The belief that local actors' economic activities around the reserve where a threat to this fragile environment, prompted a conservation model that restricted people's access to the reserve and its resources. This discourse, however, is contested by local actors who argue that the area was historically considered a tribal commons from which local actors derived their livelihood benefits. In this regard, conservation in the area was characterised by contestations between the state and the local community in the areas. The current discourse of participation, influenced by changing political and economic circumstances, is aimed at addressing these contestations in order to pursue the goal of protecting this 'fragile environment'.

Attributes of the community:

The local community in this area can be divided into two, the one inside the reserve and the

community outside the reserve. Although both depend on the reserve for their livelihoods, the state distinguishes these groups based on their legal status in the area. Those in the reserve are considered 'illegal settlers' or 'squatters', as human settlement in government reserves is illegal. This group is highly heterogeneous (culturally and economically) in the sense that most settlers (apart from the original inhabitants) have only recently moved into the reserve from various parts of the country. In this regard, this group is characterised by low social capital (e. lack of social cohesion) and do not share the same values (lack a common understanding) in as far as natural resources are concerned. In contrast, the community outside the reserve is less culturally and economically diverse and comprises mostly one ethnic group whose settlement in the area predates the establishment of the reserve. For the past three decades, the relationship between these two communities and the state has been characterised by lack of trust and reciprocity. This situation creates a lot of challenges for the implementation of participatory natural resources management in the reserve.

Rules-in- use:

Under the protected area model, the state acted as both the constitutional and collective choice body that determined who had the right to access or use resources in the reserve. Boundary and position rules guiding resource management excluded them from accessing resources in the reserve and participating in the decision making process surrounding the management of the reserve. In addition, the payoff rules excluded local actors from benefiting from the resources as all revenue from the reserve exclusively accrued to the state. These rules were primarily defined through statutory regulations. However, this research shows that the community, both in and around the reserve, have historically appealed to custom and tradition as a source of collective choice rules and aggregation of their preferences. In this vein, customary authorities such as the village committee are viewed as de-facto collective choice decision making bodies and a means for defining both boundary and position rules. This has resulted in conflicts between the state's formal rules and local actors' own rules (i.e. resulting in what is termed as sterile dualism).

Joint forest management (JFM) and the discourse of participation seeks to remedy this situation by creating new aggregatory arrangements that allow communities to participate in defining boundary, information and position rules. The JFM committee, acting as the new collective choice body has now put in place new rules to be used which have been framed as 'JFM' rules.

The new pay off rules under JFM allows local actors to derive livelihood benefits from the reserve and to participate in management activities.

Action situation:

The participation of local actors in participatory resource management is structured around the new concept of JFM. The JFM area is now the arena for local actor's interaction with the state. The main actors in the process of JFM formation are the state and the communities within and outside the reserve. JFM is construed as sharing decision making powers and responsibilities over natural resources between the state and local communities. However, in practice, JFM is framed in such a way that the state continues to be the main driver of the process and the decision making space of local communities is limited by the fact that the state continues to prescribe the conditions for local actor's participation and the goals of conservation. Despite the new JFM rules, the heterogeneity of the community in the reserve, pre-existing customary rules and tribal claims to the reserve land by the Soli tribal community (both outside and inside the reserve) are a major deterrent to the establishment of a new natural resource regime. This is compounded by the economic context in which local actors view the reserve as primarily a source of livelihood rather than a conservation area.

4.1 Kenya

The problem:

Promotion of participatory wildlife management in the form of community conservancies in Northern Kenya has been problematic and remains controversial. The common justification is engagement of local communities in wildlife management and promotion of alternative livelihood system. In practice, implementation of participatory environmental management faces daunting practical challenges that hinder achievement of the broader objectives. We investigate these constrains in the case of Biliqo-Bulesa wildlife conservancy in Isiolo District of Northern Kenya. The conservancy was established in 2007 by the community living around Biliqo and Bulesa administrative wards with about 5000 members. Biliqo-Bulesa conservancy is a member of a network of community conservancies in northern Kenya under the umbrella Northern Rangeland Trust. It also enjoys supports from the Kenya Wildlife service which is the national

institution with mandate to manage wildlife.

We conducted semi-structured interviews with key actor including local leaders of the two wards and the officials of two local Non Governmental organizations (NGOs) campaigning against the conservancies in the communal rangeland. More data was generated from a meeting of over 80 pastoralist elders to discuss the problem of conservancy. In all the discussions, we inquired about the operation of the conservancy, level of participation of the local people in the management and decision-making, rules of access, boundaries, benefit sharing mechanism, livelihood impact and future scenarios for extensive livestock production.

Biophysical Conditions:

Northern Kenya is a marginal environment with low rainfall and high spatial temporal variability. Water, which is an important determinant of livestock distribution across the rangeland, is very scarce. The landscape is characteristically heterogonous with patches of key grazing resources located at far off distances. The conditions necessitate daily and seasonal mobility to track the resources. The position of the pastoralists who oppose creation of the conservancy is that exclusion from accessing key grazing resources around Biliqo-Bulesa including dry season fodder and important salt lick will have negative impact on the herd management strategy. Excludability becomes an issue in the case of the "core conservation areas" (area set aside exclusively for wildlife) otherwise rangeland is communally owned and there is no restriction for the pastoralist to graze wherever there is abundance of grazing resources. However change in grazing pattern from seasonal to all year round has resulted to increased pressure on the grazing resources, leading to valid concerns of 'subtractability'. The conservancy members have to employ local wardens to protect the wildlife and enforce rules and regulations for access.

The political-economic context:

The community has suffered historical political and economic marginalization. In 1960s, the community took part in a secessionist war and suffered damaging economic blow. Forty years down the line, the impact is still very apparent as demonstrated by low livestock holding at the household level. Political mistrust is still evident with high incidences of insecurity in the region. On the other hand, the community suspects government activities and are suspicious of any

development initiatives, especially those that relates to land ownership. The Conservancy project is associated with external interests aimed at dislodging the local from their grazing for alternative investments.

Discourses:

The dominant discourse to justify creation of conservancy in northern Kenya is that of Biodiversity losses in 'unprotected' rural landscapes. Informed by global crisis narrative of biodiversity loss at alarming rates, key actor including states and nongovernmental organizations whom aim to reverse the trend through concerted conservation efforts. The discourse is influenced by the local political-economic context because wildlife poaching in the area is blamed on the poverty of the population and general insecurity in the region.

Attributes of the community:

The dominant community living around the conservancy is the Waso Boran. The community has very elaborate system of political and resource governance. Families and households enjoy strong clan ties and other relationships which influence decisions on the use of grazing resources. The close-knit social relation is built on trust among clan members and the wider community. Over the years, the clan network has fostered strong social capital where community members are supported in times of need. Furthermore pastoralists practice reciprocity to access neighbouring rangeland and water resources. The clans share similar customs, norms and understanding of spatial and temporal resource variability that is used as cultural repertoire for deliberation and implementation of popular strategies for resource governance. Excision of Biliqo-Bulesa conservancy for wildlife management interferes with the traditional resource use arrangement and is therefore opposed by the pastoralists.

Rules-in-Use:

The rangeland in northern Kenya is communally owned and there is no restriction for the pastoralist to graze wherever there is abundance of grazing resource. Access and resource management is regulated by traditional customary rules under leadership of the local elders council (Jarsa dheda). Creation of conservancy introduces new access rules and changes the stewardship from local elders to the conservancy officials. The official and conservancy committee selected from the members holds the most powerful position for running the

conservancy. They have the authority for day-to-day management including recruitment and supervision of the community game wardens. Although theoretically the members in this position ought to change on regular basis, the boundary rules to effect the changes are not seen as transparent by the members. Information and payoff rules are managed by the officials and communicated to the members of conservancy on regular basis.

Action situation:

The action situation is an arena for interaction and the outcomes are shaped by external variables including the pre-existing community attributes such as strong clan ties that are interrupted by the creation of conservancy and the new resource management practices. The conservancy therefore disrupts traditional social networks that served both as an economic cushion and also as the foundation of social cohesion. The nature of grazing resources characterised by high spatial-temporal variability is not compatible with the conservancy model that is based on more predictable ecosystems. The new rules of the conservancy, that replace the customary rules and decision-making mechanisms, create new forms of stratification and and power relations, increasing vulnerability and conflict.

An important factor contributing to conflict at the point of interaction is the claim and counter claims of various actors who are can be broadly classified as: (a) members of conservancy: They are true beneficiary of the new resource management strategies under conservancy. (b) Non member pastoralists: They are the main contenders of establishment of the conservancy. They have historical claims on the area earmarked for conservancy. Their central concern is that creation of conservancy limits their access to key dry season grazing resource and salt licks within the area. The main outcome is disregarding the conservancy rules by this group of actors who maintain their traditional land use patterns. This has created constant waves of conflict with the pro-conservancy group. (c) Local NGOs: They are against conservancies. Their central thesis is that conservancies are just ploy to displace pastoralist from key grazing resources.

4.3 U.S

The problem:

Participatory watershed approaches to environmental governance is a response to ecological

degradation of water resources and political stalemate resulting from traditional approaches to environmental conflict resolution (largely through litigation). Water resource conflicts are prominent in the western United States (Sabatier et al., 2005), and recreational access, water quality and water quantity problems often serve as the impetus for the establishment of watershed partnerships (Leach et al., 2005). To investigate this process research was conducted in Montana, USA with an incorporated non-profit watershed partnership – the 'Blackfoot Challenge.' We carried out participant observation and twenty-one interviews using a semi-structured interview guide. Semi-structured interview guides ensure consistency across the interviews, yet also allow some flexibility for participants to talk about topics of interest to them.

Biophysical conditions:

The Blackfoot Valley watershed lies at the southern end of what is known as the Crown of the Continent Ecosystem, an 18 million-acre area of the Northern Rocky Mountains extending into portions of Canada and the United States. The Blackfoot Watershed totals about 1.5 million acres, with private ranchlands (24% of watershed) comprising most of the foothills and lower valley and the upper, forested and mountain areas being owned and managed by the state of Montana (5% of watershed) and Federal (49% of watershed) governments as well as Plum Creek Timber Company (private ownership, 20% of watershed). The diverse nature of land ownership equates to diverse ownership of water rights and uses. When ranchers consume a unit of the water resource, the potential for that resource to be enjoyed by recreationists decreases. Similarly, federal agencies have a statutory mandate under the endangered species act to maintain minimum flows for endangered fish species, thus reducing the amount of the resource available for agricultural purposes. These subtractability problems are exacerbated during drought years. Currently, exclusion costs are minimal in part due to 'memorandum of understanding' between the Blackfoot Challenge and federal agencies.

Political-economic Context:

The political-economic context, both locally and nationally, is supportive of a watershed partnership participatory approach to environmental governance. The homogeneity, ethnically and culturally, of both the residents in the Blackfoot Valley as well as the participants in the non-profit organization is not only a derivative of historical settlement patterns but also the political

economy of local land-uses. Ranching and forestry livelihoods have and still tend to dominate the social and cultural milieu of the watershed (and to a lesser extent, but increasing, are recreation and tourism activities). However, external threats exist to the livelihood options available for local residents, namely habitat fragmentation through exurban development. Housing development at the wildland-urban interface is challenging the traditional notion of what it means to 'live rural' and in 'a working landscape.'

Discourses:

A local discourse of 'open space' conservation has emerged as a powerful call to participatory engagement bringing diverse stakeholders to the table. Directly informed by the political-economic context of exurban development, this particular discourse includes an aspect of working lands that appeal to ranchers as well as in-tact landscapes that is attractive to land trusts and government agencies (Brunson et al., 2008). This has provided the discursive platform for environmentalists, ranchers, and loggers to participate towards a common conservation goal. Further, in April 2011 America's Great Outdoors initiative was announced to address the challenges, opportunities, and innovations surrounding modern-day land conservation. Through this initiative, the Blackfoot Challenge and similar participatory conservation organizations have been explicitly recognized as a model for water resource and land conservation.

Attributes of Community:

The Blackfoot Challenge represents the interests of seven geographical communities of place, which can be categorized as four communities of interest: landowners, agencies, land-trusts and business. Almost four decades of collaboration in the watershed has led to high levels of social capital and common understanding of challenges and opportunities. Norms of fairness, reciprocity, and trust between the actors involved, characterize this community.

Rules in Use:

In the complex system of federalism in the United States, it is often difficult to define collective choice rules because a myriad of agencies, governments, and statutes govern the operational rules applied to a particular geographic area. However, the management actions produced by collaborative institutions (such as the non-profit watershed organization in this case) provide new sets of operational rules governing the use of resources within the watershed. Therefore, it is

possible to discern the rules-in-use, which are relatively clear and codified due the processes of the formal non-profit organization – the Blackfoot Challenge – whose mission it is to 'coordinate' efforts of conservation in the watershed.

The boundary rules dictate that residents of the watershed participate in the collaborative efforts. Further, inclusive stakeholder participation is a goal that means balancing a certain ratio of landowners and agency employees (federal and state) participating in organization committees. Positions are relatively fluid, and members vote to elect executive committee members. Landownership maps of the Blackfoot watershed exist, with ownership boundaries (public-private) largely dictating authorized and forbidden domains. Aggregation rules exist, some by the state of Montana water statutes, and other less formal water sharing programs that require permission to use a neighbour's allocation. The organization aims to be transparent, and information regarding the workings of the Blackfoot Challenge is public.

Action situation:

The level of control each participant has over choice is structured by various incentives and deterrents. Specifically, landowner livelihoods depend on maintaining productivity in agriculture and ranching, and sustaining the water resource for agricultural irrigation to support these livelihoods. The level of control over choice is constrained by statutes as well as voluntary agreements. The natural resource management agencies largely operate on legislative mandates to conserve habitat and water resources under the Endangered Species Act and other statutes (for example the minimum levels of flow to sustain endangered fish stock), which comes with the distinction of authority and control. If this authority is not balanced with a desire for collaboration, these attributes can often deter participation from other stakeholders. The land trusts are primarily driven by land conservation as a response to exurban development using tools of conservation easements and outright purchase of land. The set of allowable actions (tax and real estate law) are clearly linked to outcomes for these participants. Land conservation efforts without community support often deter future participatory efforts. Local business operators are driven by economic principles to be economically viable businesses (guest ranches, recreation outfitters), maintaining a large degree of control over their choices.

Participation in the watershed partnership is largely structured by the formal organization, the Blackfoot Challenge. Membership largely comes from association with the Blackfoot Challenge

and non-members may still possess harvesting rights, but do not (presumably) take part in any voluntary agreements. Water programs are instituted to monitor the efficiency of ranch water extraction technologies. Drought events make outcomes more tenuous. Generally, good information is available regarding the condition of the resource and regarding joint outcomes (i.e. water efficiency program). This process is sensitive to the needs of local actors (landowners) and, locally, provides a forum to address the tensions between community, federal agencies, and environmental groups.

4.4. Tibetan rangelands (People's Republic of China)

The problem:

For the last 15 years the Tibetan rangelands have been subject to natural resource conservation and environmental governance programs implemented by the Chinese central government. The Sanjiangyuan region, where the watershed of the three major rivers of China, the Lacang, the Yangtze and the Yellow are located, has received priority attention. The Chinese government has implemented an extensive program of resettlement and sedentarization of the Tibetan nomads. Government policies target pastoral activity of the nomads as a major stressor for the rangelands and therefore the watershed. The Chinese government claims that the resettlement is voluntary and that the Tibetan nomads are actively involved in a process of environmental restoration and economic development. To investigate this process we conducted research in this area in 2007 and 2011. Data collection aimed at including a categorical diversity of respondents, including: nomads, resettled nomads, government officials, civil servants, religious exponents, local and international NGO staff. Overall, 142 interviews were conducted. For each category of stakeholder different interview and data collection methods were employed, such as unstructured and semi-structured interviews, informal conversations and observation.

Biophysical conditions:

The Sanjiangyuan area is the part of the Qinghai-Tibetan plateau that contains 90% of the watersheds of China's rivers (Haiying et al., 2002, Qiji et al., 2005). The plateau altitude ranges from 1500 to 5000 mt and generally has the form of arid steppe. Annual precipitation varies from 100 to 300 millimetres. Six months of the year frost covers the area and permafrost is present

over large parts of the plateau. The eastern and southern areas have grasslands, which have been traditionally inhabited by nomadic pastoral population. The aspect of subtractability and excludability of the rangelands varies according to the institutional arrangements established during the different historical and political periods. However, a multiplicity of factors such as demographic pressure, ecological disturbances, policy and institutional arrangements has increased the level of subtractability and excludablity over the years.

Political-economic context:

The political-economic context is particularly salient in the process of environmental governance of the area. Qinghai, with a 45.5 % non- Han population, is the third largest province in the PRC with the highest percentage of minority nationalities (after TAR and Xinjiang). Tibetans represent the largest minority (22%), followed by Hui (16%), Tu (4%), Salar (2%) and Mongols (2%) (Goodman, 2004). In 2001, 39 counties out of 46 (the majority of the rural counties) were officially classified as "poverty stricken" (Qinghai Statistical Yearbook 2001 in Goodman, 2004). In 2001, under Premier Jiang Zemin's slogan "Open Up the West through rebuilding a green west", a five-year Plan based on environmental sustainability, internal infrastructures, transport and communication was introduced (Goodman, 2004). Qinghai's development strategy is part of the wider "Open Up the West" campaign (xibu da kaifa) introduced by the CCP in 1999 to develop the economy and reduce the economic and infrastructural gaps between the rich East and the poor interior provinces.

Discourses:

The resettlement programmes are supported by two main government discourses (Yeh, 2005). The first is related to the environmental restoration of the area. The government invokes a scientific justification that describes the area as environmentally degraded by nomadic pastoral activity. In parallel a second discourse forwarded by the government and local authorities is on the backwardness of the nomadic people and the necessity of moving on to a modern system of production. Local authorities describe the resettlement programs as a positive transition in which the nomads themselves are the main actors and not passive recipients. However this study observes how although the Tibetan nomads are not forced to sedentarize through coercive and violent means, there are other legislative systems that reduce the possibility of the population to self determine their choices.

Attributes of Community:

The interviews indicate that the level of information and awareness regarding grassland governance is very high and often discussed between the family members, the groups and inside the village assemblies. The Tibetan nomads traditionally consider themselves 'poor', 'medium' or 'rich' according to the number animals owned by the household. The cultural homogeneity of the Tibetan nomads is very high. Traditionally the Tibetan nomads are considered as very religious and all the interviewees indicated that Buddhist practice and religious activity are a fundamental aspect of their life. According to the interviews, the Buddhist beliefs provide a platform for common ethics and behaviour. The most important aspect of the action situation regards if the nomads were looking forward to the resettlement policies or if they were happy with their nomadic life. Over 95 % of the interviewed people revealed that they did not want to move to the resettlement, but rather live their lives in the grasslands.

Rules in Use:

The boundary rules define the boundaries of the population that can access the resource. In the Tibeten case, there is an ethnic component as much as a socioeconomic one: Chinese han and Chinese Muslim are not present in the pastoral activity. In the case study, the position that the actors hold depends on the hierarchical level of the decisions taken. The main actors, Tibetan nomads, have authority only at the village government level. Nomads (only men) participate to village assemblies. Nomads have no representation in the higher levels of decisions that affect the land access rules. The nomads tend to respect the traditional village and inter-villages rules rather than the ones imposed by the government policies. Research found that the level of shared information regarding land tenure and grazing information in the village is very high. Payoff rules are related to the sanctioning systems of the previous rules. At the government level sanctions can vary from fines, to confiscation of animals to arrest. At the village levels instead, not respecting the rules is an issue discussed in the village assemble and resolved without the judicial intervention.

Action situation:

In this case study the primary actors/participants are the Tibetan nomads (the community) and the Government. The action situation has been analyzed looking at how the level of participation

of the nomads varies as a consequence of the resettlement policies in relation to the decisions and actions related to: a. who is allowed to harvest resource units, timing quantity, b. technology and location of harvesting, c. how harvesting activities are monitored, enforced and sanctioned, d. what are the conflict resolution mechanisms involved with appropriation activities, e. what is the role of the rules, f. what strategies are used by the participants (Mwangi and Ostrom 2009). Discursively, Chinese officials explain the "participation" in the resettlement programs as completely voluntary. However, the inclusion of the Tibetan nomads in the decisions processes is hindered by the general discourse between local authorities on the "backwardness" of the nomads. The absence of the inclusion of the nomads' perspectives in the governance of the territory is evident when looking at the implementation of the resettlement policies.

5 Discussion

The four cases described in this research show how participation, as a construct for natural resource management, has gained ascendancy in conservation discourse and is being used to legitimize various conservation agendas in different socio-political contexts. While all four cases posit a strong rhetoric of participatory resource governance ideals, in at least three of the four cases, there are significant gaps between this rhetoric and practice. For example, in the Tibetan case, there is a situation where participation is an imposed project in which the state-centric vision of watershed restoration is discordant with the nomadic lifestyle of local actors and institutional arrangements that govern the organization of their livelihoods. Through the IAD framework, the research shows how the rules-in-use guiding participation in the watershed preservation program have not resulted in any transfer of decision making powers to local actors. Instead, drawing on Hobley's typology of participation (see table 5.1), participation has been contextualized in such a way that local actors are passive participants in the design and implementation of operational rules. Moreover, narratives of the local actors' backwardness have been used to justify the subversion of their institutional arrangements and exclusion of nomadic pastoralist from the decision-making process. This situation appears to validate Cooke and Kothari's (2001) arguments, that despite the rhetoric of local actor's empowerment and the democratic language underpinning participatory programs it is more likely for participation to foster tyranny than democratic ideals. This happens when participation is framed in such a way

that powerful actors continue to override local actors' interests and constrain their decision making space.

Similarly, in the cases of Zambia and Kenya, the process seems to be characterized by a similar situation. Although local actors are represented on decision-making resource governance bodies, their participation is, in practice, a means to achieving goals set by external actors (i.e. the state). Consequently, local actors are merely co-opted in decisions made by the state and other external actors. Applying Hobley's 1996 framework, this is more representative of functional participation (see also Buchy and Race, 2001; Jones, 2006). Although this differs from a situation where local actors are completely ignored in decision-making, local actors still have very limited decision-making spaces because of the influence of powerful actors in the participatory process. In the Zambian case study, for example, operational rules guiding resource access and management, despite local actors being represented on joint forest management committees, have been made to conform to bureaucratic regulations developed by the state such that the rules still represent the decisions of external actors rather than that of local actors.

Similarly in the Northern Kenyan case, local communities were duped to believe in the rhetoric of 'participatory conservation' without adequate knowledge of long term implication to their livelihood system and the unique bio-cultural landscape that they have managed historically. These cases show how unequal power relations between actors operating at various levels (e.g. between the state and local communities) involved in participatory programs favor the interests of the more powerful actors. This challenge, however, is not limited to relationships between state actors (and NGOs) and the community, but also between members of the local community itself. The Kenyan case, for example, shows how benefits of natural resources conservation can easily be skewed in favor of one group of people at the expense of other groups in the community. Again, Cooke and Kothari (2001) have pointed out how the notion of 'community' in the discourse of participation may serve to conceal the power relations within communities and mask biases in interests and needs based on ethnicity, class, religion, gender and other factors (see also Brown, 2003). This suggests the need for participatory process to engage critically with the notion of community in order to understand the various interests involved in the process.

In the fourth case study participation can be described as interactive. In this case the rules-in-use are decided through a deliberative process that allows the articulation of various actors' interests. It is important to acknowledge that participatory governance is taking place in an environment characterized by clear tenure arrangements (i.e. clear property rights), a less conflictive political-economic context, and homogeneity in the local actor's livelihood characteristics. The same cannot be said of the three cases where traditional property rights (e.g. those of nomadic pastoralists) conflict with modern property rights and the political economy of all the three cases is generally unsupportive of the type of participatory programs developed. In addition, the case of USA shows a participatory process that is largely driven by local actors themselves rather than imposed on local actors.

Indeed, at the core of participatory natural resource governance is that local actors themselves must play a significant role in the creation of governance structures and institutional rules if the ideals of participation are to be achieved. The fourth case raises a point that is crucial for the discussion: participation in natural conservation would seem higher in the U.S., which is the only case where the property rights are clearly defined. This would apparently endorse Hardin's discourse on the importance of an actor (either a private or state) that manages the CPRs. However, this is what could be deduced if only the institutional aspects of these cases were analyzed. However, modifying the IAD framework with a political ecology perspective provides different results. By analyzing the political-economy context and the discourses underpinning the notion of participation, together with the institutional aspects of the cases, we gain a more comprehensive understanding of how participation is interpreted and translated into practice in different contexts. In the Tibetan case, for example, there is a millenary history of traditional institutional arrangements that govern the access to common pastures. However, when it comes to the development of central government policies these arrangements are eradicated by top down policy implementation. Similarly, in the Zambian and Kenyan cases, participatory process are co-opted by the most powerful actors. In the case of the US, participation depends on property rights and, as the community is quite homogenous, power issues are less relevant. In conclusion we find that the Political Ecology complements the results of an IAD and that in order to analyze complex and non-homogeneous political-economic contexts it becomes valuable.

6 Conclusions

In this paper we have conducted a comparative analysis by applying the same analytical framework to four different case studies in different geo-political settings. We have looked at how the institutional dynamics, rules and discourses in different geo-political contexts produce different levels of participation in natural resource management programs. Understanding this can point to barriers that limit participation in various contexts. Equally important is the simultaneous influence of institutions, discourses, and political-economic context in affecting social and ecological outcomes of conservation interventions. Including the political ecology perspective in the institutional analysis strengthened its analytical power when looking at similar cases but in very different situations.

We have illustrated how a similar discourse on participation can vary significantly depending on the context. This comparative analysis increases our understanding of how institutional dynamics are strongly influenced by the discourses and the political-economic context in which they occur. Although participation has been globally applied as a panacea for natural resource management, this study illustrates the gap between theory and practice and shows that the first step for understanding this is to contextualize the institutional dynamics. As international environmental NGO's, state governments and other actors continue to promote participation as the solution to natural resource management problems, it is critical to remain aware of the barriers and implications of turning this discourse into practice.

Application 2.B. Towards the integration of musiasem and IAD.

The Tibetan nomads' resettlement case

CHAPTER 6
THE SEDENTARIZATION OF TIBETAN NOMADS. CONSERVATION OR COERCION?[4]

The literal translation from Chinese of the word "Sanjiangyuan" is "three river heads". This is the name of the area where the headwaters of the Yangtze River, the Yellow River and the Mekong River are located (6.1), in the western region of Qinghai, People's Republic of China (PRC). Soil erosion and land degradation in this area and increasing episodes of droughts and floods of the three rivers have pushed the Chinese Government to implement a massive strategy for the development and environmental preservation of the watersheds region. The Sanjiangyuan policy has several components. One is the resettlement and sedentarization of the overall nomadic Tibetan population, which historically inhabited the region.

Fig 6.1. Map of Tibet Autonomous Region, Qinghai and surrounding regions in PRC

4 This chapter has been published in *Ecological Economics from the Ground Up* (Dell'Angelo 2012).

Source: adapted by author from http://www.kekexili.typepad.com/

The policy is being promoted with a system of constraints on the number of animals the nomadic households can herd in relation to the land they control. On the other side, there is a system of subsidies that, in exchange for not grazing for a period of ten years, ensures the nomads a basic salary and gives them a house in a resettlement camp. However, what will happen after the ten years of resettlement is not clearly defined by the government. State control and tentative sedentarization of the nomadic populations is something that historically has happened in every country that has had nomadic traditions. Moreover there is an underlying political issue, which is the historically conflictive relationship between Chinese Han people and Tibetan people. This is even stronger in the case of the nomads that are often considered by Chinese academics and government officials as backward (Fischer, 2006; Yeh, 2007).

The Sanjiangyuan environmental protection policy raises many doubts. This is a mode of environmental governance characterised by very little social participation and a great deal of mistrust towards **traditional ecological knowledge**. The social, cultural and economic consequences of the resettlement policy on the nomadic population have been enormous and might be irreversible. Also, on the ecological and environmental side there are reasons to believe that stronger scientific attention should be devoted to the choices that have been taken. While the PRC government describes the Sanjiangyuan policy as being scientifically solid, there are several elements, including strong political bias, lack of participation and transparency, a high degree of uncertainty and an absence of scientific data that make this assertion difficult to believe.

Box 6.1. Traditional Ecological Knowledge

As defined by the Convention on Biological Diversity of 1992, Article 8 (j), Traditional Ecological Knowledge refers to the knowledge, innovations and practices of indigenous and local communities around the world. Developed from experience gained over centuries and adapted to local culture and environment, Traditional Ecological Knowledge is transmitted orally from generation to generation. It tends to be collectively owned and takes the form of stories, songs, folklore, proverbs, cultural values, beliefs, rituals, community laws, local language and practices. Traditional Ecological Knowledge should be understood as a knowledge system including: i) the knowledge based on empirical observations essential for

survival (species taxonomy, distribution, and life cycles); ii) the understanding of ecological processes and natural resource management (practices, tools, and techniques); iii) the socioeconomic organization necessary for effective coordination and cooperation (rules and taboos); and iv) the worldview or "cosmovision" (religion, belief, and ethics) (Berkes, 1999).

In this chapter, the Sanjiangyuan policy will be described with attention to the issue of the resettlement of the Tibetan nomads. In section 2, the Sanjiangyuan policy will be specifically described, geographical and historical information provided and the general development and modernization ideology in which the policy has been produced explained. Moreover in the same section there will be a brief description of some of the characteristics of the Tibetan nomads. In section 3, the most relevant effects of the Sanjiangyuan policy will be described with particular attention to the socio-cultural and economic effects on the nomadic population, the biophysical scientific perplexities that the policy raises, and the hesitation that this policy produces among the international NGOs that would like to intervene. In section 4, the overall problematic will be discussed referring to ecological economics and political ecology concepts useful to understanding this complex situation.

1 The Sanjiangyuan environmental protection policy

Protecting the watersheds

The Sanjiangyuan policy of environmental protection, in Qinghai, People's Republic of China (PRC), was established by the State Council, the State Forestry Administration and Qinghai's Provincial Government. It aims at restoring the grassland where the watersheds of three of the main rivers of Asia, the Yangtze River, the Yellow River and the Mekong River are located (Dong and Chen 2002; Qiji et al., 2005). As these rivers suffer increasing levels of hydro-geological instability, the Sanjiangyuan policy established that in order to preserve and restore the grassland in the watersheds area, the Tibetan nomadic population of the Sanjiangyuan area which includes the Tibetan Autonomous Provinces of Haungnan, Yushu, Guoluo, and Hainan must abandon pastoral nomadic activity, be resettled and sedentarized. In 2007 official figures indicated that 60,000 nomads had already been resettled, with another estimated 100,000 nomads to be resettled by 2010 (Foggin, 2008). Independent sources state that the final plan is to resettle the totality of the nomadic

population, around 200,000 people in the Sanjiangyuan area (Tibetan Information Network).

The official translation of the Sanjiangyuan programme is: "*Overall Programming of Qinghai ecologic protection and of Qinghai's Three River Source headstreams area Establishment"*. The 79th State Council Executive Meeting, presided over by Premier Wen Jiabao, approved the programme on January 26, 2005, incorporating prior programmes, namely the 2003 "Restoring grassland from overgrazing and ecological migration projects" and the 2001 "Provincial Three River Nature Reserve". The Sanjiangyuan programme has received constant attention from central government and on several occasions has been described as a key "backbone" of the "Open the West Campaign". The programme created an influential "Sanjiang Bureau" that receives funds directly from Beijing central government and an Implementation Leading Group of 31 organs, including the Provincial Party Committee's Propaganda Department, a Political Research Office, a Development and Reform Commission, an Agricultural and Animal Husbandry Department and Forestry Bureau, etc. The programme involves 16 counties from Yushu, Guoluo, Hainan, Huangnan, and Tibetan Autonomous Prefectures (21 percent of Qinghai province) and is set to be extended. The overall ten year budget is 7.6 billion Yuan. The Programme intends to: "restore the ecological function of the Headstreams Area; promote harmony between man and nature; endorse sustainable development and support comparative well-being living standards of peasants and nomads[1]"

The main components of the Sanjiangyuan programme are related to environmental protection and the socioeconomic transition of the nomadic population. The different components of the Sanjiangyuan programme of environmental protection are entitled as follows: "Restoring Grassland from Over-grazing", "Restoring forest from Over-grazing", "Control of Degraded and Deteriorated Grassland", "Control of Grassland Wild Rat Damage", "Fire Prevention of Forest and Grassland", and "Water Conservation". Meanwhile, projects related to the nomads refer to: "Grazing Prohibition", "Ecological migration" (resettlement), "Small Town Establishment", and "Grassland Protection[2]".

2 Geographical and historical information

Qinghai officially became a Chinese province in 1928 (Goodman, 2004). In 2001, 39 counties out of 46 (mainly all the rural ones) were officially classified as "poverty stricken" (*Qinghai Statistical Yearbook* 2001 in Goodman, 2004). Moreover, its heterogeneous ethnic composition is the result of a convulsive historical past that saw Tibetans, Chinese Han and Chinese Hui Muslims in belligerent

conflict. Qinghai, with a 45.5 percent non-Han population, is the third largest province in the PRC with the highest percentage of minority nationalities (after TAR and Xinjiang). Tibetans represent the largest minority (22 percent), followed by Hui (16 percent), Tu (4 percent), Salar (2 percent) and Mongols (2 percent) (Goodman, 2004). The ethnic distribution is evidently geographical with the majority of the Han living in Xining, a modernized capital, and the majority of the Tibetans living in rural and pastoral areas.

I observed the fast transformation of Xining between my first time in the city in 1997 and my last time there in 2007. In 1997 it was a rural village with dirt roads and few cars. In 2007 with a population of 1,029,400 it was a modern city with futuristic buildings and manifest economic dynamism, ranked 352 out of 652 Chinese cities (Official website of the Xining People's government).

The administrative division of the province reproduces both the contemporary ethnical geographical distribution[3] and the 'ante 1928' relations of power and cultural hegemony: 5 out of 8 prefectures are officially classified as 'Tibetan Autonomous Prefectures' and one as a Tibetan-Mongolian Autonomous Prefecture (Fischer, 2004). Chinese administrative division is in the order: Provinces and Autonomous Regions on the first level; prefectures, second level; counties, third level; townships, fourth level; villages, lowest level.

Qinghai's comprehensive morphology started to change rapidly in 1956 when the Chinese Communist Party (CCP) designed and implemented a provincial plan of development. Industrialization, intensive agricultural production, migration-led plans, and collectivization were the pillars of Mao's Great Leap Forward. From 1956 to 1959 it is estimated that 876,000 (one third of Qinghai province then) Chinese people in-migrated into Qinghai because of government plans.

In the Tibetan areas socioeconomic plans were implemented at the same time as Tibetan resistance was suppressed. For the pastoral areas, the strategy was well expressed by Mao's slogan "turn the pastoral area into an important agricultural base"; the nomads were forced to resettle and to participate in agricultural activity on collective state farms. Besides the direct consequences[4] of the "Peaceful Liberation of Tibet" by the People's Liberation Army (PLA), the implications of the acute famine caused by the socioeconomic strategy of the Great Leap Forward across China are well known. Specifically in Qinghai, the conversion of pastoral rangelands to crop production, with no consideration of altitude and climate, produced tragic outcomes of land degradation (Goodman,

2004; Yeh, 2003). The increase in the death rate in the province attributed to the famine was over four per thousand, the third highest of China's Great Leap (Yang, 1996 in Goodman, 2004).

A new era started as, under Deng Xiaoping's leadership of the PRC, liberal pro-market reforms shifted the direction that had been charted by Mao. In the Tibetan rural and pastoral areas, de-collectivization took place. Under the so-called 'responsibility' system the nomadic households had the opportunity to return to pastoral activity on the rangelands. This "return to pastoralism" was not a return to a pure "traditional system" because of land management and pastoral administration policies[5]. However, it is generally accepted that, after the introduction of the responsibility system reform, Tibetan pastoralism regained a strong degree of vitality (Goldstein, 1996).

In this same period of economic reform, Qinghai's government continued to push towards more intensive extraction of mineral and non-mineral resources, and enterprise transfer programmes and defence installations. The first atomic tests were also conducted in the area. With increasing financial dependence on central government, Qinghai recorded the worst provincial economic performance of the PRC, lasting through most of the 1980s and 1990s (Goodman, 2004). Concern for Qinghai's economic performance and environmental degradation[6] urged the central government to reshape a new development strategy. In 2001, under Premier Jiang Zemin's slogan "Open up the West through rebuilding a green west", a Five-year Plan based on environmental sustainability, internal infrastructures, transport and communication was introduced (Goodman, 2004).

Qinghai's development strategy is part of the wider "Open Up the West" campaign (*xibu da kaifa*) introduced by the Chinese Communist Party (CCP) in 1999 to develop the economy and reduce the economic and infrastructural gaps between the rich East and the poor interior provinces. Holbig (2004: 40) describes this campaign as a "fragmented cluster of diverse agendas, sometimes competing but not necessarily contradictory". Holbig (2004) defines the central points as reducing regional monetary flow inequalities and foreign investment; implementing infrastructure development; tackling turbulent issues for minority nationalities (the highest concentration of whom is in TAR, Xinjiang and Qinghai); embracing sustainable development.

3 The general development policy context: "open up the west"

The Sanjiangyuan programme, as stated by the official media, is one of the backbones of China's campaign to "Open Up the West". This campaign, announced in 1999 by President Jiang Zemin, started in January 2000 with the ambitious goal of 'developing' the interior and western provinces of China. The campaign declared the central government's intention to redirect resources to the regions that had been neglected by the growth strategy and benefits of the preceding 20 years. Several authors observed that one of the characteristics of the 'west' was the high concentration of non-Han ethnic minorities. Goodman (2004) estimates the highest percentage of minorities in TAR (96 percent), Xinjiang (62 percent), and Qinghai (46 percent) provinces.

In 2000, Premier Zhu Rongji stated that "common prosperity" would come from "strengthening of national unity, safeguarding of social stability, and consolidation of border defence[7]". Goodman (2004: 12) observes that all of these were "barely coded phrases for being concerned about issues surrounding the non-Han Chinese". Holbig (2004), describing the academic input of the 'Open the West" campaign, observes how, in China, academic debate is structured by the policy preferences of government organs and leaders and, conversely, how central government decisions are affected by official academic research. Referring to the academic input of the campaign, Holbig reports that, Hu Angang, director of China's leading Research Institute on National Conditions, criticised the uneven economic growth and government investments between the East and the West during the 80s and the 90s. Moreover, Holbig (2004) describes how Hu Angang advised the government that the regional disparity and the ethnic fragmentation were more acute in China than in Yugoslavia at the time of its disintegration. Hu Angang's warning to the central government was that, if no remedy were found to this situation, national unity and political stability would be threatened. The central government responded by launching the "Open Up the West" campaign.

The campaign, as Holbig (2004: 41) observes, is more a strategy, a "diffuse decision-making process shaped by dynamic interactions between numerous actors at central, provincial and local levels over almost two decades" rather than a precise policy. Furthermore, Goodman (2004) remarks that the socioeconomic variability of the western provinces has produced a strong heterogeneity in programs related to the campaign. Goodman (2004: 20) also highlights that the central commonality across this multifaceted campaign is the "high profile of a discourse of state environmentalism".

4 Tibetan Nomads

The term nomad[8] comes from the ancient Greek verb “nomadein” which literally means “to herd the flock to pasture”. This philological root contains the essential description of the nomadic life: ‘movement’ and ‘animals’ represented the two fundamental pillars of the nomadic dimension. Pastoral nomadism, as a mode of production and a form of life, is steadily disappearing all over the world on account of a political, economic, demographic and historical processes that began to have effect at the end of the 19^{th} century and were consolidated during the 20^{th} century (Sandron, 1998). The literature on nomadic communities in different areas of the world identifies a common and relevant influential factor: the rise of modern states and the extension of various forms of state control and governmentality have drastically constrained nomadic existence (Goldstein, 1991; Goldstein and Beall, 1989; Miller, 2000; Pirie, 2005; Salih, 1990; Yeh, 2003; 2005). However, there are regions in the world where the nomadic way of life has effectively survived. In central Asia, pastoral nomadism is still an important mode of production and represents a socioeconomic category.

Nomadic populations historically have inhabited what may be defined as “Ethnographic Tibet” (Richardson, 1984; Norbu and Simmons 1997). Today, it is estimated that 40 percent of the Tibetan ethnic population conducts a pastoral nomadic or semi-nomadic life (Tibet-net, 2007). The Tibetan nomadic population presents a certain degree of heterogeneity. Tribal forms of social aggregation (Pirie, 2005) and linguistic differences between one tribe and another (Norbu and Simmons 1997) are the main features of this heterogeneity. However, Buddhist religious commitment, oral tradition, lifestyle, moral values and culture tie this ethnic group together (Norbu and Simmons 1997) in a territory as big as Western Europe and with one of the lowest population densities (average $2.2/km^2$)[9] in the world. Tibetan nomads, as a socioeconomic group, are one of the main pillars of both traditional and contemporary Tibet (**Figure 6.2**).

Fig. 6.2. Traditional pastoralist practices. Photo by the author.

In various historical periods, 'tribes' from different regions had diverse power relationships with Tibetan or Chinese sovereigns (Goodman, 2004; Norbu and Simmons 1997; Yeh, 2003). Despite a historical submission to external higher systems of power (dynasties, kingdoms, monasteries, governments), both Chinese and Tibetan, the nomads' social structure and fundamental authority dimension is the tribe (Norbu and Simmons 1997; Pirie, 2005; Yeh, 2003). Norbu and Simmons (1997) in their journey amongst the nomads observed how a large nomadic area in Golog prefecture was originally called Serthar (rebellion) because of the nomads' disrespect for every form of authority, whether Chinese or Tibetan. Yeh (2003) observes that during the Manchu Qing dynasty rule (after 1644) over Qinghai, the emperors' power was in many nomadic areas only nominal, with great difficulties in collecting tax and tributes. However, because of the nomads' strong Buddhist belief, the religious and secular authority of the Tibetan monasteries has been extremely influential during diverse historical periods (Norbu and Simmons 1997; Yeh, 2003). It is interesting to note that "trans-regional pan-Tibetan identity" in opposition to the strong regional and nomadic tribal

fragmentation, is a recent phenomenon, ironically produced by Chinese hegemony (Yeh, 2003).

5 Consequences of the Sanjiangyuan environmental policy

Biophysical perplexities

The Sanjiangyuan policy rationale is that in order to safeguard the hydro-geological stability of the watersheds of the Yangtze, the Yellow and the Mekong rivers, the grasslands of the Sanjiangyuan area need to be protected and then restored. The environmental protection and restoration of the Sanjiangyuan area is considered a fundamental priority by the Chinese central government because of the importance of its ecosystem services, in particular watershed functioning. The scientific explanation endorsed by the Chinese government is that due to "irrational" and "backward" human activity (referring to nomadic pastoral activity) (Fischer 2005a, 2008b; Yeh 2006), and to climatic reasons[10] the Sanjiagyuan area is suffering increasing environmental degradation, in particular soil erosion, desertification, wetland and lakes reduction and increasing phenomena of river droughts and floods (Gong et al., 2008).

Taking a definition of ecosystem services as "the conditions and processes through which natural ecosystems, and the species that make them up sustain and fulfil human life" (Daily et al., 1997)", it might, in the light of the underlying political reality in the Tibetan areas, be worth posing questions such as: "ecosystems services for whom?" and "how should decisions be made where there are trade-offs between different types of ecosystem services?".

In the case of the Sanjiangyuan area, the importance of ecosystems services is evident at the local level for the Tibetan nomadic population specifically relying on the provisioning and cultural aspects of the ecosystem services, but also at the national level, in terms of their importance to provisioning and regulating functions vital to the area's watersheds. The main problem here is that the political background heavily influences the production and implementation of environmental policies aimed at preserving the Sanjiangyuan area. Moreover it is clear that the environmental management of the region produces strong internal conflicting trade-offs between the different types of ecosystem services. For example, even if we assume for one moment that the sedentarization policy will have a positive impact on soil conservation (supporting services), it nonetheless poses a grave threat to the traditional way of living and knowledge of the local population that is so strongly related to the cultural and provisioning services of the Sanjiangyuan area ecosystem. Furthermore, "freedom of choice and action", described as one of the main constituents in the Millennium

Ecosystem Assessment framework of interaction between ecosystems services and human well-being (MEA 2005), is sharply restricted in environmental governance processes of the area, giving the impression that the local nomadic population is regarded by the Chinese authorities as a problematic stressor that has to be removed.

Apart from the controversial socioeconomic and cultural aspects of the resettlement process, concern has also arisen in relation to ecological and environmental dimensions. The PRC government, pushed to take action in the preservation of the ecological and hydrological stability of the rivers by the consistent alternation between droughts and floods, focused and devoted most of its efforts and attention on the watersheds area, neglecting the importance of other factors such as the misuse of water resources downstream, the instability produced by the construction of dams and geological engineering, the causal determinants of soil erosion and grass land degradation.

Even if hypothetically, the hydro-geological instability of the rivers could be resolved just by focussing on the protection and restoration of watershed areas, there is an absence of evidence/scientific studies that demonstrate a link between the phenomena of land degradation and **desertification**[11]**,** specifically with regard to pastoral pressure in well defined areas. A pastoral ban has been implemented in the entire area no matter what are the biophysical conditions. This policy follows the orthodox equation that with fragile soils prone to erosion and desertification, pastoral activity is always a negative factor.

Moreover, there are interesting studies that demonstrate how traditional ecological knowledge, developed through centuries, has a positive effect on fragile ecological systems while the absence of humans is not necessarily a positive environmental protection force. Another disputed aspect is the wisdom of the “Control of Grassland Wild Rat Damage” campaign. This aims at exterminating the rodents blamed for increasing soil degradation. However, according to Smith and Foggin (2006) the extermination of the plateau pika (*Ochotona curzionae*) is detrimental to the environment of the Qinghai Plateau ecosystem. According to the authors the plateau pika is a **keystone species** for biodiversity on the Plateau and has a positive effect on the rangelands ecosystem. The plateau pika, which is the main target of the ‘rodent control’ although is not a rodent but a lagomorph (small mammal), is a keystone specie because it: (i) digs burrows that become primary homes to a wide variety of lizards and birds; (ii) produces microhabitat disturbance that increase plant species richness; (iii) is an important prey for most of the predator species in the plateau; (iv) represent a

positive factor for ecosystem-level dynamics (Smith and Foggin 2006).

Box 6.2. Keystone Species

The science of Conservation Biology tries to find reasons why biodiversity should be preserved. Biodiversity is the variety of life at three levels: ecosystems, species, and genes. Here we focus on the species level. There are many species in the world, between 10 million and 20 million perhaps. Of these, only about 2 million have so far been catalogued by scientists (botanists, entomologists, etc.). Species are disappearing faster than we have time to get to know them. Some ecosystems are characterized by the large number of species they contain ("species-richness"). Other ecosystems (or the same ones) are characterized by the uniqueness of the species they contain ("endemic species" in a desert, for instance). Are some species more valuable than others? Are there "redundant" species? These would be species that fulfil no singular function in ecosystems. Nevertheless we might believe they have a right to live. It is in the context of such questions in Conservation Biology and in the Economics of Biodiversity that the notion of "keystone species" is pertinent. The term has its origins in Robert Paine's studies in 1969 of marine biology in California. When the top predator in the ecosystem he studied (a starfish) disappeared, the whole ensemble of species collapsed, hence the architectural analogy with the keystone in an arch. Keystone species are those whose importance is disproportionately large relative to their abundance. An ecosystem may experience a complete shift if a keystone species is removed, even though that species seemed to be a small part of the ecosystem as measured by its frequency or by its biomass. Another example of a keystone species would be a predator that ingests numerous individuals of an herbivorous species that would otherwise eliminate many plants, but a keystone species is not always a top predator. If bees disappear, pollination would be negatively affected. Other species are keystone because of their "engineering" roles, burrowing and making tunnels which are used by other species, such as prairie dogs in America.

Socio-cultural, economical and metabolic implications

The recent resettlement of Tibetan nomads has had profound socioeconomic and cultural effects on the affected population. This is not easy to quantify as secondary official data are missing and because of its highly politically sensitive nature. A previous Human Rights Watch (2007) report was

produced with indirect interviews of Tibetan in exile in India, and not directly with the population in the studied area. For this reason, the present chapter is valuable because information was provided by the population living in areas where resettlement has taken place. In order to have a better description of the issue, however, further research (which is difficult for political reasons) is necessary. Still, some evident social, cultural, economical and metabolic consequences emerge from the current study and observations contained within it.

The effects of the Sanjiangyuan policy have been produced in the last 10 years. One of the main impositions of the policy was a definition of a ratio between land dimension and numbers of animals. This type of policy had already been developed prior to the implementation of the Sanjiangyuan policy (Yeh, 2005) and at the moment of the first field investigation in 2007 the ratio was "one sheep for 12 *mu* of land[12]". The nomads are forced to sell all the animals that exceed this carrying capacity ratio, otherwise they receive heavy fines. On an economic level this has produced rapid and severe impoverishment, with all families interviewed declaring the impossibility of survival under such constraints.

Determining an optimal ratio between number of animals and land for the whole region based on the notion of carrying capacity is now regarded as untenable in ecology, and as an approach has been superseded by the concept of resilience. Moreover this rationale is applied as a panacea that does not address the **complexity** of evolving social-ecological systems. Another interesting transformation has been with regard to mobility, as the equivalence scale between animals[13] weighted the horses very heavily, most families where forced to sell them. On two different trips to Tibetan areas in 1997 and 2007, I personally observed that horses had been replaced by motorbikes as the main mode of transport (**Figure 6.3**).

Fig. 6.3. Transformations of the metabolic patterns and transport. Photo by the author

Box 6.3. Complexity

Complexity is a condition of systems composed of many interconnected parts, where the behaviour of the whole system cannot be fully understood by simply analyzing the behaviour of its components. Complex systems are adaptive and generate a new quality of collective behaviour through self-organization. They are frequently characterized as having extreme sensitivity to initial conditions as well as emergent behaviour that are not predictable or completely deterministic (Meyers, 2009). Failing to understand complexity often leads to policy resistance and the worsening of problems. Ignoring the time and spatial distance between causes and effects typically results in policies that generate transitory improvement before the problems grow worse (Sterman, 2000). According to Sterman (2000), natural and human systems combine several characteristics which give rise to complexity:

- **Dynamics**, systems change at many different and sometimes interacting time scales;

- **Tight couplings**, which reflects the notion that "everything is connected to everything else", given the multiple intra and inter relationships between actors and natural systems;
- **Feedback**, where decisions made in tightly coupled systems lead to actions which influence subsequent decisions;
- **Non-linearities,** characterizing relationships where the effect is not proportional to cause;
- **History-dependence,** wherein some decisions create path dependence, precluding alternative options and leading to irreversible actions;
- **Self-organization,** describing situations where behaviour arises spontaneously from the internal structure of systems. Small and random perturbations are often amplified and moulded by the feedback structure generating different time and spatial patterns;
- **Adaptiveness,** relating to changes in the capabilities and decision rules of the agents in complex systems, leading to evolutionary and learning processes.

Several mathematical and modelling methods and tools (e.g. agent based modelling, cellular automata, game theory, system dynamics) have been progressively applied to scientific, engineering, and societal issues that can only be adequately described in terms of complexity and complex systems (Meyers, 2009). Complex systems are becoming the focus of innovative research and application in many areas, providing a theoretical justification for a post-normal approach to the management of science-related issues (Funtowicz and Ravetz, 1994b). Such is the case in ecological economics, where the engagement of complex knowledge communities has been increasingly advocated for responding to complexly interacting socio-physical systems and environments (Henshaw 2013).

The second crucial phase of the Sanjiangyuan policy has been the development of the resettlements. The resettlements are new villages built either at the periphery of towns or otherwise independently, often in the middle of very isolated valleys. The typical structure of a resettlement site is represented by small houses all of the same dimension in rows, the whole site is usually surrounded by a fence or a wall, at the entrance of the resettlement usually there is a small clinic and an administrative office, some times there is also a police station. Once they sign the agreement with the Chinese

government and agree to move to the resettlement area, resettled nomads are obliged to sell all their livestock and not return to the grasslands for ten years. The Government officials declare that the resettlement is completely voluntary and that this is not a phenomenon of land expropriation. It is very difficult to imagine then that after 10 years, nomadic families will have the necessary means/instruments to reclaim the land that they owned before moving to the resettlements.

Ten years of government subsidies are included in the resettlement agreement. On a monetary scale, the well-being of nomadic households on the surface seems to improve, as they pass from a near zero monetary monetary flow to a subsidy which in 2007 on average (it can change from different counties) of 3000 rmb per year. However in terms of nutritional indicators, the nomads lament that they used to eat meat every day when they were living in the grasslands, something no longer do in the settlement.

Tibetan nomads traditionally do not send their children to school, but as in China primary education is universal, free, and compulsory, nomadic families were fined for not obeying the law. In some cases nomadic families send their children to school until the age of 8-9 where attendance in full time boarding schools is possible. In new resettlements all nomadic children receive primary education; however, they systematically cannot continue beyond the primary level because secondary school is too expensive for nomadic households. Moreover the role of education of Tibetan populations is strongly debated as Chinese education is prevailing on Tibetan education and there is a strong phenomenon of loss of Tibetan culture and language among younger generations.

The economy of the resettled nomads is completely dependent on government subsidies and although some programmes and courses have been developed to facilitate their adaptation from a subsistence pastoral economy to a market cash flow economy, the majority of the nomadic population stays unemployed. Three main training courses have been implemented by the Government with the intent of providing jobs to the resettled nomads: stone carving, carpet making and driving courses. These courses have produced paradoxical effects such as nomads learning to drive cars but not being able to get a driving license because they do not know the Chinese language. Moreover carpets and stone carvings are not part of the traditional art craft of the nomadic culture. Another Government solution implemented with great difficulty was the inclusion of nomads in the “Control of Grassland Wild Rat Damage”, the *Ochotona curzionae* blamed for increasing soil degradation. However, the Tibetan nomads are generally Buddhist and see the killing

of animals as morally repugnant.

The government intervention through resettlement programs has produced evident transformations in the metabolic patterns of the nomadic people. Fundamental aspects such as time allocation, nutritional habits, economic inputs, energy, water and material consumption (Giampietro, 2004) have all been drastically transformed by moving to the resettlements. Resettled nomads for most of the time are now without a continuous occupation. The gender balance as well changes, and females have a less central role in the economic production of the household. A recurrent theme in interviews was that in the resettlement "there is nothing to do" and televisions appear now as a central object in the households. It is generally acknowledged that in the resettlements there is an increase in alcohol abuse similar to other indigenous communities that had their traditional life patterns dismantled. Energy and water use changed as well.

Water and sanitation and electricity are generally guaranteed in the resettlements. For heating, the nomadic households had traditionally burned yak's dung, but in the resettlements they burn coal, which is expensive in relation to the subsidised monetary flow they receive. Another transformation, not directly related to the resettlement programme, but related to modernization aspects and to animal reduction policies, is the oil consumption increase that has followed the recent substitution of horses as main transport system by motorcycles. Moreover, all material use and consumption has been transformed with the introduction of industrial consumer goods. For example, the nomadic tents traditionally made out of Yak's hair are gradually disappearing, while products such as plastic bags and instant noodle containers instead are becoming common, usually disposed of directly after use by being thrown into the grasslands.

Some interviewed government officials declared that after the ten year period of grassland restoration and subsidies, the nomads will be permitted to return to their traditional lifestyles. However, there are many questions related to this projection, some of them are: how will the nomads be able to re-buy their animal stocks? After living for ten years in houses how difficult will it be to readapt to life in traditional tents? How will the property rights issue be considered and how will they redefine the use of land in absence of documentation? How will the education issue be resolved? How will the nomads deal with the fact that the traditional pastoral knowledge has to be kept constantly alive in the daily practice and that the new generations have a gap of knowledge and pastoral habits?

6 NGO dilemma

NGOs are often active in the **governance** of environmental protection. However, the few international NGOs working in Tibetan areas under firm governmental control face a serious dilemma in relation to what is happening with the resettlement programmes. Their interest in the preservation of culture, linguistic identity, and Tibetan traditional knowledge and values means that international NGOs must seriously consider what sort of intervention is desirable. They have to be careful about what kind of intervention they can attempt, avoiding any political involvement or activities that make reference to politically sensitive questions, such as Tibet's independence from the PRC, relations with the Tibetan Government in Exile, human rights, and any other issue that would undermine the sovereignty of the Chinese government.

Box 6.4. Environmental Governance

Governance is what authorities do. It refers to the practical management of power and policy. Governance may be exercised by a government (nation-state), a corporation (business entity), through customary institutions (tribe, family, etc.) and so on. It may be used for any purpose, good or evil, for profit or not. Three of the main bodies that have promoted the concept of governance since the 1980s are the World Bank (WB), the International Monetary Fund (IMF) and the United Nations Development Programme (UNDP). According to the latter, governance is "the rules of the political system to solve conflicts between actors and adopt decision (legality). [The term] has also been used to describe the 'proper functioning of institutions and their acceptance by the public' (legitimacy). And it has been used to invoke the efficacy of government and the achievement of consensus by democratic means (participation)" (UNDP, 2004). In this context, "good governance" has become a dominant buzzword in the literature on sustainable/international development, implying that "bad governance" is one of the root causes of all evil within our societies. Major donors and international financial institutions such as the WB and IMF routinely base aid and loans on condition of structural adjustment reforms to ensure that measures of "good governance" are undertaken (IMF 2005).

According to the United Nations, "good governance" has eight characteristics (UNESCAP, 2006):

- *Participation:* participation is a key cornerstone of "good governance". Participation

could be either direct or through legitimate intermediate institutions or representatives. Participation needs to be informed and organized. This means freedom of association and expression on the one hand and an organized civil society on the other hand.

- *Rule of law:* "good governance" requires fair legal frameworks that are enforced impartially. Impartial enforcement of laws requires an independent judiciary and an impartial and incorruptible police force.
- *Transparency:* transparency means that decisions taken and their enforcement are done in a manner that follows rules and regulations. It also means that information is freely available and directly accessible.
- *Responsiveness:* "good governance" requires that institutions and processes try to serve all stakeholders within a reasonable timeframe.
- *Consensus oriented:* "good governance" requires mediation of the different interests in society to reach a broad consensus in society on what is in the best interest of the whole community and how this can be achieved.
- *Equity and inclusiveness:* a society's well being depends on ensuring that all its members feel that they have a stake in it and do not feel excluded from the mainstream of society.
- *Effectiveness and efficiency:* "good governance" means that processes and institutions produce results that meet the needs of society while making the best use of resources at their disposal.
- *Accountability:* accountability is a key requirement of "good governance". Not only governmental institutions but also the private sector and civil society organizations must be accountable to the public and to their institutional stakeholders.

In the case of resettlements, NGOs recognize that there are several problems that could be solved through aid and local cooperation. The main point is that resettlement is seen as a process that eradicates local culture and the nomadic identity. For this reason international NGOs find themselves in the undesirable position of deciding whether or not to bring aid to resettled peoples.

For example, the houses in the resettlement villages often have inadequate insulation, are coal dependent, and do not have proper water and sanitation systems. In terms of economic local development, NGOs could help in developing activities aimed at supporting local economies, in the transition from a subsistence pastoral economy to a cash flow-market economy. However, although the scope of intervention for international NGOs is wide, the dilemma of taking part in a process that has a direct effect on the eradication of the nomadic Tibetan culture, remains.

We can compare what is happening to pastoralists in Tibet to these Western notions of governance. Politics involves processes by which a group of people with initially divergent opinions and interests reach decisions, while governance conveys the administrative and process-oriented elements of governing. Such a definition assumes the possibility of separating "politics" and "administration" but this distinction is questionable, giving the facts that both notions involve aspects of power.

Amongst political ecologists, the concept of governance has developed a usage distinct from that expressed in the broad definition above. It refers to the trend away from state-centric forms of social and economic regulation, and the transfer of its regulatory and administrative functions to variously scaled non-state actors (consumers, NGOs, corporations, and social movements, for example) and institutions (such as global environmental accords, corporate codes of conduct, and investment treaties) in the governance of society–environment relations (Liverman, 2004, in Himley, 2008). This reconfiguration of the public-private divide has occurred largely as states have ceded authority over resource questions with the implementation of neoliberal policies (through for example the internationally networked interaction of IFIs, NGOs and states at different scales) which favour public–private 'partnerships' and market-based mechanisms as means to achieve 'efficient' resource use and allocation (Himley, 2008). This is certainly not the case in China.

In grappling with these issues of environmental governance, political ecologists, like ecological economists, are particularly concerned with institutions that structure resource access, use, and conservation, and with property rights regimes, especially how traditional systems of complex and overlapping property rights have been transformed through processes of imperialism, internal colonialism, state formation, and capitalist development. In this regard, the concept of enclosure as a means for reconfiguring property rights is seen as key to the implementation of neoliberal reforms (Himley, 2008).

Although "good governance" is regarded as an essential tool for strengthening democracy Diamond, 2005), its promoters never question the democratic nature of market institutions. In particular, they do not seem to acknowledge that by definition the capitalist firm is anything but democratic as its owner(s) are fundamentally autonomous in decision-making. Perhaps counter-intuitively, it appears that the doctrine of "good governance" has in fact been a powerful tool for the promotion of neoliberal reforms under global capitalism, reforms that ultimately demands minimization of state power and legitimization of that of the market. For all these reasons, the application of the notion of "good governance" in the Tibetan context raises many perplexing issues.

7 Discussion

After Mao Zedong's death, economic development was firmly directed by Deng Xiaping and the People's Republic of China, conducted through economic reforms that conjugated neoliberal solutions with an authoritarian and centralized control (Harvey, 2009). In this context, Chinese leaders applied the equation that economic prosperity would represent the best solution for governing a country with secessionist tensions and reclamations of independence. This was particularly evident with the "Open Up the West" campaign.

The Chinese top-down development of "underdeveloped", peripheral and "non-Han" regions reiterates many of the concepts of modernization theories that shaped the development era after the Second World War. A leading concept in the modernization theories of the 50s and early 60s was that one of the main obstacles to the development of "underdeveloped" regions were local backward cultures and values. The anticommunist American academic Bert F. Hoselitz, in his essay "Non-economic Barriers to Economic Development", wrote that "values systems offer special resistances to change, but without wishing to be dogmatic, I believe, it may be stated that their change is facilitated if the material economic environment in which they can flourish is destroyed or weakened" (1952: 25).

Ironically, several authors emphasize the general tendency in Chinese leaders, and in Marxist-inspired Chinese literature, to link poor economic development in Tibet with the "*intrinsic backwardness*" of Tibetans. The commonly held belief among Chinese leaders is that Tibetan cultural norms and Buddhist religious influence inhibit social and economic development (Fischer, 2005b; Yeh, 2007).

Environmental protection and economic development become in the Sanjiangyuan area the two

sides of the same coin of the development discourse for Qinghai:

The Three River Source program (Sanjiangyuan program) is a great strategic task of ecological environment construction in the grand western development program which will not only provide a favourable natural environment for the western development but also serve as an important guarantee for the economic development and ecological security of China and countries in Southeast Asia. It is the important mission endowed by history to Chinese people to strengthen the ecological protection of three river source region. (*Qinghai News*, September 23, 2006)

As Escobar (1988) describes, recalling authors such as Michel Foucault and Edward Said, the circulation and production of discourses is an integral part of the exercise of power. This is particularly evident in the case of the Sanjiangyuan programme, which is not only promoted through information on the news and official media but also with a massive campaign of posters diffused in the valleys.

The transformation that is happening in the nomadic areas of Qinghai is rapidly occurring through a top-down process of dispossession, particular to the context of this Communist regime. As Harvey (2009) describes, in the advancement of the neoliberal capitalist dimension, the State plays a fundamental role in promoting the processes of land commodification and privatization, of conversion of different forms of property rights, of suppression of the rights of the commons, of commodification of labour power and elimination of alternative and indigenous form of consumption and production. This is what is happening with the Sanjiangyuan environmental programme and the resettlements of Tibetan nomads.

The fact that the political context in which this process is advancing is one of communism actually makes the role of the state more effective than how it could be in neoliberal democracies. The rationale behind the subsidies for resettled families (i.e. the nomads have to be resettled in order to restore the grasslands) could potentially be viewed as form of payment for ecosystem services by the Chinese government. This approach however is not explicitly stated by the Chinese government, which insists on the narrative that the resettlements are not only positive for the environment but also represent a form of development and modernization, and are therefore good by definition.

The Chinese government, with the Sanjiangyuan policy, putting a ban on the use of the grasslands and imposing strong limits to the number of animals for the non resettled nomads, is acting on the

property rights regime of the region. This is possible because of the "fuzziness" of property relations in rural Tibetan areas (Yeh, 2004) and because often the nomads do not refer to a written system, nor are they able to read and write in the Chinese language. The underlying logic of the Government recalls the narrative expressed by Hardin (1968: 1243): "picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons", and that the use of land by the nomads will produce a "tragedy of the commons".

However, as we have seen in the preceding chapters, Hardin confused "commons" with "open access". In the case of Tibetan nomads, the grasslands have always been exploited according to customary rights negotiated between the different nomadic families usually in a pacific way, but also with cases of violence and battles for the control of land. However, none of the customary rights and nomadic institutions are taken into account by the Chinese government in discussions on the issue of access to pastures. Currently the population usually leads a semi-nomadic existence, spending half of the year in summer pastures and the other half in winter pastures at a minor altitude. That the Chinese government is telling nomads that agree to resettlement that they will be able to return to the land after ten years of grassland recovery is a cause for concern. This is in light of the fact that no official written plans or strategies have been produced stating the government plans for how the nomads will be able to reclaim the grasslands that they used to inhabit. It is also not clear, or at least it is not officially stated, if the Chinese government is expropriating the land and planning to withhold property rights.

It is interesting that with the resettlements and relocation of Tibetan nomads, the ban on herding has been voluntarily accepted, with no need of direct violent coercive force. This happened as the Chinese government gradually reduced the number of animals allowed for determined areas of land, a process that dramatically impoverished a large number of nomadic families, according to my interviews. It is also notable that the drastic transformation of the lives of up to 200 000 nomads was justified by the use of scientific discourses and rationales for environmental protection. Sanjiangyuan policy took a top-down scientific approach, regarding its subjects as backward, giving little or any consideration of traditional ecological knowledge. Traditional ecological knowledge is completely subjugated by the Chinese mainstream system of values that tends to consider Tibetan nomadic culture as backward (Fischer, 2005b; Yeh, 2007). We can ask, what is the value of traditional knowledge, in which units can it be measured? Beyond technological knowledge, what is the value of a language of a culture, of a religion?

The Chinese government's treatment of Tibetan nomads as an environmental stressor that has to be reduced, if not eliminated, does not only raise serious ethical concerns, but also raises grave doubts over the benefit that policies based on such presumptions can have on the ecosystem. In this complex situation, the role of NGOs is very important but very difficult. Hopefully the increasing attention to the interdependency that environmental issues produce will in the future create major space for collaboration and international cooperation.

---

[1] (Qinghai channel of Xinhua News website, 10/1/2007)

[2] This refers to the killing of rodents.

[3] The relevance of this factor is diminishing because of a rapid Han population increase in Qinghai's TAPs.

[4] The exact number of Tibetans killed by the PLA has had different interpretations. It ranges from the Chinese Government description of Tibet's annexation as "Peaceful" to the U.S Congress figure of over one million Tibetans (one sixth of the total population) killed between 1959 and 1979 under Chinese army occupation and in the Cultural Revolution (Mingxu and Feng, 2006).

[5] In Qinghai for example, differently from the T.A.R., the provincial government decided to attribute land and animal property rights to the nomadic households (Goldstein, 1996). For a discussion of the 'fuzziness' of property relations after de-collectivization in Tibet, see Yeh (2004)

[6] Yeh (2005) and other authors recall the increased attention to environmental degradation given by policy makers after the destructive floods and droughts of the Yangtze River in 1997 and 1998.

[7] *China Daily*, 6 March 2000; in Goodman, 2004.

[8] On this philological point I will speak of "nomads and nomadism" when referring to the pastoral mode of production which is the prevalent form of nomadism in Tibet. Also, in the Tibetan language the word *brogpa* is translated into English as "nomad", literally meaning 'that pastures in

the mountains' (Orofino, 2003).

[9] This figure is a mean average from different sources. Governmental and non-government sources on population matters are constantly divergent.

[10] The statistics of the meteorological Chinese department report that in the Sanjiangyuan region the annual rainfall reduces by 2.81 mm, that the average temperature increased by 0.25°C in the last ten years, and that the evaporation raised by 5.8 mm per 10 years (Gong et al., 2008).

[11] Deserts, as regions that receive a low amount of rainfall (below 300 mm), are not a cause for concern in themselves. The vegetation and the animal life of deserts are well adapted to such circumstances. Humans have also long lived in deserts. However, the spreading and deterioration of dry-lands is a cause for concern. The driving forces can be the excessive use of such land for pastures, or also climate change that changes rainfall patterns and increases the evaporation of water. There are international agreements to stop the process of desertification, defined by the United Nations Convention of 1994 as land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities.

[12] 1 mu = 1/15 ha.

[13] The equivalence between animals is calculated as: 4 sheep = 1 Yak; 6 sheep = 1 horse.

CHAPTER 7

NEOLIBERALISM AND METABOLIC PATTERNS IN THE TIBETAN RANGELANDS: THE RESETTLEMENT TRANSFORMATION

1 Introduction

Nomadic pastoralism, arguably the longest continuously practiced mode of economic production on earth, is today steadily disappearing as a way of life. This can be traced to political, economic, demographic and historical processes that began at the end of the 19th century, and were consolidated during the 20th century (Sandron 1998), through which the lands used by pastoralist have been appropriated and drastically changed by rapidly growing settled populations. A common influential factor, recognized throughout the literature concerning the demise of nomadic communities is the rise of modern states, the extension of various forms of state control and more recently, the influence of 'environmentalist' governmentalities (sic Michel Foucault: 1974), which have drastically transformed the prospects for nomadic existence in the 21st century (Bradburd 1987; Goldstein and Beall 1989; Salih 1990; Goldstein 1991; Klute 1996; Lenhart and Casimir 2001; Miller 2000, Pirie 2005; Yeh 2005).

Despite Tibet's regular appearance in an international news topic and the great importance of pastoralism to its economy, details of how pastoralism is changing in Tibet are scarce. With the following, small-N, analytically triangulated (Roe, 1996), with a case study of 32 pastoralist households in the Tibetan-Qinghai plateau (23 traditional and 9 resettled) we aim to help address this gap in the literature. Similarities and differences between the societal metabolism of the traditional and resettled villages are studied through reference to demographic, time use, resource access and monetary flow and expenditures data, which are analyzed using a combination of: descriptive comparison of the two village types, based on measures of central tendency; correlations between the selected variables across all households; goodness of fit differentiations among household types and between the two village types and the process based accounting tool Multi-scale Integrated Assessment of Social Ecological Metabolism '(MuSIASEM) developed by Giampietro and Mayumi (2000a; 2000b).

Due to the sensitivity of the political context and the associated research constraints, our data set for this case study is exceptionally small. However, in light of the dearth of information available, regarding rural change in Tibet, it allows us to provide new information about the situation of pastoralists there. In addition, our reliance upon MuSIASEM, which focuses attention on the internal relational structure of processes of economic production, helps in analyzing the structural transformation that the resettlement policies are producing in the Tibetan pastoral system. Although such data can not be statistically extrapolated, it nonetheless provides valuable insights regarding the process of rural transformation taking place in Tibetan pastoral areas.

The structure of the paper is as follows: first, the general background on the case study and theoretical framework is introduced. Second, the methodological approach described; Third, data collection procedures presented. Fourth, data analysis and the results of our comparison illustrated. Last, reflections on the implications of the results for advancing further study of rural change in pastoralist settings and for understanding the factors and forces threatening the nomadic way of life in Tibet.

2 Case Study Background and Theoretical Approach

Up until recently, Tibetan pastoralism had survived, in spite of the turmoil of the Chinese cultural revolution and the radical transformation of the collectivization period (Goldstein, 1991,1996), which began in 1959, when the People Republic of China took control of Tibet. At that time, several top-down policies were implemented by the Chinese Government, in an effort to control and rationalize the nomadic pastoral production system (Goldstein et al. 1990, Goldstein 1991, Miller 2000, Yeh 2005; 2009). These drastically modified the production patterns and institutional arrangements of Tibetan nomads.

However, during the period between 1980 and 1999 Chinese policies allowed a return to the traditional nomadic system of production and the pastoral traditional activities gained new vigour. Looking at the larger picture of Chinese economic development, after Mao's death in 1976, and a persistent economic stagnation, a new era of economic reforms took place under the leadership of Deng Xiaoping. The Chinese economic reforms of the 80s coincided with a global neoliberal turn. In China this manifest in the creation of a market economy that combines neoliberal and

authoritarian policies: what Harvey (2007: 120) calls "Neoliberism with 'Chinese Characteristics'."

In recent years, a new stage of radical transformation has been introduced, through what has been described elsewhere as an 'environmentalist' governmentality, created through discourses on environmental protection and poverty alleviation (Yeh 2005, Fischer 2006). It is this more recent period of transformation that provides the focus for our case study, which is based in the Sanjiangyuan area, specifically in Yushu and Hainan Tibetan Autonomous prefectures.

The modernization of agriculture was a main pillar of Chinese reform in the 1980s, accompanied by a shift from agricultural communes to an 'individualized household responsibility system' that created the preconditions for a market oriented economy. Rural monetary flows and outputs increased at 14% per annum during the 80s but then stagnated and fell in the mid 90s, leading to a marked rural-urban divide (Yang and Kai 2003). According to Harvey (2007), China's urban/rural differential in real monetary flow in 2005 was the largest of any country in the world. He argues that failures of the State Owned Enterprises and crisis of the rural economy created a combination of vast unemployment and under-utilized surplus financial capital, which were both channelled into massive debt-financed infrastructure projects and an urban development boom (Harvey 2007).

Labourers have flocked from the Chinese countryside cities, and both monetary flow and social capital have been polarized, both between and within the rural and urban economies. Kay (2005; 2008) describes a similar situation in his discussion of 'new ruralities' in Latin America, which he also attributes to the neoliberal agricultural, social, economic and development policies implemented in the 80s. Key features of these 'new ruralities' are: increasing multi- and pluri-activities, in which farmers must engage in order to support their households; increasing reliance on non traditional and non farming economic activities, including external wage labor in construction and agribusiness; transformation in social structures; changing mobility patterns; migration and urbanization.

Kay's description of the emergence of new ruralities as direct outcomes of neoliberal policies in Latin America provides us with a point of reference for our study of the rural transformation taking place in the Tibetan plateau.

The economic transformations that followed the "Open Up the West" campaign 'xibu da kaifa' (Goodman 2004) can be understood as Neoliberalism with 'Chinese Characteristics' reaching the Tibetan plateau. In 2000, the Sanjiangyuan programme, which has been described by the Chinese media as one of the backbones of the "Open Up the West" campaign, systematized the resettlement and sedentarization of the Tibetan nomads. The traditional nomadic production process in Tibet is based on the individual pastoralists, or 'drogpa,' who lives according to a specific worldview: the household shares economic activities and properties and the village accesses and defines the institutional arrangements for use of common pastures. Chinese governmental policies had a strong impact on Tibetan pastoral traditional institutional arrangements and production systems.

For example, in response to the property allocations of 1995, the system of common pastures has been gradually substituted by individual households pastures, moreover nomads began to fence their lands and to replace tents with houses, changing social, mobility and metabolic patterns.
Rather than looking only at monetary flow statistics, in order to assess the impacts of these transformations, following Farrell and Mayumi (2009) and Scheidel (2013) we employ principles from Georgescu-Roegen's (1971) flow/fund model of economic production, in order to conceptualize how differences in the social life-world, or 'cuisine' (Farrell and Mayumi, 2009: 303), of traditional and resettled nomads is related to the metabolic patterns exhibited in their economic life.
Georgescu-Roegen's (1971) flow/fund model of the economic process provides an alternative to conventional static representations by complementing the traditional distinction between factors of production, with the two production 'element' categories: funds and flows.

Funds typically correspond with 'Land', 'Capital' and 'Labor' and flows, may refer, for example, to monetary flow and expenditures and production inputs and outputs. However, these categories are to be understood in a semantically open way that reflects the boundaries of the system or process in question: fund elements represent "the agents of the process" while flows elements "are used or acted upon by the agents" (Georgescu-Roegen, 1971: 230). This means that the same material

[5] Similarly to what took place during the introduction of the 'household responsibility system' in the 80s, in 1999, Tibetan nomads households were allocated 50 year property rights for a homestead and additional land for their winter pasture.

might be both a fund and a flow: “hammers are used to hammer hammers” (1971: 231). This insight is particularly relevant for understanding the economic production of pastoralist nomads, where the herd is, at the same time, both a fund that can produce flows, and in the case of the individual animals comprising that herd, some of the animals are sold or consumed, making them flows. Scheidel (2013) argues that Sen’s capabilities approach (Sen 1999), and Carter and Barrett’s (2006) assets-based approach to the study of poverty, can be combined with Georgescu-Roegen’s (1971) flow-fund model, in order to provide a theoretical basis for combined analysis of the social and material well-being of people living in poverty. Following Carter and Barrett (2006), he argues that indicators of poverty should explicitly reference the asset basis, rather merely the monetary flows into and out of households. This makes it possible to differentiate periods of cash poverty from structural situations of poverty, and so provides more reliable information concerning the likelihood that a household will remain or fall into poverty in the future. Scheidel (2013) proposes that Carter and Barrett’s (2006) position regarding the relationship between assets and poverty avoidance, is highly compatible with Georgescu-Roegen’s (1971) position regarding the relationship between funds and economic production and we agree.

Moreover, we propose that this compatibility is particularly relevant for understanding poverty in a pastoral context, where status and wealth and are often judged through reference to the asset/fund herd size (Swift 1986). On the one hand, Lybbert et al. (2004) find, based on a 17 year longitudinal study of pastoral household in southern Ethiopia that there is robust evidence of an asset poverty threshold that correlates both with the possibility of falling or persisting in poverty traps and the size of a household’s herd. On the other, for traditional pastoralist activities, herd size, which influences a household’s capacity to produce wealth and wellbeing, can be understood as a fund.

By embedding his interpretation within Sen’s (1999) discussion of capabilities, Scheidel argues that poverty measures should be based on reference to an individual’s capacity to transform available material and social resources in order to guarantee a certain level of wealth and wellbeing. Since the capabilities approach emphasizes the importance of context and processing potential for measuring well-being, it allows us to extend our analysis of rural poverty to include reference to relational and subjective aspects of deprivation. By combining this position with Georgescu-Roegen’s arguments, concerning the role of funds in economic processes, it is possible to establish a set of semantically

open but materially concrete asset and capabilities based points of reference for analyzing poverty and well-being in pastoralist communities by taking herd size, which is the central fund in the economic process of pastoralist production, as our central point of reference.

We do this by building on the Societal Metabolism6 approach as illustrate in Chapter 4 which allows us to build relational representations of the use of key funds, within a specific economic process. It is in this perspective that we investigate what are the transformation of the societal metabolism of Tibetan nomads identity and mode of production, produced by resettlement and sedentarization programs.

This allows to discuss the social and material transformation produced by resettlement and sedentarization policies within a single frame and to provide new data, regarding the impacts of rural change in the Tibetan plateau.

3 Methodology

The Case Study area:

The Tibetan-Qinghai plateau, with an average elevation of 4500 m covers most of the Tibetan Autonomous Region and also the Qinghai province of the People's Republic of China. It is generally described as a high altitude steppe with extensive permafrost. The plateau has traditionally been inhabited by Tibetan nomadic people, with economic production based on yak, sheep and horse herding (Norbu and Simmons 1997). In the eastern part of the plateau, in Qinghai province, the Sanjiangyuan area, which literally means 'three rivers source', contains the watersheds of the Yangtze, Yellow and Mekong rivers. In order to protect this watershed area, in 2000, the Chinese Government created the Sanjiangyuan Nature Reserve. With an area of 152,300 km2, it is the largest nature reserve in China (Li 2007 in Shen and Tan 2012). It is also inhabited by roughly 300,000 Tibetan nomads7 (Foggin and Torrance-Foggin 2011, Shen and Tan 2012).

[6] See opening editorial for a review of the concept and methodology

[7] Throughout the paper we will use the term nomads which refers to the nomadein.. The term nomad comes from the ancient Greek verb "nomadein" which literally means "to herd the flock to pasture". The terms "Nomads and nomadism" in this context are referred to the pastoral mode of production which is the prevalent form of nomadism in Tibet. Also, in the Tibetan language the word *'brogpa* is translated into English as "nomad", literally meaning 'that rangelands in the mountains' (Orofino, 2003). This philological root contains an essential description: 'movement' and 'animals,' which represent the two fundamental pillars of the nomadic way of life.

Recent resettlement and sedentarization policies in the Tibetan-Qinghai plateau (starting in 2000 and still ongoing) have been justified based on the claim that these are required, in order to protect the Sanjiangyuan watershed from environmental degradation (Dell'Angelo 2012). They are also linked to the Chinese government's 'open up the west' campaign (Goodman 2004), which is based on three presumptions: (i) that the Tibetan nomads are 'backward' and that their modes of production and lifestyle need to be 'developed;' (ii) that, echoing Hardin's (1968) tragedy of the commons narrative, Tibetan nomads have a natural propensity to increase their livestock numbers, which leads to overgrazing; and (iii) that overgrazing is the primary cause of erosion and desertification in the Sanjiangyuan watershed and that this is the major threat to the ecological health and hydrological stability of China's most important watershed.

Over the past 60 years the Tibetan-Qinghai plateau has already undergone a dramatic social-ecological transformation, due to the Chinese central government's previous resettlement policies. Since this first period has already transformed the landscapes, ecology, and metabolic, socio-cultural and institutional features of the rural areas of the plateau, our baseline point of reference here is not precisely traditional nomadic practices but rather surviving traditional practices.

The major distinction, as we discuss here below in detail, is that surviving traditional practices allow Tibetan nomads to continue practicing pastoralism as a way of life, whereas the Sanjiangyuan resettlement programs threaten to make this this both socially and materially impossible.
The data reported here was collected in two villages, one 'traditional village' and resettlement both of which are located in the Hainan prefecture, in the Qinghai province. The precise locations of the case study villages are not reported here, in order to protect the confidentiality of our interlocutors.

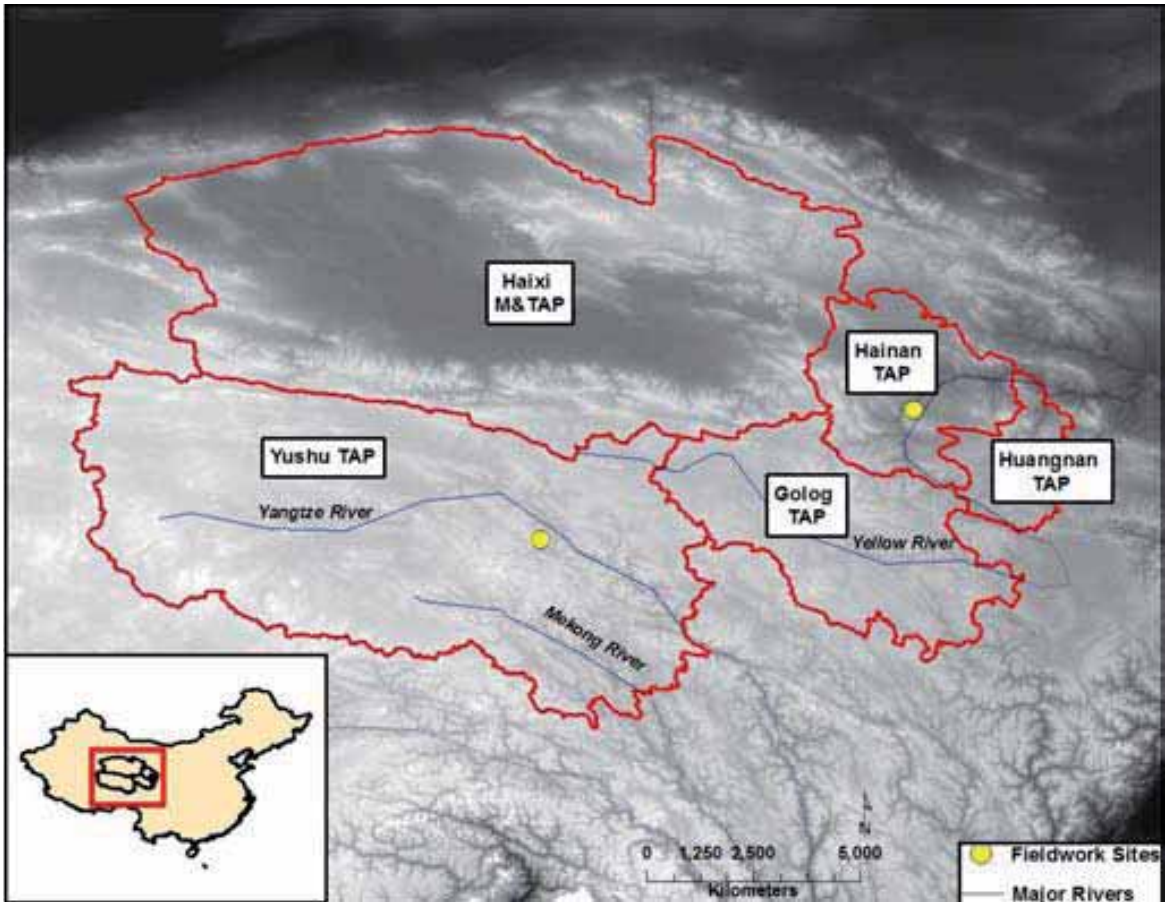


Figure 7.1: Map and fieldwork sites

The traditional village: The village we studied is compatible with the Chinese government administrative unit of a natural village, several of which are grouped together to form the official administrative villages that comprise the first tier of Chinese government authority. In the case of the nomads a natural village does not necessarily correspond to a physical place. A traditional village can have households in more than one valley, with the current nomadic villages in this region having been brought together as the result of a slow and relatively independent process of households and family group aggregation. The village reported upon here is composed of 187 households, with 30% of these spread across nearby valleys and the remainder located in the same valley. The village has an internal assembly, formed by all adult male members, that elects a 5 person committee that is in charge of the village affairs. One of the most important aspects of the institutional and political sphere of the village is the management of the summer pasture, which in this particular case is still commonly shared and used by every household of the village, following rules decided in this assembly.

Resettlement: The resettlement that we studied has 300 households. People started to move into the resettlement in the fall of 2007. The household origins are 10 different traditional villages, with each traditional village contributing roughly 10 % of the resettlement households. All the villages are part of the same township 8. The distance from the resettlement to the nomads' rangelands varies from approximately 12 to 25km. All the households in this resettlement correspond to the third9 plan of resettlement programs. The physical characteristics of the Resettlement, which are similar to every other resettlement observed during the field visit to Qinghai, are that the housing and infrastructure of the resettlement is homogenous and uniform. Every house within a resettlement is identical in terms of size, materials and shape. The typical format is a one room, with a central coal stove, connected to electricity and water, with a small fenced courtyard in front of the house and in some resettlements, especially those from the first program, a small sheep and yak cote. Most of the houses in the resettlements have a television and a fridge. In some cases an external wall contains the resettlements and the studied resettlement, as in most cases, has its own primary school.

[8] The Chinese administrative structure is the following: village, township.

[9] Since the beginning of their implementation the resettlement programs have varied in terms of pastures use restrictions, amount of subsidies, cost of the houses, distance of the resettlement from the original village. Ptackova (2011, 2012) describes some of the differences between the later and earlier resettlement programs. Interviewees generally refer to first, second and third plans.

Fig 7.2. Resettlements. Photo by the author.

4 Methods

4.1. Data collection and sampling strategy

The fieldwork was conducted in two different stages in the periods June-July 2007 and September-October 2011. In the first stage the aim was to investigate the general problematic and policy context, as no scholarly publications on resettlement in Tibet were available at that time. At that time it was observed that the resettlement program had profound consequences for both the institutions and social metabolism of the resettled households. Based on data collected in the first stage of fieldwork, the second stage focused on acquiring detailed metabolic and institutional information that would make it possible to analyses these changes.

Primary data collection for this study was conducted using a combination of in-depth semi-structured interviews and focus group discussions. The metabolic information reported below is

based on quantitative data concerning demographic structure of households,10 area of land owned and area of land used, time use, monetary flow and expenditures in monetary terms, diet, herd size and characteristics, energy and materials use, and secondary assets. Time use data includes time dedicated to both economic and non economic activities.

During the first stage of fieldwork 67 people were interviewed, including government officials, traditional and resettled nomads, international rural development experts and Chinese researchers. During the second stage of fieldwork 75 people were interviewed. Interviews were conducted with 23 households in the traditional village and 9 households in the Resettlement, with one or two members of each household. Traditional village households were selected for interviews, from a population of 187 households in the traditional village (n=23 out of 187), using a preliminary focus group discussion that aimed to identify representatives for three family group types, which were selected for detailed data collection: small, medium and big herd size. The 9 households interviewed in the Resettlement were drawn from a population of 300 households and were selected on as random a basis as was possible (n=9 out of 300). While the sample size for the Resettlement interviews is very small, in particular with regard to the total number of household, the political sensitivity of the research topic made it impossible to collect a larger sample or to comply fully with standards for random sampling. Nonetheless, this is more data than has been available to date and due to the structural homogeneity of the resettlement situation, ous situation of these resettled Tibetan nomads. In addition, our aim here is not to make statistically robust predictions, for which these data are not suitable, but rather to combine quantitative metabolic and qualitative institutional information, in order to provide a richer understand of what the households we were able to interview have been experiencing, and how this has impacted on their ecological and institutional lives.

4.2 Data analysis

Below we present the results of a comparative analysis of the social metabolisms of the traditional and resettlement village, based on a combination of individual and household information, including demographic data, activities/time use, energy use, mobility patterns, monetary monetary flow and

[10] We consider the household unit composed by the members of the family that share the same sources of monetary flow and expenditures

expenses and nutritional information. All statitical data analysis was conducted using XLSTAT. Individual information has then been aggregated in order to scale up from the individuals level to the household level.

We use basic descriptive statistics in order to compare the basic overall composition of the two types of villages, to which we apply a Spearman correlation analysis test, in order to assess the degree of interdependence between the number of working members of a household, monetary flows into and out of the household, herd size and non-herding economic activities for both village types.

It can be explained qualitatively, as this reflects a general tendancy, observed in the second stage of fieldwork, for the young and elderly to be left behind in the settlements. Using univariate clustering, we identified four different groups of statistically distinct household types across the entire population of surveyed household, with reference to annual monetary flow data. We chose to aggregate the two village types, for this clustering analysis, in order to compensate for the low n of the resettlement village sample. We are aware that this is far from ideal and have conducted a Chi Square comparison of structure of the annual monetary flow distributions in the two sample sets (traditional and resettlement villages), in order to provide some insight into the plausibility of this aggregation step [this is very simple – we can do it on Sunday – please let's DISCUSS]. Keeping in mind that the n=9 sample size for the resettlement households provides very few degrees of freedom, the resulting Chi Square significance at XX% confidence suggests that this step does not introduce systematic bias into the clustering.

Using the non-parametric Kruskal-Wallis test, we then examined differences between these four household types, with respect to other variables. Based on the results of the Kruskal-Wallis test (reported in Annex X), we selected herd size and total amount of 'owned' land as complementary variables, in order to compile the four representative household profiles used here below.11

[11] Although land cannot be owned, under Chinese law, households have exclusive land use rights which operate in the same way as land ownership, in all aspects except transferability. We used the term owned land here as a convention, to represent these exclusive land use rights.

5 Results

The descriptive statistics of both the traditional village and the resettlement sample reveal the following (n = -1) level results synthetized in Table 7.1.

Table 7.1. Characteristics of sampled population

Variables	Traditional Village	Resettlement
Average number of members per family unit	5.78	6.11
Lives in the rangelands (%)	100	~ 40
Lives in the resettlement (%)		~ 60
Gender		
Female	50	54
Male	50	46
Average total owned land in Mu	~ 510	~ 1238
Livestock numbers	~ 182	~ 245
N of households with motorcycles (%)	~ 74	~ 56
N of households with fridge, TV and stoves (%)	~ 83	~ 22

Traditional village (TV): In depth interviews with the village leaders and elders, supported by the household interviews, reveal that every household in the village has a small cultivation area, used for subsistence. As land cannot be sold, by Chinese law, and was divided between family groups by the government in 1999, land ownership, as defined here, is relatively homogenous. Herd size, however, which represents one of the main productive activities of the village, is subject to stronger variation across households.

In order to cross reference the static household profile and metabolic data, we have aggregated data collected in the traditional village regarding individual activities, in order to generate annual household level averages time use, monetary monetary flow and monetary expenditures Table 7.2.

Table 7.2. Traditional village aggregated metabolic data

Activity	Time	Activity	Monetary flow	Expenses per category	
“Relax”	35.4%	Herding	57.2%	Rented land	22.1%
Sleep	33%	Caterpillar	29.3%	Medicines/hospital	21.7%
Herding	9.7%	Construction	7.2%	Clothes	16.3%
School	8.7%	Rent land	2.6%	Flour, rice, vegetables	10.4%
Housework	4.5%	Agriculture	2.4%	Meat, diary prod.	7.3%
Festivals	3.5%	Subsidies	0.6%	Agricultural inp.	6.1%
Caterpillar	1.9%	Religious	0.4%	Celebrations	4.9%

Activity	Time	Activity	Monetary flow	Expenses per category	
Construction	1.0%	Shops	0.2	Transport	4.8%
Religious	0.6%			Mobile phone	3.3%
Agriculture	0.5%			Food for animals	2.0%
Shops	0.3%			Electricity	0.8%
Government	0.2%			Coal/Dung	0.2%

The “Activity Time” shows the average time use divided per activities of the traditional village household sample. An average of ~35.4% of time has either not specified or received generic descriptions, such as “nothing to do” “relax”. A standard value of 33% of time has been assigned for sleeping and resting. Among direct economic activites, herding, to which households dedicate an average of roughly 10% of their time, represents the largest share of the time budget.

The ‘Monetary flow’ chart shows the distribution of average annual household monetary flow for the traditional village sample across the core monetary flow generating activities of the nomads, listed in Table 7.2, with the lion’s share represented by “Herding” (~57%), including the sale of cattle (Yak and Sheep), diary products and wool, followed by “Caterpillar” collection (~29%) monetary flow from harvesting and sale of wild iartsa gonbu, caterpilar fungus, which is in high demand as an ingredient in traditional Chinese medicine (see Winkler, 2008 for further details). “Construction” (~7%) monetary flow, from low skill work on housing and infrastructure projects, “Renting land” to others, for herding, caterpillar harvesting or agriculture (~3%), and own “Agriculture” activities (~2%), contribute most of the remaining annual average monetary flow, with government subsidies, religious activities (involving rituals conducted by lay Buddhist practitioners), small shops, manufacturing activities and driving services, all of which are unevenly distributed across the sample population, making up the rest.

In the ‘Expenses’ chart we provide an overview of average annual expenses for the same sample. Here “Renting land” and payments for “Medicines and Hospital” represent the largest shares of expenses, with roughly 22% of total expenditures dedicated to each, followed closely by food expenses (17,7%: split roughly 40/60 between purchase of meat and diary products and of rice, flour and vegetables, respectively) and the purchasing of “Clothes” (16,3%). The remaining household expenditure are consistently associated, across the sample, with “Cultivation” (6%) costs, for

agricultural inputs, expenditures for “Celebrations” (~5%), both religious and lay, “Transport” (~5%),, generally for petrol, in most cases motorcycles, “Fodder” (2%), “Electricity Bills” (<1%), and “Coal/Dung” purchases, for heat and cooking (<0.5%).

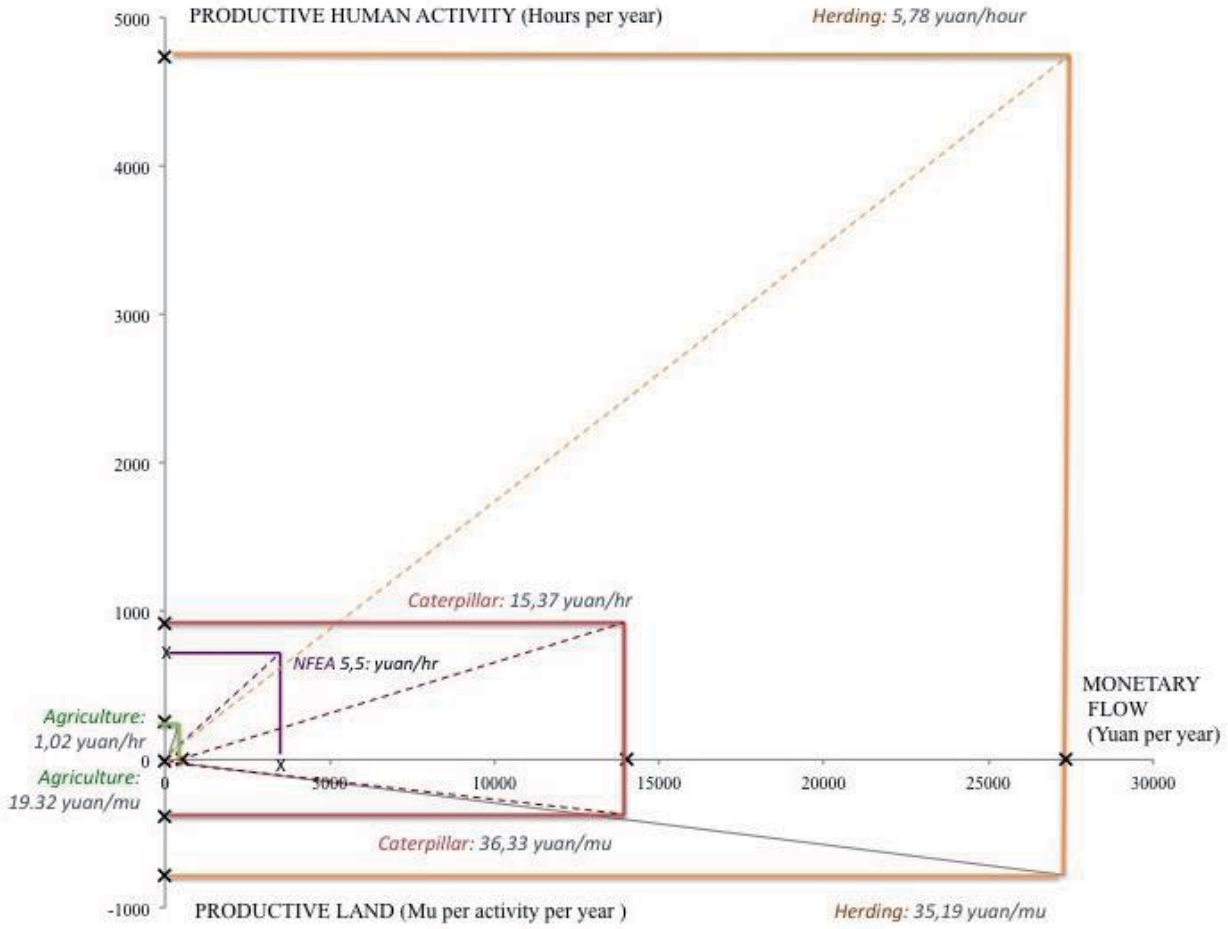


Figure 7.3: Flow/fund representation of Household Averages for the Traditional Village Sample

Taking up the formalization Figure 7.3. presents an analysis of the traditional village economic activities in relation to the its extensive variables (i.e. absolute values of fund and flows) monetary flow (flow – measured in Yuan/year), land (fund – measured in mu of land used per year) and human activity (fund – measured in hours allocated in the chosen category per year) and its intensive values (i.e. flow/fund ratios). The activities that are analyzed are ‘herding’, “agriculture”, ‘caterpillar harvesting’ and non-farming economic activities (NFEA) which include the off farm activities ‘construction’, ‘manufacturing’, and ‘driving’. The main characteristic of the NFEA is that

they are activities that do not depend on neither the land fund nor the herd fund.

Our results show that herding counts for the higher amount of time and relies on the largest share of land, in absolute terms provides the largest share of the traditional village monetary flow. Caterpillar harvesting is second in terms of share of time, land and monetary flow followed by the NFEA and agriculture. However, if we look at the flow/fund ratios intensive values we can get relevant information about the productivity of production factors. These flow/fund ratios give a preliminary idea of the monetary flow generation characteristics of the different activities. It is evident that in the case of caterpillar harvesting there is the higher monetary return for hour (15.37 yuan/hr) followed with a large difference by herding (5.78 yuan/hr), NFEA (5.5 yuan/hr) and finally agriculture (1.02 yuan/hr). In the case of the monetary return per land used, caterpillar harvesting is the higher (35.33 yuan/mu) herding the second (35.19 yuan/mu) followed by agriculture (19.32 yuan/mu), while NFEA do not rely on land.

According to the MuSIASEM approach such an analysis multiscale of the metabolic pattern of social system can be used to study three aspects of sustainability:

(i) VIABILITY – given the endowment of production factors – in this case labor supply, land accessible, animals, other technical devices – it is possible to generate the required flow of money and other goods and services consumed by the household?

(ii) FEASIBILITY – given the methods of production and consumption – in this case the set of activities expressed by the household – are the resulting biophysical flows (considered both on the supply and the sink side) compatible with the reproduction of ecological funds (soil, terrestrial ecosystems, water funds) affected by these flows?

(iii) DESIRABILITY – is the resulting metabolic pattern (determining a profile of allocation of human activity over a given set of activities) desirable to the people, when considering their cultural identity, aspirations and taboos?

This integrated analysis mixing biophysical and socioeconomic variables is necessarybecause the agriculture in the studied village is mainly for household self subsistence. This implies that when considering the performance of both agriculture and herding the monetary value of the goods consumed by the household are not included in assessment of direct monetary flows. Looking at

monetary flows it appears clearly that NFEA represent both a minor share of the village activities in terms of time allocation and that the economic return is not high. Stil monetary flows can play an important role for food security. In the case of resettled households in this plan instead, receive a fixed subsidies amount that correspond to 3000 RMB per household per year, 800 RMB per household for coal, 2300 RMB per every household member with less than 16 or more than 60 years. All the children in the resettlement go to school in the resettlement school for 9 compulsory years.

The monetary flows are independent from the productivity of production factors. So the analysis of the internal availability of production factors (labour, land and animals) and the analysis of the return of these production factors in relation to different activities is less important.
In the case of the resettlement due to political sensitivity and research constraints it has not been possible to collect the same amount of data as in the traditional village.

5.1 Correlations

We have studied the correlations between the different variables unifying the TV and the RES in a single data set in order to have some preliminary comparisons at the household level.

Table 7.3. Correlations among working family members, monetary flow per year, herd size, total peroductive owned land, and NFEA. The values shown in the talble are the Spearman correlation coefficients.

	Family working members	Monetary flow per year	Herd size	Total owned land	NFEA
Family working members	-				
Monetary flow per year	0.277	-			
Herd size	0.409**	0.596***	-		
Total owned land	-0.256	0.619***	0.483***	-	
NFEA	-0.084	-0.166	-0.312*	-0.319*	-

NFEA, non-farming economic activity
***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

The results of the Spearman correlation analysis are shown in Table 7.3. We found a significant and positive correlation between the monetary flow per year and the herd size of the different households, between the monetary flow and the total amount of land owned and between the herd size and the total amount of land owned. Moreover we found a slightly negative relationship between the non-herding economic activity and the monetary flow per year, herd size and a significant (at 0.10 level) negative relationship between NFEA and size of land owned.

Table 7.4. Average characteristics of the different household types calculated by the univariate clustering test and difference calculated with the Kruskal-Wallis test.

	Household types				Kruskal-Wallis test
	High	Medium-high	Medium-low	Low	
n	2	3	14	12	
Monetary flow	107250.00	58106.67	28450.79	-3874.33	$\chi^2 = 25.49$***
Herd size	786.00[b]	177.33 [a,b]	214.21 [a,b]	92.00[a]	$\chi^2 = 11.10$**
Total owned land	3400.00[b]	2410.00[b]	517.00[a,b]	426.42[b]	$\chi^2 = 13.30$***
Non herding economic activity	0.00	3.87	9.11	15.98	$\chi^2 = 1.52$

*** and ** indicate statistical significance at the 0.01 and 0.05 levels, respectively.
Note: Household types with different letters (a and/or b) were significantly different according to Dunn's multiple comparison test.

Table 7.4 shows the four different groups of households subdivided by monetary flow from the unified TV and RES sample, performed with the univariate clustering analysis and the differences in herd size and total amount of land. These groups show that there are a few numbers of households that have a very high or high amount of land and herd, followed by the majority of households that have considerably lower herd sizes and owned land. Group "low" is the only one whose average monetary flow per year is negative, meaning that they are indebted.

Finally in figure 7.4 we bring together the four typologies of households divided per monetary flow of the unified TV and RES sample and analyse the relationship between NFEA and the funds 'owned land' and 'herd size'. The cubes correspond to the RES households while the spheres to the TV, the four scales of grey to the different monetary groups. From this figure we can observe that families with higher monetary flow have also larger land and herd size. It is also possible to

visualize the positive correlation that holds for the TV between land and herd size for the RES. It is observable that the households with lower monetary flow have smaller land and herd size. Finally what is important to observe is that while there is significant correlation between monetary flow and both land and herd size and a slightly significant negative correlation between NFEA and both land and herd size, there is no correlation between NFEA and monetary flow.

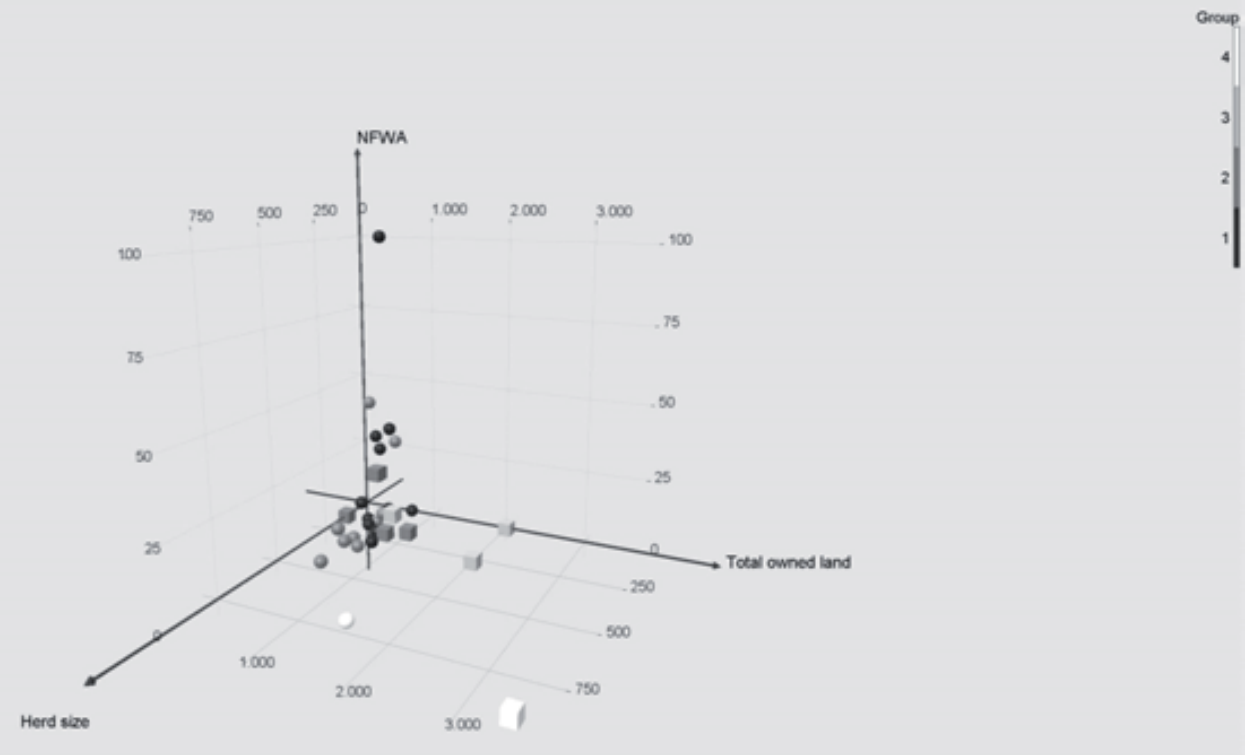


Fig 7.4 NFEA – herd size – productive total own land – correlations among monetary groups of the RES and TV

Among the different results of this case study there are some that are particularly noteworthy. In synthesis:

(i). the traditional village largest share of time per activity and monetary flow is for pastoral activities (‘herding’ and ‘caterpillar harvesting’) while ‘NFEA’ represent a minor share manly related to ‘construction’ activities;

(ii). Also in in relative terms, the intensive values of yuan/per hour in the TV shows higher values for herding and caterpillar harvesting than for NFEA, moreover it is evident from this figure the importance of the fund ‘land’ for these activities;

(iii). In the unified TV and RES sample, monetary flow is significantly correlated with land size and herd size while NFEA presents a negative correlation with land and herd sizes
(iv). In the RES and TV sample there is evidence that households with larger size of land and herd do not engage in NFEA but there is no correlation between NFEA and monetary flow.

These preliminary results confirm the importance of pastoral activities (mainly Herding and Caterpillar harvesting) in both the TV and RES in terms of time allocation and monetary flow generation. Moreover looking at Herding, Caterpillar Harvesting, Agriculture and NFEA (in figure 3) one of the main insights is that although herding and NFEA have similar values in terms of monetary return per hour the aggregated number of hours allocated is much larger for Herding than NFEA.

This suggests two different interpretations that are not mutually excludable, first that nomads in a traditional setting prefer to herd rather than to do NFEA activities such as working in the construction business, manufacturing, working as drivers or working for the government or running small shops. Second, that there is a lack of NFEA opportunities, which is a possibility suggested also by figure 7.4 in which is possible to see that there is no correlation between NFEA activity and households with low monetary monetary flow, low herd size and low land size. It would be intuitive that with a high availability of NFEA opportunities households without land and herd, would be all working in NFEA sectors but this is not happening.

6 Discussion

The results of this exploratory case study indicate the possibility of interpreting the Tibetan nomads rural contemporary transformation as a form of extension of Neoliberism (with “Chinese characteristics”) in the high rangelands of Tibet. Our preliminary results show some interesting similarities with the rural transformations that Kay identifies as fundamental features of the “new ruralities” in Latin America.

The results of this case highlight the importance of traditional farming activities in terms of time allocation and monetary flows among Tibetan pastoralist. Moreover it shows the centrality of the ‘land’ and ‘herd’ as factors of production for this specific form of livelihood. From a societal

metabolism perspective funds are fundamental for the preservation of the identity and the functions of a given system. In this case study, land and herd emerge as the core of the Tibetan pastoral system.

The resettlement policies have in a first round directly moved the nomads far away from their land and created restrictions on herd size. The more recent resettlement programs instead have kept the sites relatively close to the rangelands and gave less attention on the overgrazing issue. This has produced a clear consequence that is that the nomadic households have adapted by sending their children (also as a consequence to compulsory education policies and fines) and the elders to the resettlement sites while the productive members stayed in the rangelands with their herds. In this way the economic, productive and nutritional changes of the pastoralist households were minimized. In other words the price to keep the metabolic functioning of the household has been to transform and disaggregate the family structure. In both cases the resettlement and sedentarization policies act directly on the funds, physical or social, on which the identity of the Tibetan nomads is constructed.

The resettlement and sedentarization policies are promoting the emergence of what in Kay's word appear like 'new Tibetan pastoral ruralities' that should represent a transitional stage towards a modern system of production in which the Tibetan nomads abandon their "backward" productive activities and are integrated in a market economy, receive education and do not affect negatively the rangelands ecology through herding.

As Harvey (2009) describes, in the advancement of the neoliberal capitalist dimension, the State plays a fundamental role in promoting the processes of land commodification and privatization, of conversion of different forms of property rights, of suppression of the rights of the commons, of commodification of labor power and elimination of alternative and indigenous form of consumption and production. This echoes Polanyi's (1994) account of the commodification of labor, land and money as precondition for the market to function properly. However the Tibetan pastoral system has showed a strong adaptive capacity and resisted to major drivers of change since 1959 reproducing its mode of production on a solid system of values.
Nevertheless, as Hoseltiz illustrated, "values systems" that "offer special resistances to change" can

be reduced “if the material economic environment in which they can flourish is destroyed or weakened” (1952: 25).

CHAPTER 8

A GREAT TRANSFORMATION: RESETTLEMENT POLICIES, INSTITUTIONS AND METABOLIC PATTERNS IN THE TIBETAN RANGELANDS

Abstract: This case study focusses on the environmental governance dynamics of the Sanjiangyuan area in the Tibetan Rangelands in Qinghai and its consequences on the nomadic population. This particular area of the Tibetan-Qinghai plateau contains the watersheds of three of the most important rivers of Asia: the Yellow, the Yangtze and Mekong rivers. Official media report that as a response to the persistence of drought-flood phenomena of these rivers, PRC's Central Government has implemented major policy measures and allocated substantial funding. One of the crucial aspects of these environmental policies is the objective to resettle and sedentarize the nomadic population. Therefore, Tibetan nomads' life style, mobility patterns, production system, institutional arrangements and metabolic patterns are going through a dramatic change. In this research I apply the IAD, integrating Institutional Analysis, Political Ecology and Societal Metabolism bodies of scholarship, in order to investigate and explain this complex issue.

1 Introduction

Pastoral nomadism, as a mode of production and a form of life, is steadily disappearing all over the world on account of political, economic, demographic and historical processes that began at the end of the 19th century and were consolidated during the 20th century (Sandron 1998). The literature on nomadic communities in different areas of the world identifies a common and relevant influential factor: the rise of modern states and the extension of various forms of state control and governmentality have drastically transformed nomads existence (Goldstein and Beall 1991; Klute 1996; Lenhart and Casimir 2001; Miller 2000; Pirie 2005; Salih 1990). This phenomenon has been extensively investigated where Africa is concerned, while the Tibetan-Qinghai plateau, which is one of the areas that have one of the highest percentage of nomadic population12, has not receive similar scientific and research attention. The reasons for Tibetan pastoralist to be under-investigated

12 If calculated against the Tibetan population…(XXX)

can be mainly related to the fact that conducting social research in Chinese politically sensitive areas is forbidden.

Fig 8.1. Nomadic women during daily pastoral activity. Photo by the author.

Since 1959, when the Chinese government took military direct control over the Tibetan areas, the nomads have been subjected to different policies that aimed at governing their mode of production. However in 2003 that the Chinese Government started a new round of policies explicitly aimed at resettling and sedentarizing the nomadic Tibetan population (HRW 2007). These policies have been implemented in different Tibetan nomads populated regions, but in Qinghai they have been implemented with a particular persistence. Initially the resettlement policies have been presented as solutions for specific problems mainly related to overgrazing and rangeland degradation and only for small shares of the nomadic overall population. However in 2010 the Chinese Government stated that the resettlement of the entire Tibetan nomadic population is a policy priority.

This paper investigates the environmental governance of the rangelands in the Tibetan areas of

Qinghai, China. It examines the patterns of interaction between traditional and Chinese governance institutions within the Tibetan nomads social-ecological system with a particular attention to the recent phenomenon of resettlement and sedentarization policies. In this research Institutional Analysis, Political Ecology and Societal Metabolism bodies of scholarship are brought together to develop a comparative institutional analysis between a traditional nomadic village and a resettlement site. The different outcomes of the two systems are investigated and the following research questions addressed: i) how are the Tibetan rangelands governance institutions changing as a consequence of the central government policies? ii) what are the main discourses and narratives behind the resettlement policies? iii) What socioeconomic and metabolic differences between a traditional village and a resettlement can be highlighted? iv) is it possible to apply the evaluative criteria 'sustainability' to this complex issue?

Fig. 8.2. Resettlement site. Photo by the author.

2 Methodology and methods

The Institutional Analysis Development framework (IAD) has been extensively used for the study of CPRs and common-property regimes in the field of natural resource management (Oakerson 1992; Agrawal 1999; Ostrom et al. 1994; Ostrom 2000, 2005) but also for other complex interdisciplinary research tasks, for example the study of government incentives, the analysis of institutional impacts on monitoring and evaluation in development projects (Gordillo and Andersson, 2004) and institutional analysis of reforestation policies (Clement and Amezaga 2008). The IAD framework is used in such a large variety of empirical settings because it is helpful for identifying and rigorously analyzing the structure of a situation, in particular the influence of the rules, the essential characteristics of the actions and events taking place and the main actors, subjects, and communities involved (Ostrom, 2005).

Nevertheless, a recurrent critique of institutional analysis is that does not highlight the role of power and politics. To address this limitation, Clement (2010) proposes a modified "politicised" version of the IAD that takes into account the assessment of policy change and policy impacts, across multiple levels of governance (Clement 2010). Here in this case study a further modified version of Clement's IAD framework is used, which makes it possible to integrate analysis of multiple governance levels (IAD) and to include political aspects of the structuring (Clement, 2010) transmitted through discursive practices (Hajer and Versteeg 2005). Moreover in order to take into account the biophysical aspects of the case studied, drawing from the literature on Societal Metabolism (Giampietro 2004, Giampietro et al. 2009) the dimension "Metabolic patterns" was added to the framework.

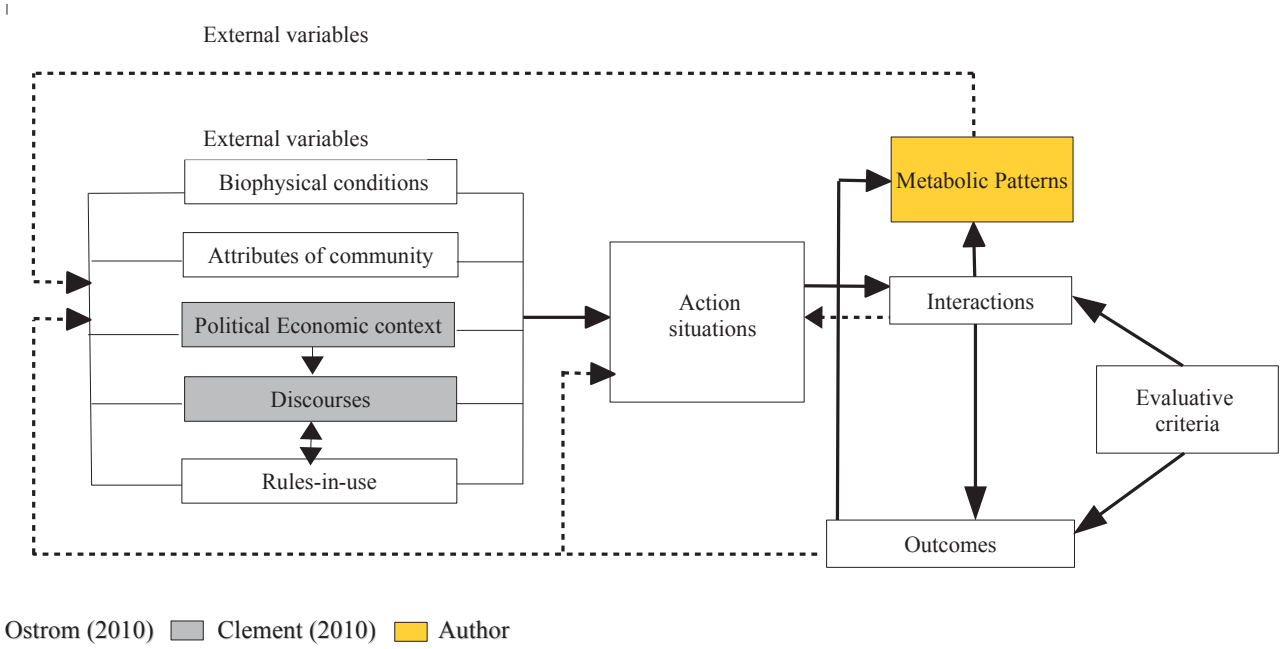


Fig 8.3. Integrated IAD framework

A case study approach has been adopted here, in particular because understanding the institutional arrangements of the local nomadic community requires study of rules that often are not written and difficult to conceptualize from within a non-nomadic logic (Beckmann and Padmanabhan, 2009). The fieldwork was conducted in two phases, first from June-July 2007 and then from September-October 2011. During the first phase 67 in-depth interviewed were conducted and 75 in the second. The first and the second field works were conducted following a similar research approach but with some important methodological and contextual differences. The provinces where data was gathered in 2007 and 2011 were different. During the first phase a wider variety of people were interviewed, in order to get a picture of the general aspects of the resettlement issue. Moreover in 2007 the

political tensions in the Tibetan areas were looser and it was possible to interview government officials while in 2011 this was not feasible. During, the second fieldwork in 2011 most of data collection was conducted in one specific 'traditional village' and in two resettlement sites (that will be kept anonymous). One of the characteristics of the traditional village studied is that the summer pastures are in common and the institutional arrangements for the management of the common land of the village are shaped by rules decided at the village level.

The case study incurred in some research limitations and constraints. The Chinese government does not authorize research in Tibetan areas on contemporary issues. Moreover the government considers the resettlement programs a very politically sensitive issue. The political sensitivity and high level of control makes it particularly difficult to gather information without putting your informants in a problematic situation. Exacerbation of political tensions following the 2008 Olympics and the self-immolations of Tibetan monks, which started in 2011, made the research conditions even more difficult. This constrained what methods could be used to gather information, as well at the time that could be spent in interviews and direct observation and the possibility of requesting and receiving information from certain actors, such as government officials. The selection of the interviewees, in this context, was a very important and delicate issue. For this reason, the initial plan of using questionnaires in the second field work was abandoned. The data gathering that was possible was via in-depth interviews. The interview guides used in the second fieldwork designed to capture three categories of information: 1. Resettlement and environmental policies; 2. Village level land tenure institutional arrangements; 3. Household metabolism.

Apart from the traditional systems of communication a commonly used mean of policy information dissemination in the Tibetan rural areas is posters. For this reason posters represent an interesting object to support study of how shared understanding is produced and how the transformation of this understanding is employed and exploit for policy making and implementation (Hajer 1997). All the policy posters that have been encountered during the two fieldworks missions have been photographed and their contents analyzed. This provided the possibility to understand the discourse that the government diffuses in the remote nomadic areas. Moreover it has been possible to understand the evolution of the discourses from 2007 and 2011 and look at this in relation to the evolution of the resettlement policies.

3 Modified IAD Analysis

3.1 Action arena

The focal level of analysis of this case study (i.e the action arena) is the 'governance' of the rangelands. The action arena is the conceptual unit that coincides with the main focus of analysis in the IAD. In a complex social-ecological system the action arena is the holon that the researcher can investigate in order to better understand and get insights on the functioning of the system. The holon *action arena* is made of two other holons, the *action situation* and *actors/participants* that interact (Ostrom 2005). In the original version of the IAD (Ostrom 1994) the action arena structure is affected by three clusters of exogenous variables the <biophysical conditions>, <the attributes of the community> and the <rules>.

However, considering the nature of the issue analyzed, three clusters have been added for the application of IAD to the current case study: the cluster <metabolic patterns>, following Giampietro et al., (2009) and following Clement's work (2010) the clusters <political-economic context> and <discourses>. Within an action situation, Ostrom et al (2005) recommend that one consider seven types of variables: 1. participants, 2. positions, 3. Actions, 4. potential outcomes, 5. information, 6. transformation functions, 7. payoffs (Ostrom et al. 2005). In this case study the actors/participants has been restricted to two categories the Tibetan nomads (the community) and the Government. This is a simplification that does not consider the diversity of actors (ie. village leaders, women, elders, young, Chinese officials, Tibetan officials, county, province, region, central government officials, NgOs experts, scientists etc) that is consistent with the selected level of the analysis, to compare how the consequences of the resettlement program are experienced by, respectively, Tibetan nomads and the Chinese government authorities. Fundamental aspects of the 'governance of rangelands' that have been considered in the case study are: a. who is allowed to harvest resource units, timing quantity, b. technology and location of harvesting, c. how harvesting activities are monitored, enforced and sanctioned, d. what are the conflict resolution mechanisms involved with appropriation activities, e. what is the role of the rules, f. what strategies are used by the participants (Mwangi and Ostrom 2009).

3.2 Political-economic context

The political-economic context is a fundamental element of the analysis. The political aspect in the Tibetan issues is so strong that affects the most basic daily life elements of the Tibetan people. The

research itself had to take into account strong political limitations. Also in this case the analysis of the political-economic variables had to be restricted to a subjective selection that included as main variables: i) historical events: (mainly the policies that followed the Chinese occupation in 1959); ii) China's recent economic growth; iii) global modernization forces (including ecological modernization, technological innovation). The People's Republic of China is going through an unprecedented change in terms of speed and scale. The rural areas of PRC are a fundamental target of the Government's economic strategy.

In particular the western areas, with the highest levels of ethnic minorities, rural activities, and lowest economic performance indicators are a fundamental target for the country's social and political stability. In particular the Tibetan question is perceived and represented as a threat to national security and cohesiveness and the economic development as a remedy. In 1999, Premier Jiang Zemin's slogan "Open Up the West through rebuilding a green west" announced one of the priorities of China's development strategy. The Central Committee of the Communist Party of China approved the "Open Up the West" campaign stating the intention to develop the economy and reduce the economic and infrastructural gaps between the rich East and the poor interior provinces. The central points of the development strategy, synthesized as (Holbig in Goodman 2004): embracing sustainable development, reducing regional monetary flow inequalities and foreign investment; implementing infrastructure development; tackling turbulent issues for minority nationalities.

3.3.Discourses

Fig 8.4 Resettlement posters. Photo by the author.

In this political-economic context, according to the Chinese government narrative the environmental protection of the grasslands and watershed and the socio economic development of the Tibetan nomads mode of production become the two sides of the same win-win coin. The resettlement policies have been implemented with the support and through the creation of clearly defined discourses on the importance of the Tibetan grasslands for the hydrological security of China, on the proposition that there is severe environmental degradation produced by nomadic activity, and on the argument that it is necessary to modernize the backwardness of the nomadic population. These discourses have been promoted by the official media, and with a diffuse use of propaganda posters in the rural and more remote areas. Discourses, intended as "a specific ensemble of ideas, concepts, and categorizations that are produced, reproduced, and transformed in a particular set of practices and through which meaning is given to physical and social realities" (Hajer, 1997:27) extend their presence in the nomadic areas through a large diffusion of posters. The posters address concepts that are always ascribable to policies at the provincial, regional or national level. The analysis of the

discourse of the posters observed in the first and the second field work revealed different narratives. In 2007 the central discourse was the restoration of grasslands and the protection of the watersheds, with a specific attention the Sanjiangyuan area protection. In 2011 instead, the education of the nomadic population was the core theme of the posters that were observed.

Table 8.1. **Posters Discourses**

	Percentage of posters	
Discourse content	**2007**	**2011**
Environmental Degradation	91%	5.8%
Poverty alleviation	5%	14.7%
Education	4%	73.5%
Population control	0	2.9%
Gender equality	0	5.8%

3.4 Rules in use

In order to identify the main features of the institutional arrangements involved with the nomadic mode of production in the study area, it has been useful to first analyse the variations happened from before 1985 till the present.

Table 8.2. Historical reconstruction of institutional arrangements in the case study area

Year	**Land use: (winter, autumn, summer pastures)**	**Livestock property**	**Seasonal moving**	**Rules**	**Housing & Transport**

Year	Land use: (winter, autumn, summer pastures)	Livestock property	Seasonal moving	Rules	Housing & Transport
Before 1958	Shared between people of the same tribes (township)	Family	Moving in 3 different rangelands on the 3 different seasons	Non written customary rules, Battles between different tribes, peacekeeping role of Lamas	Black tent all year Horses
1958-1962	Shared between people of the same township	Village	Moving in 3 different rangelands for the 3 different seasons	Chinese Military and officials-> Village leaders	Black tent all year Horses
1962-1964	Shared between people of the same township	Family	Moving in 3 different rangelands for the 3 different seasons	Chinese Military and officials-> Village leaders	Black tent all year Horses
1964-1980	Winter land was divided by groups. Summer and autumn land by townships	Group	Moving in 3 different rangelands for the 3 different seasons	Chinese Military and officials-> Village leaders and group leaders	Black tent all year but all together putting the tents in circle Horses
1980-1999	Winter land was divided by families Summer and autumn land by village	Family	Moving in 3 different rangelands for the 3 different seasons	Chinese officials	Black tent all year Horses

Year	Land use: (winter, autumn, summer pastures)	Livestock property	Seasonal moving	Rules	Housing & Transport
1999-2011	Winter, summer land divided by family with a 50 years use right RESETTLEMENT POLICIES	Family	winter and summer pasture no transhumance	Discussed in the text.	Houses And Motorcycles

Source: Author's elaboration of in-depth interviews

Following Ostrom's (2010) explanation of rules as exogenous variables directly affecting the elements of an action situation rules, these are understood in this analysis as the set of instructions that define and influence an action situation in a specific environment (Ostrom 2005). The analysis of the case study has been conducted (see Table 8.3) referring to the following categories of exogenous variables: boundary rules, position rules, scope rules, choice rules, aggregation rules, information rules and payoff rules (Ostrom 2010). The action situation under analysis is the one that relates to access and use of the grasslands. The problem with identifying working rules is that large part of the information is implicit and non-written and often not conceptualized by the actors. There are several decision making levels[13] in the analysis of this case, with two different levels that are more representative: the 'Government level' (that refers to rules and decisions taken at Central government, regional and county level) and the 'Village community level' which is the unit that most coincides with the traditional nomadic institutions. The boundary rules define the boundaries of the population that access the resource. In the studied case Tibetan nomads are accessing rangelands. There is an ethnic component here to the socioeconomic performance within the action situation. Chinese Han and Chinese Muslim are not present in the pastoral activity.

However, the new government policies seem to open the space for a different kind of exploitation of the rangelands by new actors, such as minerals extraction and logging companies. The position rules

[13] Central government, regional government, province, county, township, village, and household

are the ones that define the position that an actor has in a certain situation. In the case study, the position that the actors hold depend on the hierarchical level of the decisions taken. The Tibetan nomads arrive only at the village government level. Nomads (only men) participate in village assemblies. There is no representation of nomads in the higher levels of decision making that affect the land access rules. Scope rules represent the limits that the actors (appropriators) implicitly or explicitly respect when using the resource. From the information gathered for this case study, the nomads tend to respect the traditional village and inter-villages rules rather than the ones imposed by government policies. Choice rules include the rules that bring together technical knowledge with resource use.

Also in this case there is a strong divergence between traditional knowledge and government experts knowledge. The most important case is the indicators the nomads households, families or villages use when deciding how long to graze, as compared with the government decision to ban the land and restrict the numbers of animals. Information rules mainly define what kind of information can be revealed and what should be shared. In the case study it has been observed that the level of shared information within the village is very high. Tibetan nomads in the village don't have incentives to keep secret related to land tenure and grazing from each other. In the case of the information between government officials and nomads instead there is an incentive on both sides to keep secret information. This spans from the number of animals possessed, the monetary flow generated on side to a non-disclosure of the real reasons behind policies decisions. Payoff rules are related to the sanctioning systems of the previous rules. At the government level sanctions can vary from fines, to confiscation of animals to arrest. At the village levels instead, not respecting the rules is an issue discussed in the village assembly and resolved without the judicial intervention.

Table 8.3. Working rules in the traditional nomadic village and resettlement site

Working rules for rangeland use:	**'Traditional nomadic village' Tibetan rules**	**'Resettlement site' Chinese rules**
Boundary rules	▪ The only herders that can access the common land of the village are the nomads from the village	▪ The nomads in the resettlement cannot access the pastures ▪ No decisions are taken in the resettlement on the land

Working rules for rangeland use:	'Traditional nomadic village' Tibetan rules	'Resettlement site' Chinese rules
		management and access
Position rules	▪ All the male adults participate to the village assembly. ▪ Village committee composed by 5 people (2 village leaders, 2 members and village committee members and 1 accountant)	▪ There is no assembly where decisions for the whole resettlement are taken ▪ There are group leaders which are representative of the people from the different villages in the resettlement
Scope rules	▪ The village assembly decides when to use the common pastures and for how long ▪ There are no violations of the decision of the village assembly	▪ The nomads know that they can be fined if they access pastures ▪ If the nomads have the possibility they will herd illegally
Choice rules	▪ Rules defined for the techniques for the caterpillar fungus harvesting in the common village land. ▪ Traditional norms define pastoral activity techniques	▪ Government officials implement settled ranching programs
Aggregation rules	▪ All the decisions on the common pasture are first discussed in the assembly	▪ Decisions are imposed by the government
Information rules	▪ The level of shared information in the village is very high and the possibility to verify as well.	▪ Information is often kept secret on both sides. The government does not reveal exhaustive info on the programs.
Payoff rules	▪ Breaking of rules is first discussed in the village assembly and elders are called to decide.	▪ Government imposes sanctions like fines, confiscation and arrest but the possibility to monitor is reduced

3.5 Attributes of the Community

The definition of community can vary according to the context and the interpretation of the

researcher. In the case of CPRs it generally coincides with the group of appropriators/resource users. According to Ostrom (2005) the attributes of the community that influence the action arenas include: the composition and size of the considered community; the understanding and information that the members of the community share about the analyzed action situation, the distribution of resources and level of inequality between the members; the level of homogeneity in the preferences of the members of the community; the values, norms and behaviors accepted or rejected between its members. In the studied case it is possible to refer to 'community' when speaking of the overall category of Tibetan nomads because it has very homogenous characteristics. However, the most useful unit to analyze is the village, also if in some cases this can be just an administrative construction, for example households of the same family group can be part of different villages, households of the same village can live in different valleys or households from different villages can live in the same valley. But when it comes to decisions regarding the rules related to the rangelands the village level is where the action is. In Qinghai, according to 2004 statistics there were approximately 583.500 people living in pastoral areas (FAO 2005).

The large majority of people living in pastoral areas are Tibetan nomads, with 200 000 nomads counted and just in the Sanjiangyuan area. The size of a village can vary but usually as they are administratively designed the range is between 500 and 2'000 people. The interviews revealed that the level of information and awareness of the grassland governance issues is very high and often discussed between the family members, the groups and inside the village assemblies. The Tibetan nomads traditionally consider themselves 'poor', 'medium' or 'rich' according to the number animals owned by the household, while the size of the land owned is usually not an indicator of the families' wealth14. Inequality has been reduced with Chinese redistributive policies however levels of economic inequality have been observed in the fieldwork. According to the interviews a household with less than 10 Yak is considered 'poor', with more than 20 and less than 40 'medium' and with more than 40 'rich'. In the studied village the distribution of rich medium and poor was averagely around 1/3. The cultural homogeneity of the Tibetan nomads is very high.

Traditionally the Tibetan nomads are considered as very religious and all the interviewees answered that Buddhist practice and religious activity are a fundamental aspect of their life. The Buddhist beliefs were according to all the interviews the common ground for ethics and behavior.

14 However this changed with the recent boom of the harvesting of the caterpillar fungus

Interestingly, the elders complain that the young generations do not have the same faith that they used to have but when interviewed people younger than 30 years old they would still answer in almost all cases that Buddhist believes and karma15 influence their life. The most relevant aspect of the preferences related to the considered action situation was if nomads were looking forward to the resettlement policies or if they were happy with their nomadic life. Over 95 % of the interviewed people revealed that they did not want to move to the resettlement and preferred to live their life in the grasslands. The small percentage of people that declared that they were happy about the resettlement were elders that didn't have family members to take care of them, but also in this case they answered that they missed the life in the rangelands.

Finally a fundamental difference that emerged between the traditional village and the resettlement is the level of cooperation. In the traditional village every interviewed household declared that they could rely on cooperation with members of the same village for several group activities such as house building, black tent making, taking care of children and harvesting activities. Also the social trust in the village appeared very high and most of the members declared to know everyone in the village and "had their doors open" for people to come. On the contrary in the resettlement sites the level of cooperation changed. The resettlement are mixed with households coming from different villages. As a result cooperation in the resettlements is limited to the households from the same villages and there are very little social relationships between people from different villages. In the resettlement the level towards the other members appeared low and the interviewed people declared in most of the cases to be afraid of thieves and damage to their properties.

3.6 Biophysical Conditions

When applying the IAD framework to the understanding of a complex socio and ecological system there are a huge number of biophysical variables that could be taken into account in relation to the rules in use and the attributes of the community (Ostrom, 2005). For this reason the choice of these variables is subjective. The aspect of subtractability and excludability of the rangelands varies according to the institutional arrangements established during the different historical and political periods. However wit is possible to define that during the years, for several causes (i.e. demographic pressure, ecological disturbances, policy and institutional arrangements) the level of subtractability

15 explanation of Karma (xxxx)

and excludablity of the rangelands increased. The choice of the biophysical attributes considered in this analysis has been restricted to: i) land degradation; ii) population variation (of humans and livestock); iii) seasonal changes. Land degradation is the first biophysical element that needs to be considered in the analysis of the patterns of the nomadic mode of production. Government national policies, local authorities and interviewed nomads all give a central importance to land degradation.

PRC's central government states that grassland and pasture degradation of Qinghai-Tibetan plateau is the main threat to the health of the watersheds of the three most important rivers of the country: the Yellow, Yangtze and Mekong. Local government authorities and village decisions organs have been acting in relation to the issue of land degradation and most of the nomads interviewed (above 80%) during the field work have expressed concern for land degradation and soil erosion (problems with the skin of the land). However the scientific explanation for this phenomenon is not well documented. Government officially states that overgrazing and proliferation of *pikas16* are the fundamental causes. This statement is supported by very few data and debated by opposing positions in the scientific international literature. Population patterns are another very controversial variable in a country that implements restrictive population control measures and with a strong historical-political conflict.

In the case of human beings two radically different positions can be found both in scientific and general literature. Tibetans in the Diaspora, Tibet support groups and usually western observers and researchers report that Han Chinese and Muslim Chinese are surpassing the Tibetan population in Tibet through extensive and government-supported migration. It is possible to find the terms 'population' or 'demographic invasion' in relation to this issue (Fischer 2005a, 2008b). Moreover, Tibet support groups denounce that forced abortion and sterilization of Tibetan women has been implemented in more circumstances in public hospitals. On the other side the official position of the Chinese government is that Tibetans, being an 'ethnic minority', have fewer constraints on their reproductive possibilities. Tibetans as all other ethnic minorities in China, are allowed to have 2 children per family in urban areas and 3-4 children in rural areas, against non ethnic minorities (i.e Han Chinese) which have to respect the 'one child policy' . Animals demography regarding sheep and Yak stocks is not less controversial. The official statistics are recorded by the prefectures Animal Husbandry Bureaus, however there is no homogeneous statistical record of the number of

16 Explain what are pikas

animals per region per year. Furthermore, there are strong doubts regarding the data gathering methods and the validity of the accessible data because of the incentive of the herders to not declare the real number of their animals to government officials because of restrictions on the number of permitted animals and the fear of confiscation (Sneath 1999).

Seasonal patterns are another fundamental biophysical attribute for the nomadic activity. Traditionally the mobility of Tibetan nomads followed the four seasons transhumance mobility patterns. For each season a pasture with different altitude would have been appropriate (Norbu and Simmons 1997). This has been the mobility system till Chinese annexation. At the moment nomadic families mobility patterns have been strongly modified by government and local institutional arrangements but still the livestock cannot graze for 12 months the same area. Generally nomadic families now have a 'winter' and 'summer' pasture. In certain cases the winter and summer pasture corresponds to different altitudes and the rotation is also related to snow coverage while in other cases it is just a symbolic definition and the only purpose is land rotation. The climatic conditions are however a fundamental determinant of the pastoral mode of production. Although there is a diffuse narrative and an increasing scientific attention on climate change effects on the Qinghai-Tibetan Plateau (Harris 2010), evidence on the relationship between climatic patterns and nomadic activity is not present in the scientific literature.

3.7 Metabolic patterns

Analysing the social-ecological metabolism in a traditional village system and in a new resettlement system revealed important information for understanding the transformations produced by institutional arrangements change as a consequence of government resettlement policies. The analysis of social-ecological metabolism has its theoretical roots in the work of authors such as Liebig, Podolinski, Lotka, Prigogine and Georgescu-Roegen (Giampietro et al. 2000). It understands the relationship human-nature as constrained by entropic laws in a system that is complex and dissipative. This analysis focuses at the 'village level' which is the unit choose for the action arena study. Looking at some of the crucial aspects of societal metabolism in the two systems studied - the 'traditional village' and the 'resettlement site' - some patterns and trends can be identified for the following categories: time, land, energy, materials, nutrition, water, human activity, mobility and information (see **Chapter 7**).

In the resettlement system land access is heavily restricted, with bans that initially were established

for 10 years but that in many cases become permanent because of the impossibility of the households to return to the grasslands once they don't have their flock anymore, which is generally the case when households move to the resettlement. Nomads move from a pastoral mode of production and reproduction to a system where they do not have control on their resources and means of production. The way nomads use their time is drastically transformed in the resettlements and they move from a situation in which very little time is not employed in some pastoral activity (there is here a gender differentiation that is maintained in the resettlement), to a situation in which most of the time is spent without an activity.

Work in the resettlement becomes wage work with nomads employed for construction work but often unemployed. All the energy, material, water, and nutritional inputs become in the resettlement external, and the household moves from a self-subsistence economy to a market dependent one. The Government subsidizes the resettled families, which in all the interviews declared that do not receive enough money for eating and heating their houses. The nutritional aspect is according to the interviews particularly important as the resettled nomads constantly declare that the reduction of the meat in their consumption pattern is a big reason of concern. Mobility patterns are completely transformed, the issue of sedentarization, depends on the fact that the nomads stop moving their flock with seasonal transhumance. Information flows change as a consequence of the process of schooling that is extensively implemented with the compulsory education system. It is important to point here the critique to the education policies in Tibetan areas which prioritize Chinese over Tibetan language. The traditional ecological knowledge which is practiced in the pastoral system is not put in practice in the resettlement.

3.8 Patterns of interaction & (Policy) Outcomes

The Chinese government has influenced the governance of the Tibetan rangelands since 1958. However in the period starting from 1999 relevant structural changes in the rangeland SES governance system occurred. A fundamental policy decision has been in 1999 the redefinition of land use rights. The Chinese government, assigned to each nomadic household a 50 years land use right for winter and summer pastures. This policy decision taken at the PRC's Central Government level for all Tibetan nomadic areas, drastically changed the landscape of Tibetan rangelands. Two main phenomena have been produced, first the fencing of households pastures. Second, the construction of houses. This policy changed the mobility patterns of the nomads and incentives

sedentarization, but did not eradicate the nomads from the rangelands. In 2003, instead resettlement policies started to be introduced.

The main difference with the previous programs was that these policies were not only aimed at sedentarizing the nomadic population but also at relocating it and concentrating in resettlement sites, moving them away from the grasslands and reducing the numbers of animals. The resettlement policies from 2003 to 2009 were officially developed for the purpose of grassland protections and restoration and involved animals reduction and in most of the cases up to 10 years land use ban. In Qinghai the government launched the 'ecological migration program' in 2003, (HRW 2007) and rapidly resettled in concentrated settlements 28 000 thousand nomads from the core of the Sanjiangyuan area. The year after in 2004, the Government announced the intention to move another 43 600 people from the Sanjiangyuan area and create a 'no man's land' (*wurenqu)* for grassland protection. In 2010 then, the Government declared that the programmed plan for the Tibetan rangelands in Qinghai was to resettle and sedentarize the entire nomadic population (Xinhua 2010). The different resettlement programs in Qinghai such as the "*Ecological Resettlement"* and the "*Nomadic Settlement"* (interviews, Ptackova 2011) are a fundamental part of the environmental protection of the Sanjiangyuan area. The environmental protection has been described on various occasions as one of the backbones of the "*Open up the West"* agenda (Goodman 2004).

3.9 Evaluative Criteria

One criterion that is most used in the IAD literature for evaluating social-ecological governance systems and resource extractions pattern is sustainability. However, the term *sustainability* especially as an evaluative concept, is loaded with normative value and cannot be used in a neutral way accepted by the different social actors involved in the same action situation but interacting in non-equivalent realities. Questions such as "Sustainability of what?", "…for whom?", "…for how long?", "…at what cost?" (Munda 2004; B. Walker 2005) are answered differently depending on which perspective is given weight. Since there is no single perspective that can provide a universal answer to these questions, the main epistemological characteristic of sustainability is the impossibility of being defined in absolute terms (Giampietro 2004).

4 Essay's conclusive discussion

As stated in the introduction this paper addressed the following questions:

i) how are the Tibetan rangelands governance institutions changing as a consequence of central government policies?

ii) what are the main discourses and narratives behind the resettlement policies?

iii) What socioeconomic and metabolic differences between a traditional village and a resettlement can be highlighted?

iv) Can we define a set of relevant criteria for sustainability when dealing with this complex issue?

Through the application of a modified IAD, that integrated discourse and societal metabolism aspects, some answers were provided.

i) Regarding the first research question, the Tibetan rangeland ecological governance systems in the Tibetan-Qinghai plateau went through numerous structural changes induced by the Chinese government policies since 1959. The institutional arrangements of the rangeland governance changed accordingly to the different policies implemented in five different periods since 1958. In particular the period 1999-2011 produced changes in the institutional arrangements that had a direct and immediate repercussion on the nomadic existence. Soon after 1999, the majority of Tibetan nomads, encouraged and supported by the Chinese Government fenced the owned land and built houses in the winter pastures. As a consequence of fencing horses become a less ideal system of transport because of the impossibility to move through valleys and were rapidly substituted by motorcycles as the main mean of transportation. This shows how the institutional arrangements are tightly connected with the metabolic transformations of a social-ecological system. The main aspects of the transformation of institutional arrangements since 1958 can be summarized as:

1. The Chinese Government became the main legislative and political actor for the governance of the Tibetan-Qinghai rangelands social-ecological system.
2. The decisions of the Chinese Government regarding the nomadic activity, land access, and environmental protection have been taken at the central national level and implemented in a uniform top-bottom way.

3. The differences between the different policies (for example different resettlement programs and interventions) are not related to a different application of programs to different ecological contexts but to political priorities changes at the central government level.
4. The traditional Tibetan institutional arrangements are still effective and work in as a nested system where the villages are not resettled and have shared common land.
5. The institutional arrangements that govern the nomads-rangeland social-ecological system have been disrupted through the resettlement policies.

ii) Regarding the second research question, 'what are the main discourses and narratives behind the resettlement policies?, the poster discourse analysis revealed that while in 2007 the main narrative behind resettlement policies propaganda was related to environmental concern and ecological restoration programs in 2011 the focus shifted on education. The role of formal education in the Tibetan nomads culture is beyond the scope of this paper but it appears as a crucial factor in the transformation of nomadic life style and the transmission of traditional ecological knowledge to the future generations.

iii) Regarding the third research question The metabolic patterns and socio economic differences between resettlements and traditional villages have been previously described. It is important to highlight that moving from a traditional village to a resettlement affects all the main metabolic aspects of a nomadic household such as time, land, energy, materials, nutrition, water, human activity, mobility and information. For future research it would be interesting to scale up at a higher hierarchical level moving the level of analysis from the household level to the regional scale and in order to understand what are the outcomes of the resettlement policies on the overall rangeland system.

iv) Regarding the fourth research question, ‘we define a set of relevant criteria for sustainability when dealing with this complex issue?’It should be said that although the concept ‘sustainability’ has to deal with the impossibility to be defined in absolute terms there are some features that should be considered when comparing resettlements with traditional villages. The traditional nomadic

institutions have been the result of a long process of adaptation to the ecological context while. The nomadic mode of existence and production is tightly linked with the biological system (using Georgescu-Roegen terminology they depend on a fund-flow relation which identifies dependence of flow of resources used by humans from the ecological funds).

A proper perception of the relationship between the Tibetan nomad, his livestock, the seasons, the pastures requires considering a set of narratives much larger than the simple analysis of economic and productive activities, it requires entering the sphere of religion, beliefs and meaning of life. As in other nomadic contexts in Asia and Africa nomadism developed through a nested organization of different levels of rangeland governance (Mwangi and Ostrom 2009; Humphrey and Sneath 1999). In the Tibetan rangelands case the rules and norms that shape nomadic activity, land access, conflict resolution move across the family, groups, tribes and village levels. This implies that when there are ecological disturbances the Nomads respond and adapt with different and multi level solutions and the source of the problem is spatially and temporally closer to the people involved in the solution. The problem is that the environmental conditions now are drastically different compared with before. It has been largely debated in the scientific literature that the top down mono-centric panaceas are counterproductive. In the specific resettlement policies context, the main features can be summarized as: a. the fact that the government becomes the main actor and that establishes objectives that are not endorsed by the local population; b. that the central government does not acknowledge the role of traditional institutional arrangements and consider them backward17; c. that there is no scientific evidence on the fact that the desired outcomes of the policies are beneficial for the ecosystem.

Considering these three aspects it is clear that the central government institutional arrangements are delinked from the socio and ecological dimension that has evolved in an adaptive manner in the traditional nomadic institutions. However in order to have a thoroughly integrated representation of the system it would be necessary to extend the analysis to:

(1) The feasibility domain (the fund-flow relations that are compatible with the ecosystem – pressure of animals on resources);

(2) The viability domain (the size of the production factors and the productivity of production factors in relation to the regime of consumption);

17 on the concept of 'backwardness' in relation to Chinese Governemnt view of Tibetans see Fischer 2005b, 2008b; Yeh 2005.

(3) The desirability domain (whether a proposed metabolic pattern that is feasible and viable is also acceptable to the local people according to their cultural identity and present aspirations**.**

These three last point would be interesting for future research and would improve the integration of the IAD framework and the analysis of the resettlement case.

Application II.C Using "IAD" to study possible bias in the use of science for governance – the case of Geothermal power development on Mount Amiata

CHAPTER 9

SOME POLITICIANS ONLY DRINK BOTTLED WATER? A CASE STUDY ON THE POLICY-SCIENCE DYNAMICS OF THE AMIATA GEOTHERMAL POWER PLANTS DEVELOPMENT

Abstract:

This chapter investigates the policy-science dynamics related to the geothermal power production development on the Mount Amiata in southern Tuscany, Italy. The hypothesis is that the decision makers that have the regulatory authority on geothermal production are minimizing the risk and damages that geothermal power production can produce to the Mount Amiata water basin. The guiding research question of this paper is: "what are the problems with the decision making process related to geothermal production on the Mount Amiata with a specific attention to the case of power expansion of the "Bagnore 4 plant".

The Mount Amiata, classified as a compound lava dome, had its major eruptive episode 300 000 years ago. However the Amiata geothermal activity is currently used for the production of electric energy with 5 different geothermal power plants producing 594 GWh per year. At the same time the Mount Amiata contains an aquifer that has a fundamental socioecological importance, among several other ecological functions, it generates fresh drinkable water for 700 000 people.

The dominant scientific and policy position is that the geothermal energy production activity has minimal ecological impact. More specifically the thesis promoted by policy makers and several commissioned scientific studies is that geothermal energy production has zero impact on the watershed because the geothermal basin and the aquifer are not physically connected. However,

since the beginning of 2000, independent studies started to question the neutral impact of geothermal power production on the Amiata ecosystem. Two main concerns have been raised, first that the geothermal electric power production is depleting and contaminating the Amiata aquifer. Second that the emissions of the Geothermal power plants contaminates air water and soil and can be related with increasing cancer morbidity and mortality rates.

This chapter uses the IAD modified version as developed by Clement (2010). Semi-structured and in depth interviews have been conducted with different stakeholders, experts and decision makers in order to understand and describe the issue. The empirical analysis of the dynamics between scientific production and policy decisions of the "Bagnore 4" power plant authorization produces interesting information for understanding further the institutional dimension and limitations of complex adaptive systems management with particular attention to watersheds.

1 Introduction

"*I don't understand! It seems that the politicians don't drink the same water as we do. Maybe they don't care about the watershed because they only drink bottled water!"*
(Interviewed citizen in the Mont Amiata, 8 August 2011)

The Mount Amiata described by the great Italian Poet Eugenio Montale as *valleys of elves and mushrooms* (Montale 1951) is a place of rare beauty and great historical value. Santa Fiora, the town that holds one of the main concessions for geothermal exploitation in the area was mentioned in *La Divina Commedia* by Dante Alighieri (1321). The word Amiata comes from latin *Ad Meata,* which literally means "the way of the springs", name that was evidently given for his water resources which currently provide fresh drinkable water to over 700 thousand people in south Tuscany and North Lazio.

The Amiata, was and still is one of the poorest areas of central Italy, and has been theater of historical episodes of rebellion. Gramsci (1971) and Hobsbawm (1965) describe the socialistic utopian visionary mystical movement of Davide Lazzaretti (1834 – 1878) which predicated the

liberation of the Amiata peasants from a post feudal regime. Later, in the 20th century the Amiata became a fundamental cinnabar extracting site. The mining sector represented a strong economic boost for the area and a large number of peasants found employment. By 1927, over 3300 miners were employed extracting the 25% of the World's demand of mercury (CM Amiata 2009). The Amiata mines not only characterized the economic activity of the area but they also became the fertile ground for diffusion of communist ideals and political debate. The miners of Amiata together with the local population in Abbadia San Salvatore were protagonist of one of the fiercest rebellions that exploded all over Italy after the shooting of the Italian Communist Party leader Palmiro Togliatti on the 14th of July 1948, and that was calmed down only because of the intervention of their leaders (Hobsbawm 1965).

The first geothermal power plants on the Amiata have been built between 1958 and 1962 and till the 1980 the power plants built had a power ranging from 1 to 5 Mwp. This has been a period in which the mining sector started to enter in crisis and the population trend of the area started to show a marked reduction with - 26% of the people living in 2006 compared to 1950 (CM Amiata 2009). This phenomenon has had highest rates compared with the average rates associated with the “rural exodus” that happened in the second half of the 20th in Italy (CM Amiata 2009).

Moreover social exclusion studies on Tuscan Mountain areas that takes into account indicators related to health, education, socialization, employment, accessibility to social services, Mount Amiata scored as the worst in a list of 20 (IRPET 2007). In this context the geothermal electric energy production activity has been presented as a promising occupational alternative for the area (interview) and as an economic and development boosting factor. Although the numbers of local population employed in the geothermal power activity have been very limited in numbers due to the high level of automation of the power plants the local population has shown minor forms of opposition (mainly related to landscape issues) to the development of these infrastructures till the early years of 2000.

However in 2001 the 'Macchia Faggeta' company, a cooperative that manages parts of the Amiata forest, commissioned a scientific study on the effects of the emissions of the Geothermal power plants on the flora. The study conducted by EDRA (2001) stated that the Geothermal Power Plants

emitting large amounts of mercury, arsenic, sulfuric acid, boric acid, ammonia, methane had phytoxic effects through air, soil and water contamination. This study opened the doors to the hypothesis that the water contamination from the geothermal power plants was also related to a depletion in quantitative terms of the water resource. Simultaneously, increasing rates of cancer morbidity and mortality have been started to reported (grey literature). Three main issues became of public and political concern: 1. The magnitude of geothermal power plants contamination; 2. The relationship between geothermal energy production and the decrease in the the water levels of the Amiata Acquifer; 3. The relationship between geothermal power emissions and cancer mortality and morbidity rates.
At this stage local communities and civil society self-organized in environmental committees for the safeguard of the Amiata in order to address these issues.

Nevertheless in 2007, the Regione Toscana government signed a protocol with the interested local municipalities for the development of geothermal electric power production on the Amiata with a project of developing the geothermal power production from 60MWp to 200 electric MWp. This decision has been largely contested by the local environmental committees, other civil society organizations and few political representatives and a series of scientific studies commissioned in order to further investigate the issue.

The Environmental Impact office of The Regione Toscana government, which is the central authority that has the legal power to authorize the construction and functioning of the Geothermal power plants responded to the challenges raised by the scientific studies commissioned, by the local environmental committees, with a proliferation of new scientific studies which environmental activists denounce as biased and tailored for the purpose of geothermal power development. Furthermore environmental activists denounce that every technicians or officer working for the Regione Toscana that have raised doubts and concerns on the geothermal development has been moved to other areas of work and duties.

The Amiata case is scientifically interesting for several reasons, some of them are that: first the Amiata represents a valuable social-ecological system that provides, among other important ecological functions, drinkable fresh water to over 700 000 people. Second, scientific studies and

stakeholders denounce that the CPR water is deteriorated for the production of energy and that the geothermal production adverse effects on the local population. Third, the Tuscan Regional Government has a centralized legal authority on the governance of the CPR water as the decisions of the Environmental Impact Office are binding. Fourth, commissioned scientific production plays a central role in a decision making process characterized by a high level of uncertainty, irreversibility and risk. Fifth, the local population is only marginally involved and has no legal authority on the decision making about the geothermal development. Last, geothermal energy is commonly defined a renewable, clean, non polluting form of energy production while the Amiata case raises a certain degree of doubt on this definition.

This paper aims at describing the analysis of the policy-science interface of the governance dynamics of the Amiata complex social-ecological system. In this study, an integrated Institutional Analysis of the decision making–scientific production dynamics that have been determinant for the Environmental Evaluation Office's authorization of construction of the geothermal power plant Bagnore 4, is presented. The guiding research question is ““what are the problems with the decision making process related to geothermal production on the Mount Amiata with a specific attention to the case of power expansion of the “Bagnore 4 plant”.

2 Theoretical background and analytical framework

The analysis of a Social-Ecological System such as the Amiata case is a multidimensional and complex issue. The first thing to take into consideration is that looking at a case where ecosystem importance, institutional arrangements, conflicting interests, scientific uncertainty, and irreversibility interact, creates an heroic task in terms of analytical representation, assessment and evaluation. However, as policymakers implemented decisions that directly affect the governance of the Amiata natural resource system it is important to understand what is the rationality of the decision process.

Policy makers that have to address complex sustainability issues in industrialized countries, due to environmental legislation, usually perform these kind of assessments based on the indications of scientific studies. In the “best” cases policy makers implement decisions based on scientific studies that are conducted by experts (usually with a specific and considered relevant, disciplinary

backgrounds), independently and in the respect of deontological principles, neutrality and objectivity. In the "worst" cases instead the policy-science interface is biased by other factors such as vested interests or other expressions of power influences.

Nevertheless, through the case of the Mount Amiata, I will argue that both in the "best" and "worst" cases, the policy-science dynamic that usually characterize the decision-making in relation to complex sustainability issues has severe shortcomings.
Sustainability, as presented in the common definitions involves the social, the economical and the ecological dimensions (Robinson 2004). However information referring to these three dimensions, are incommensurable and differently from the oxymoronic definitions of sustainable development it is not possible to simultaneously maximize them.

The sustainability of Social-ecological Systems (SES) has to deal with the fact that when looking at the social and ecological process simultaneously, the scales of analysis are inevitably different and their relevant observable qualities are defined on multiple levels. As a consequence the relative representations are non reducible (Allen and Starr, 1982; Giampietro, 2003; Madrid et al, 2012). The problem is that when we deal with sustainability issues, when we deal with SES we deal with processes of self-organization of socioeconomic systems that are interfering with the processes of self-organization of ecosystems, therefore, by definition, we deal with complexity.

Complexity implies that there are multiple dimensions that are impossible to capture with a single perspective (Funtowicz et al. 1999). The multiple dimensions and identities of a complex system can be understood in terms of epistemological plurality (which means that there are different coexisting non equivalent perspectives), and ontological non equivalent characteristics of the observed system (Munda 2004). This means that complex issues such as the one addressed in SES governance have to deal as Munda (2004) would define with both technical and social incommensurability.

Technical incommensurability refers to the fact that description and the representation, in scientific terms, of a sustainability issue, implies bringing together data, numbers, indicators, analyses and assessments, based on a range of different analytical frameworks numerous often non-comparable,

units and dimension of measurement. It is not possible then to meaningfully reduce this heterogeneous array of information to a single data point (Giampietro 1994). Social Incommensurability instead refers to the fact that legitimate contrasting perspectives coexist at the same time.

Moreover in the analysis of governance of complex socio socio ecological systems other two features have to be considered, first the fact that the human component of SES governance which is both object and subject in the analysis and in the implementation of governance decisions, is characterized by reflexivity. Reflexivity implies self-consciousness and purpose (i.e. human systems are learning systems) which continuously can add new attributes to the system. Second, understanding complex systems as hierarchically constituted (Allen and Starr 1982) implies that the issue of scale has a fundamental importance in both the extent of the analysis, the identification of the relevant actors and the policy measures implemented (Giampietro 1994).

This paper applies a modified version of the Institutional Analysis Development Framework (Clement 2010) to structure the analysis of this case study. As described in the previous chapters the Institutional Analysis and Development (IAD) framework (Kiser and Ostrom 1982, Ostrom et al. 1994, Ostrom 2011) is based on a set of broad variables, themselves decomposable into sub-variables, whose organizing and analytical capacity has proved useful in describing and explaining complex phenomena of policy change. The IAD has been used as a diagnostic tool for the analysis of a wide range of issues where humans interact within norms and rules that influence their choices, behaviours and decisions (Hess and Ostrom 2007). Its typology of rules provides a sound basis for understanding the role of institutions across multiple decision-making levels.

However, some criticism about the IAD and the Theory of Common literature is that the role of power, the political context and social construction dynamics are treated secondarily (Clement 2010). Moreover, theories of individual choice commonly applied in the IAD have draw from rational choice theory and neoclassical economics (Ostrom 1999). The limitations of Neoclassical economics assumptions in institutional analysis and sustainability research have been pointed by several authors (e.g. van den Bergh et al. 2000, Vatn 2007, Gowdy et al. 2009) in terms of the reductionist understanding of human action. Furthermore neoclassical economics suffers severe

shortcomings in integrating the biophysical dimension in the analysis (Gowdy et al. 2009). The IAD takes into account the biophysical conditions but this is often limited to some very specific features such as the degree of subtractability and excludability of a specific resource in relation to the limited perspective of use and appropriation.

For this reasons I find that Clement's (2010) politicised version of the IAD, which integrates critical political ecology (Forsyth 2003) and Critical realism (Harrè 1972, Bhaskar 1975) epistemological assumptions, is a valuable contribution towards a an integrated institutional analysis.

3 Data Collections Methods

The data collected is the result of 29 in depth interviews and conducted with selected members between the different social actors, stakeholders and policy makers. Moreover 2 different focus groups have been conducted with people from the local towns. The interviewees where both selected after an analysis of grey literature in order to understand the main actors involved and through snowball sampling. The in depth interviews were conducted with a semi-structured questionnaire prepared for the different categories of interviewees. The in depth interviews were conducted in March, August and September 2011. The interviewed people expressed preference to not be audio recorded and in certain cases to maintain anonymity. Some important statements have been asked to be kept off the records. All of the interviews have been noted by pen and then transcribed. I have continued to consult some of the interviewees, in particular independent scientific researchers and activist up to now. Moreover I have been constantly participating to the email exchanges of a local stakeholder group that is organized against the expansion of the Geothermal power plant and participating to their meetings via Skype on a regular basis up to December 2012. Moreover an extensive review of grey literature and newspapers articles has been conducted.

4 Case Background

4.1 Geographical and Historical information

The Mount Amiata is located in Central Italy, precisely South-Eastern Tuscany (geographical coordinates). Has an altitude of X meters, and geologically it has been classified as a compound lava dome. The most important eruptive phenomenon has been identified as happened approximately

300 thousand years ago. A complete review of the historical events of Monte Amiata is not in the scope of this work. However there are two historical phases valuable to mention as background information. First the origin of the first settlements on the Mount as the result of malaria diffusion in the plane areas in the Grosseto's province . Second, and most important for the contemporary analysis, the mining and extractive activity of the 50s.

Migrations to the mountainous areas of the Amiata have been strictly dependent to the decadence of the fertile plane areas of the Maremma in Grosseto's province. The 'pianura Maremmana', fertile and well cultivated started its decadence with the expansion of Roman influence. This lead the area to become uncultivated, and infested by malaria. People started to move to the mountainous areas sooner but the first moments of civic and township development can be identified around the 1000 (A.D) with the rule of the Aldobrandeschi family. Other important factor that is present in the historical accounts of the development of the area is not only the absence of malaria but also the great presence of watersheds and springs. Healthy environmental conditions and abundant water availability are therefore often recognized as important determinants of the historical development of the Amiata.

Second historical fundamental moment, has been the development of the mining sector at the beginning of the 1900. Till that time the area had a distribution of medium small farms with share cropping arrangements and a subsistence agricultural economy that has been described as poverty stricken. The mining development represented a sort of small "industrial revolution" for the area and cinnabar extraction became the most important economic activity on the Amiata. In 1927 the mine employed more than 3300 people from the area and attracted workers also from other provinces. By 1927 the mines on the Amiata produced 25% of the world's demand of mercury, by 1965 the production rose to almost 33% of the global demand. The mines became the only economic opportunity of the area followed by strong social tensions. Difficult working conditions in the mining sector, phases of massive employment alternated with massive dismissals and the fact that profits produced by the activity were not re-invested in the area, determined the birth of a particularly strong trade union movement and rising of social tensions. Eventually the mining sector fell in a profound structural crisis that led to the complete shut down of the mines during the 70s and the whole area fell in a deep economic recession (Comunità Montana Amiata Val d'Orcia 2009).

Box 9.1 **Rebels and Mystics on the Amiata**

In the second chapter of the book a *A rugged Nation,* Armiero (2011) speaks about 'rebel mountains' of Italy. He provides some historical accounts, from the middle age till the XXth century, of rebellion and heresy in mountainous areas. Without providing a causal explanation of this phenomenon he observes this particular concentration of cases where spiritual and religious movements in isolated Mountainous areas represented a radical break from conventional religious or institutional power structures. One of the specific cases illustrated by Armiero is the story of David Lazzaretti, mystical, heretical and rebel 'saint' shot by the Italian Army on a religious procession in Arcidosso, on the 18th of August 1878. Together with Lazaretti between 10 and 30 members of his spiritual movement were killed as well. The reason for the fierce repression of this spiritual movement can be understood looking at the political transformations that Lazzaretti was promoting through his sermons and sect organization. Lazzaretti built his church on the Monte Labbro which is a small pyramid shaped mount at the slopes of Mount Amiata now protected as a National nature conservation park. Nevertheless it is exactly there that the Bagnore 4 Power plant will be expanded. The Monte Labbro was the center of Lazzaretti's socio-political and religious organization. Through the creation of the 'Society of Christian Families' (Bardelli 1977 in Armiero 2011) he promoted sharing of labor, profits and property and education and assistance to all the members. This according to Armiero, which refers to work of Hobsbawm (1965), was a reaction to the advancement of modernization and capitalism and a defense of the peasant traditional economies, of the use of commons and civic uses of the Mountain resources such as woodland, water and pastures. Moreover, Gramsci (1971) describes Lazzaretti's movement as one of the earlier socialistic utopian, although also 'visionary' organizations in Italy and the importance of their political struggle in the shift from a Post feudal regime to a modern capitalism.

After the assassination of Lazzaretti, the soul of the political struggle for the commons was kept alive and the Communist party was firmly rooted in the area (moreover many of the members of the Lazzaretti's movement joined the party). During WWII the Communist partisans of Amiata played a central role in the Anti-fascist and Anti-nazi resistance. The resistance spirit of the Mountain again manifested in 1948, when after the failed attempt of assassination of Palmiro Togliatti, the Italian Communist Party secretary, the Amiata become lieu of extremely violent revolts. Interestingly according to Armiero (2011), when Togliatti visited the Amiata, in 1949, in

a speech to the members of the Communist Party of Abbadia di San Salvatore he tightly linked the Lazzaretti movement and repression with the 1948 uprising[18]:

'In the first few decades after national unification, one man, considered a saint by the working classes, became the leader of their struggles; then, as now, the dominant classes thought they had suppressed the struggle for justice by killing him [Lazzaretti], (…). On 14 July history repeated itself. They thought once again they had broken our resistance forever (…) but you showed they had assumed wrong'

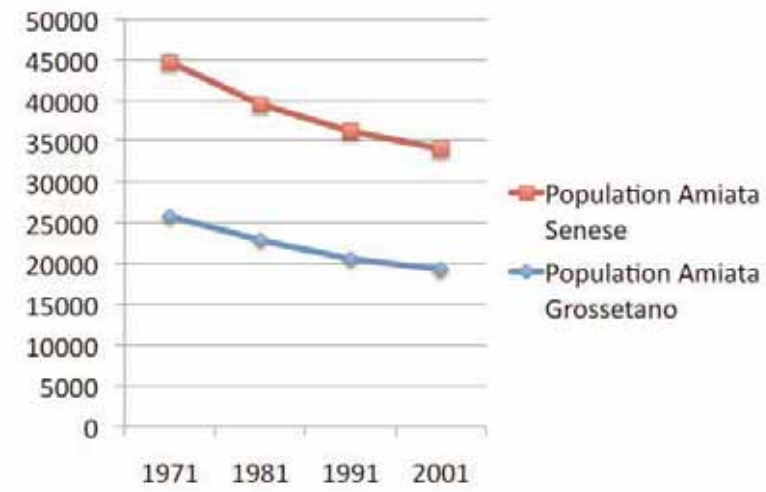
In the same place, specifically in the valley between the Monte Labbro and Monte Amiata, 33 years later, a second mystical/spiritual group started its community. In 1981, Chogyal Namkhai Norbu, a Tibetan Buddhist master and professor of Oriental studies at the Orientale Università di Napoli, bought together with his students and disciples around 100 hectares where they founded the Dzogchen community. The Dzogchen community started with a very small number of followers (less than 50) and an informal organization but attracted a growing number of people interested in Tibetan Buddhism and culture. At the slopes of the Amiata, looking the Monte Labbro, an increasing number of people from all over the world gathered periodically for Buddhist retreats, seminars and teachings. Now the Dzogchen Buddhist community counts over 6000 permanent members and centers all over the world. The Amiata center, called Merigar, registered in 2012 a number of 20'000 presences and is considered one of the main sources of Tourism revenue for the area. The new Geothermal power plant, Bagnore 4 will be built within less then one kilometer from the main temple of the Dzogchen community. The Dzogchen community has already been affected by the emissions of the plant and has asked the intervention of the Regional Government. They havedeclared that if further environmental emissions will affect the community the Tuscan site will relocate somewhere else because of the evident risk to the health of its members.

4.2 Socioeconomical characteristics of the area

The first explicative figure that can be presented is that the considered areas of Monte Amiata had a strong demographic reduction in the last 60 years. Averagely the area reduced its population by one third from 1950 to 2006 (CM Amiata Val d'Orcia 2009). Specifically the population in the area of the 'Comunità Montana Amiata Grossetano' decreased by 26% in the 1971-2001 time interval while

[18] Speech by Palmiro Togliatti at the Italian Communist Party new office inauguration of Abbadia San Salvatore on 26 June 1949 (Serafini 1981 in Armiero 2011, p. 62)

for the Comunità Montana Amiata Senese the decrease was of the order of 22% (Bazas et al. 2003).



Source: Data from Bazas et al. 2003

Figure 9.1. Amiata population trends

Although determining the causal relationship between demographic trends, transitions and socioeconomic factors is a complex and largely debated issue (Dyson 1995, 2001) it is here possible to highlight some of the major socioeconomic macro trends that can be related with demographic issues (CM Amiata Val d'Orcia 2009).

The fast decrease of the population of the Amiata areas started in the 50s. This phenomenon, which occurred all over rural areas in Italy with similar historical characteristics, has been defined as the Italian "rural exodus". However, in the Amiata areas this was even more evident with a 7% higher emigration rate compared to the average of other rural Tuscan areas. It is worth to note that in the period 1951-1971 the mountainous areas of the Amiata had a positive immigration rate in counter tendency with the general trend related to the employment produced by the mining sector. In the decade 1991-2001 the demographic situation has stabilized and a process of non-Italian immigration, not yet well censed but very easy to observe when visting the place, started after the 2000 (CM Amiata Val d'Orcia 2009).

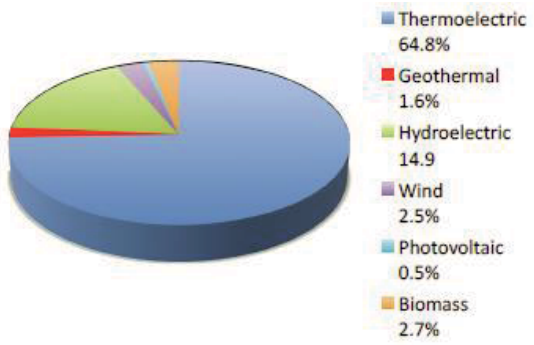
After the last mine closed in 1976, the economic pattern of the Amiata areas has not developed in a firm manner. A touristic-rural model has become the prevalent economic option. An average of 45 out of 100 workers for the 'Amiata Grossetano' area and 53 out of 100 out of 'Amiata Senese' are employed in the agricultural/rural sector and these areas contribute to the agricultural regional overall output by 1.5 and 2.5%, being above the average in comparison with the other mountainous areas. The main activities in the agricultural output in the Amiata are fodder cultivations, chestnuts plantations, sheep and goats herding. Timber, but also mushrooms, nuts represent a relevant economic factor. Moreover it is interesting to note that the Amiata Grossetano area is the third best for biological cultivation land extension (27%) among the 20 Tuscan mountainous areas (IRPET 2007).

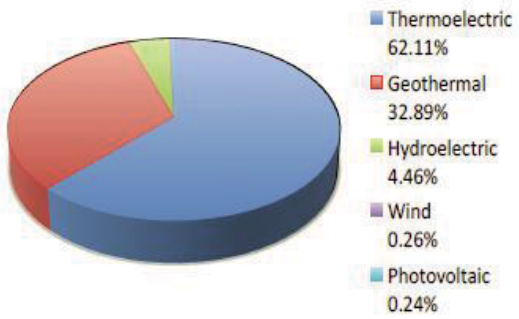
However the analysis of social exclusion reveal a worrying picture for the area. The Amiata area figures as the worse in the list of the mountainous areas in Tuscany. According to this study more then 80% of the population of the Amiata Grossetano and Amiata Senese areas suffer social exclusion in relation to Health, Education, Socialization, Employment, Accessibility to social services (IRPET 2007). The same report, conducting an analysis of the different characteristics of different synthetic indicators: demographic, economic, environmental and social services accessibility, places the Amiata Senese (Amiata Val d'Orcia in the table) and Amiata grossetano areas as the worst and the second worst out of all Tuscan mountainous areas.

4.3 Geothermal power development

In Italy there are 31 geothermal electric power plants with 711 MWp installed capacity (GSE 2009). Globally in 2010, geothermal electric power plants produced 5341.8 GWh accounting for 1.6% of the national gross electric production (Terna 2011). All the 31 Italian geothermal power plants are located in Tuscany where geothermal accounts for the 32.89% of the regional gross electricity generation (GSE 2009).

The Italian energy context





Source: Data from Terna 2011 statistics

Fig 9.2. Italy gross electricity genera tion by source in 2010.

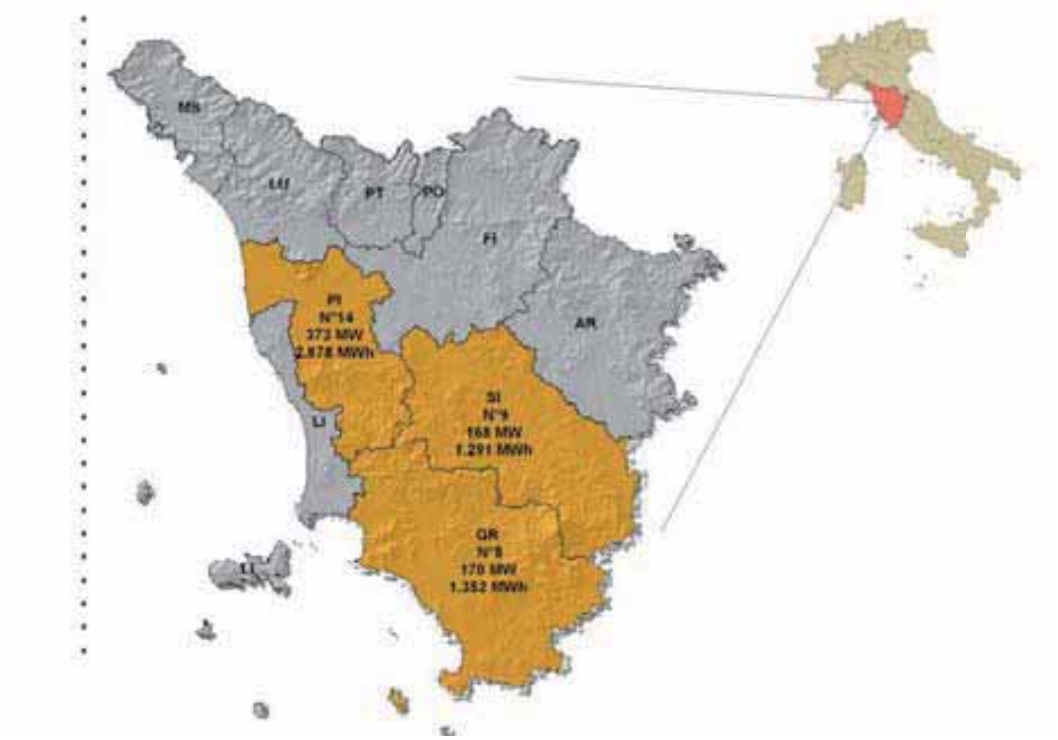
Figure 9.3. Tuscany gross electricity generation by source in 2009.

The distribution of the geothermal generation in Tuscany is the following: 52.5% of the generation in the province of Pisa, 23.6% in the province of Siena and 23.9% in the province of Grosseto (GSE 2009).

At the international level Italy in absolute terms, with 5341.8 GWh produced annually, is the third largest geothermal electric generator after U.S and Mexico, followed by New Zealand, Iceland and Japan (GSE 2009). The localization of the geothermal power plants, are mainly determined by geological and biophysical factors and availability of the geothermal resource within specific conditions.

Enel S.p.A, through its renewable energy branch, Enel Green Power, is the only economic actor that controls the overall Italian geothermal generation. Enel S.p.A is the first Italian energy provider and the second in Europe by market capitalization. Enel has been founded in 1962 as a state-owned enterprise with the primary objective of nationalizing and reorganizing the energy generation and distribution. Enel has represented the only monopoly in the energy sector till 1999, year of the energy market liberalization. From 1992 Enel become a Joint-stock company with 100% of its shares initially hold by the Italian Finance and Economy Ministry. Shares that decreased to the 31%

with the liberalization of the energy sector process started in 1999. However, also if with the liberalization of the energy market, new economic actors entered the energy generation business, Enel stays the only monopolistic actor in the geothermal sector. Moreover, Enel S.p.A operates geothermal power plants abroad. Enel's geothermal power plants oversea at the moment have a total power of 47 MWp that should reach 150 MWp in the United States and there are expansion projects for further 100 MWp in Chile.



Source: GSE 2009, p12

Fig 9.4. Geothermal generation in Tuscany

4.4 Geothermal generation in Italy and on Monte Amiata

The first case of geothermal energy use was registered in Italy during the 19th century. Francesco de Larderel, the owner of Lardarello Spa, a chemical-pharmaceutical company that extracted boron, was the first to use the geothermal heat of the area of Lardarello[2] in the industrial process. However the first experimental generation of electricity from the geothermal source was conducterd

in 1904 with Piero Ginori Conti as director of the Lardarello Spa. After the success of the initial experiments Ginori Conti developed the first geothermal electric generator in 1905 with a power of 20 kWp. From 1905 the geothermal electric generation in the area increased fast arriving to 132MWp in 1944.

As said previously, the concentration of the overall geothermal generation is in three different provinces in Tuscany. It is in the province of Pisa, where Lardarello is located, that the geothermal generation developed in the first half of the 20th century. Beyond the geographical information it is useful to keep in mind the historical classification between the "Traditional geothermal area" (with its main center in Larderello) and the "Amiata geothermal area". The Amiata geothermal area, which includes the power plants in the Piancastagnaio (Siena) and Santa Fiora (Grosseto) municipalities, has been developed more recently. The first geothermal plant on the Mount Amiata was built in 1958 at Bagnore and the second in 1962 at Piancastagnaio. The Amiata geothermal area compared with the traditional geothermal area has a modest installed power, 5 power plants in the Amiata area against 27 in the Traditional one. However the power plants in the Amiata geothermal area have a much stronger environmental impact per unit of electricity produced. Due to the chemical composition of the geothermal fluids of the area, the plants in the Amiata area have the highest polluting emission factors in comparison with the power plants of the traditional area (Regione Toscana Allegato A, Criteri Direttivi). A further difference between the two areas is that the geothermal power plants in the traditional area are vapor-dominated whereas the ones in the Amiata area are water- dominated.

4.5 The Mount Amiata geothermal development plan

Enel has a development plan for the expansion of the geothermal generation in the Amiata area. Synthetically the development plan proposed by Enel, that the Regione Toscana still did not integrally approve, targets the Piancastagnaio and Bagnore geothermal sites.

Fig. 6.2. Geothermal Power Plant Bagnore 3. Photo by the author

Regarding, Piancastagnaio, Enel proposes to shut down the oldest of the geothermal plants called PC 2 and at the same time maximize the power of other three plants PC 3, PC 4 and PC 5 with new wells. On the side of Bagnore instead the proposed plan is to triple the actual installed power expanding from 20 MWp of the current Bagnore 3 to 60 MWp with the construction of a new power plant of 40Mw (Bagnore 4). Therefore according to the expansion Enel project the overall geothermal power in the Amiata area aims at expandiong the geothermal power plants installed power from 60 MWp to 120 MWp.

Box 9.2 **Epidemiological Transition, Health and Environment**

Individuals and public health is complex issue influenced by endogenous and exogenous factors. An interesting research arena is the one that specifically focuses on the socioeconomic determinants of health (Rodgers 1979; Flegg 1982; Waldmann 1992; Wilkinson 1996; Kawachi

et al. 1999; Sapolsky 2003) A fundamental concept in this area of investigation is the one of 'Epidemiological Transition'. Richard Wilkinson in a milestone publication in the field of public health *Unhealthy societies, the affliction of Inequality* (1996) observes the historical pattern that relates economic growth and improvement of living standards to individuals' health improvement. Wilkinson affirms that primary cause for health standards improvements, morbidity and mortality decline, is living standards increase. The author highlights the relationship between increase in living standards such as nutritional improvements, water and sanitation, sewages and living conditions with economic growth. Nevertheless he identifies a threshold, defined as the moment where the epidemiological transition starts, where the causal relationship between health and economic growth is interrupted. Wilkinson (1996) and Kawachi et al. 1999 describe that the improvement in health indicators parallels per capita monetary flow increase up to the point where the primary needs are satisfied. They relate this threshold to an average per capita monetary flow that in 1991 corresponded to 5000 USD (at parity of purchasing power). Above this average monetary threshold, that corresponds with the start of the epidemiological transition further per capita monetary flow increases do not show any correlation with health indicators improvements. What is observed, is that overpassed this threshold, other socioeconomic determinants start to play a role. Wilkinson in his paper *Health Inequalities: Relative or Absolut Material Standards?* (in Kawachi et al. 1999) illustrates how the major socioeconomic factors that affect health indicators are relative and not absolute material standards. The case illustrated by McCord and Freman (1990) in Sen (1992) about the mortality rates comparison between Harlem and rural areas of Bangladesh wich have lower per capita monetary flows but lower inequality level and lower mortality rates is an example of the relative aspects of deprivation. Following this perspective monetary flow inequality becomes a primary determinant of health condition in the countries that have overpassed the epidemiological transition threshold. This thesis is supported by a large number of studies that have looked at correlations and causality nexuses between health and socioeconomic determinants in industrialized countries and that find as a common thread the increaser in monetary flow inequality or relative poverty and worsening of health indicators (Berkman,1995; Everson et als. 1997; Bosma et als.1997; Ferrie et als.1995; Kawachi et als 1999; Kennedy et al 1999; Marmot and Wikinson 1999; Sapolsky 2003). Regarding the clinical-health aspect of the epidemiological transition, a number of studies edited by Kawachi et al 1999, point that central trend is the shift from infective diseases as primary cause of morbidity and health related mortality rates (in the countries that didn't reach the epidemiological transition threshold) to cardiovascular and degenerative conditions as the main cause of health related mortality rates

(in the countries that overpassed the epidemiological transition threshold). Kawachi et al. 1999 review for causal explanations debated in the literature for the inequality as determinants of health related mortality and morbidity in the countries beyond the threshold of epidemiological transition. A first explanation refers to industrialized countries with high levels of monetary flow inequality. In this case economic inequality, as illustrated by Krugman (…) goes together with reduced public welfare and health services. Therefore in this case one of the main problems is access to health and welfare assistance. A second causal explanation is related to the link between poor health indicators and social cohesion. A third explanation focuses on the psycho-social determinants of health such as the causal link between inequality, relative poverty, and stress and the direct consequences of this on health (Sapolsky 2003). In both the second and third explanation that refer to the proximate social determinants of health, it is pointed out that the increasing tendency of high risk lifestyles that involve habits such as tobacco, alcohol consumption and unhealthy eating are major mortality and morbidity causes.
Interestingly as it will be pointed out in the analysis of the Sanitary issue on the Mount Amiata, this same kind of explanations are provided by the Sanitary Regional offices in charge of explaining with their epidemiological studies the excess in cancer morbidity and mortality rates in the Amiata geothermal. In particular, as it will be described later, the Regione Toscana episdemiological studies dismiss the causal link between the geothermal plants emissions and the cancer mortality and morbidity excess rates in the area, instead they point at the the particular lifestyles of the Amiata population as more plausible explanation for this public health critical anomaly.

The second scientific controversy is on the relation between geothermal generation activity and Mount Amiata's aquifer. This point has been first raised by the study of EDRA leaded by the Geologist Dr. Borgia, which indicated that the Mount Amiata water table is connected with the geothermal basin. For this reason the geothermal generation creates a depression that leads to a depletion and a contamination with heavy metals of the water table. A similar thesis is supported by the study of Manzella (2008). Dott. Borgia finds support of his scientific statements in the first geological study on the Monte Amiata conducted in 1970 by Calamai. Calamai (1970) which was a geologist working for Enel had the possibility of conducting the deepest drillings for the study of the Amiata system and his data indicated the connection between the water table and the geothermal basin. Differently, the study conducted by the Università degli Studi di Siena (2008) individuates a

reduction of the water table but it excludes that the causes can be found in the geothermal generation activity. They propose as explanation the reduction in rainfall, however they admit that this statement is only speculative as there are no historical series records that can support it. The uncertainty on this issue is further worsened by the absence of the hydrological balance of the aquifer.

5 IAD Integrated Analysis

5.1 Rules-in-use

On the 20 December 2007, the president of the Regione Tuscana (Tuscan Region), and the CEO of the ENEL SpA, and the whole list of mayors of the interested municipalities and presidents of the provinces and 'mountain communities' signed in front of the Economic Development Minister a general agreement on Geothermal power "*Protocollo d'Intesa, Accordo Generale sulla Geotermia*". This agreement laid the bases for the governance of the expansion of Geothermal power production on the Mount Amiata, determining the necessary scientific studies, quantifying the level of compensations and the dimension of the expansion in terms of MWp. This agreement has been ratified in the in October 2008 and then followed up by an implementation agreement signed on the 20th of April 2009 "*Accordo Volontario Attuattivo del Protocollo di Intesa del 20 Dicembre 2007 denominato Accordo Generale sulla Geotermia".*These agreements have to be understood in the general context of the Italian civil, environmental and penal law, and are particularly important because of the specifics of what they discipline and more closely relevant for the analysis of this specific case.

Box 9.3. Highlights of the General Protocol on Geothermal power

- A scientific study has to describe the dynamics of the geothermal fields.
- The *Università degli Studi di Siena* has to conduct an investigation within 4 months of time of the hypothetical risks of contamination of air and water produced by the geothermal energy production.
- The *Azienda Regionale della Sanità Toscana* (Health Tuscan Region department) has to conduct an epidemiological study of the Tuscan geothermal areas.
- The creation of a *"Tavolo Istituzionale della Geotermia"*, an institutional roundtable

formed by Representatives from the Region, Municipalities, Provinces the 'Mountain Comunities' of the geothermal area and the Cosvig (a public consortium for geothermal development)

Moreover it defined:

- The increase of 200 MWp of the Enel geothermal electric production in Tuscany by 2024
- The expiration of the mining concession for all the geothermal plants should be unified in 2024
- The amount of environmental and territorial compensations from ENEL to the interested Municipalities is 650 thousand euro per Municipality per MWp installed. For a total value of 120 millions euro for the period 2007-2024
- ENEL sponsors 250 millions to Regione Toscana, in the period 2008-2024, for renewable energies R&D programs.

5.2 Political-economic context

This analysis considered different hierarchical levels. In relation to the specific case, the local economical context has been investigated. Fundamental aspects are the high level of unemployment, ageing and deprivation of the Amiata areas which represent an exception in Tuscany which is one of the Italian regions with higher life standards. Monte Amiata had a strong demographic reduction in the last 60 years. Averagely the area reduced its population by 1/3 from 1950 to 2006 (CM Amiata Val d'Orcia 2009). The magnitude of this trend exceeds the average Italian figures related to the demographic and mobility transition from rural areas. Amiata economic activity has been characterized by the development of the mercury mining sector.

In 1927 the mines employed more than 3300 people from the area and attracted also workers from other provinces. By 1927 the mines on the Amiata produced 25% of the world's demand of mercury, by 1965 the production rose to almost 33% of the global demand. Difficult working conditions in the mining sector, phases of massive employment alternated with phases of massive dismissals, lack of re-investment in the area with the profits gained by the activity, were the reasons at the base of a strong trade unions movement and social tensions. Eventually the mining sector fell in a profound structural crisis that led to the complete shut down of the mines during the 70s and the whole area fell in a deep economic recession (CM Amiata Val d'Orcia 2009). After the 70s the Amiata pointed on handicrafts, small food industry and tourism. An average of 45 out of 100 workers for the

Amiata Grossetano area and 53 out of 100 out of Amiata Senese are employed agricultural/rural sector and this areas contribute to the agricultural regional overall output by 1.5 and 2.5%, being above the average in comparison with the other mountainous areas. However the analysis of social exclusion reveal a worrying picture for the area. Amiata area figure as the worse in the list of the mountainous areas in Tuscany. According to this study more then 80% of the population of the Amiata Grossetano and Amiata Senese areas suffer social exclusion in relation to Health, Education, Socialization, Employment, Accessibility to social services.

The same report, conducting an analysis of the different characteristics of different synthetic indicators: demographic, economic, environmental and access to social services places the Amiata Senese and Amiata grossetano areas as the worst and the second worst out of all Tuscan mountainous areas (IRPET 2007). Finally a study by Bertini and Iommi (2009) regarding the specific link between Geothermal Energy production showed that there is no causal connection between the activity related to Geothermal Energy production and socio economic performance neither positive nor negative.

In relation to the regional and national level it is also important to highlight the role of ENEL in the energy sector. In Italy there are 31 geothermal electric power plants with 711 MWp installed capacity (GSE 2009). Globally in 2010, geothermal electric power plants produced 5341.8 GWh accounting for 1.6% of the national gross electric production (Terna 2011). All the 31 Italian geothermal power plants are located in Tuscany where geothermal accounts for the 32.89% of the regional gross electricity generation (GSE 2009). On the international level Italy in absolute terms, with 5341.8 GWh produced annually, is the third largest geothermal electric generator after U.S and Mexico, followed by New Zealand, Iceland and Japan (GSE 2009).

The localization of the geothermal power plants in Italy and globally are mainly determined by geological and biophysical factors and availability of the geothermal resource within specific conditions. Enel S.p.A, through its renewable energy branch Enel Green Power, is the only economic actor that controls the overall Italian geothermal generation. Enel S.p.A is the first Italian energy provider and the second in Europe by market capitalization. Enel has been founded in 1962 as a state-owned enterprise with the primary objective of nationalizing and reorganizing the energy

generation and distribution. Enel has represented the only monopoly in the energy sector till 1999 year of the energy market liberalization. From 1992 Enel become a Joint-stock company with the 100% of its shares initially hold by the Italian Finance and Economy Ministry. Shares that decreased to the 31% with the liberalization of the energy sector process started in 1999. However, also if with the liberalization of the energy market new economic actors entered the energy generation business Enel is the only monopolistic actor in the geothermal sector. Moreover, Enel S.p.A operates geothermal power plants abroad, 47 MWp that should reach 150 MWp in the United States at the moment and expansion projects for 100 MWp in Chile.

5.3 Discourses

Following the insights of Foucault (1980), Hajer (1997), Ferguson (1994), Forsyth (2003), Escobar (2011) it is important to understand how linguistic constructions and discourses shape action and develop in coordinated interventions. In this study, it has been conducted a qualitative discourse analysis of the in depth interviews and the grey literature on the Amiata geothermal plan. Synthetically what emerges is the almost homogenous widely acknowledged importance of renewable energies in terms of positive economic, occupational and environmental impacts in particular in relation to climate change issue.

Specifically on the geothermal energy instead, the discourses are heterogeneous. Away from the Amiata, in the case of policy makers in Rome for example there is a general understanding of Geothermal power plants as renewable, “green”, “natural and therefore clean” and with a positive environmental effect in terms of climate change. In the Amiata area instead the discourses on the geothermal energy are radicalised in diametrical opposing extremes of good and bad. The environmentalist groups and some citizens describe the Geothermal power plants as a threat to the whole economy, as depleting the watershed and a polluting, unhealthy and cancerous.

5.4 Attributes of the community

In relation to this case there is an heterogenous 'community'. It here follows a table that describes the main social actors that have been identified.

Table 9.1. **Social actors**

Local and regional authorities	Regione Toscana	Comune di Santa Fiora	Comune di Arcidosso	Comune di Abbadia San Salvatore	Comunità Montana Amiata Senese	Comunità Montana Amiata Grossetano				
Private companies	ENEL									
Scientific/ Technical Organs	Università degli Studi di Siena	CEGL	ARPAT	CNR	EDRA	INGV				
Civil Society /Environmental Movements	Coordinamento Ambientalista Amiata	Gruppo nuova prospettiva	Comitato Val d'Orcia Crete Senesi	Coordinamento Comitati Ambientali Provincia di Grosseto	WWF Toscana	l'associazione Gruppo d'Intervento Giuridico o.n.l.u.s.	SOS GEOTERMIA	Merigar Comunità Buddista Internazionale	Comitato Abbadia S. Salvatore	Rete dei comitati di difesa territorio
Other categories	Hotel owners assoc.	Società Macchia Fageta								

It is possible to describe synthetically the social conflict because there are strong common characteristics between the stances of the different groups which are presented in the table. Although this paper focuses specifically on the 'Bagnore 4' power plant there are two main different geothermal power plant locations in the Amiata area, Piancastagnaio and Bagnore. On the side of Piancastagnaio there are two municipalities that are involved in the social conflict, Abbadia San Salvatore and Piancastagnaio. The interviews report that social opposition in Abbadia San Salvatore is stronger than in Piancastagnaio. Similary on the Bagnore side the main municipalities involved in the geothermal issue are Arcidosso and Santa Fiora.

Also in this second case there is a difference in the degree of opposition and Arcidosso has a much larger number of opponents than Santa Fiora. The reasons of the different levels of social opposition between one municipality and the other are vary. For example in the case of Arcidosso and Santafiora one factor that often emerged in the interviews is the fact that the direction of the winds blows the contaminants on Arcidosso rather than on Santafiora. Morever Santafiora receives more financial benefits and the has district heating from the geothermal plants. This is because the majority of mining royalties and compensation funds are for the county where the geothermal power plant is located: Santa Fiora. A very similar situation is the one that produces different with a stronger social opposition in Abbadia San Salvatore than in Piancastagnaio.

Box 9.4 Stances of the geothermal development 'opposers'

The positions and stances of different social actors opposing the further development of geothermal activity for the Piancastagnaio and Bagnore areas, can to a certain degree, be synthetically summarized and described in the following way:

- From an earlier request of complete shut down of the geothermal power plants the social oppositions now moved to the request of no further expansion of generation.
- The actual technologies are considered obsolete and not the best for reducing the environmental impact.
- The morbidity and mortality higher figures in the area that the study of the Regional Health Authority identified are suspected to be related to the geothermal activity.

- The emission monitoring is not considered timely with respect to the moment when local people detect higher emission events
- The scientific studies concluding that geothermal activity has not impact on the aquifer conservation and health condition are not considered valid. Specifically, the legitimacy of the University of Siena study is challenged by the presence of a member of the researcher team who was previously hired by Enel in a civil suit.
- The interpretation of the statistics of the Health impact study which was elaborated by the Regional Health Authority (RHA) is accused not to reflect the results emerging from the statistical analyses (this is because the statistical analysis was performed by a different organization named 'Fondazione Monasterio', while descriptive interpretation of the results was elaborated by the RHA)
- Possible impact of geothermal activity contaminates and depletes the aquifer of the Mount Amiata.
- Geothermal activity is considered not to have positive economic effects for the area nor with employment nor with economic indirect outcomes, instead it creates under development, threatens the touristic sector and is cause of migration.
- Geothermal power plants ruin the natural landscape of the area.
- In the following paragraph a synthetic table will present the different social actors involved.

5.5 Biophysical Conditions

The traditional biophysical institutional IAD analysis would look at the resource characteristics in terms of subtractability and excludibility (Ostrom 2005). In this terms the water and the geothermal resource have different characteristics. Water, following the 12 June 2012 national referendum, has been declared as a *"bene comune",* (common good), and water privatization theoretically banned. However this is not implemented and the management of water is usually based on mixed private-public companies. In the case of the Mount Amiata the water is managed by Acquedotto del Fiora Spa which has 60% of the shares possessed by Tuscan municipalities and the rest 40% by private

subjects (84,57% Acea Spa and 14,49% MPS). In the case of the geothermal resource, according to the R.D 1927, n 1443, all the mineral resources (including geothermal power) are State property and subject to mining concessions. However looking at the biophysical component in the only terms of type of goods and corresponding institutional arrangements of the interested resource limits the extent of the analysis.

5.6 Action Situation

In this analysis the main focus is on the policy-science interface of the geothermal program. Therefore I will exclusively focus on the scientific controversy issue.
Two main issues are object of a strong scientific debate that has inevitable consequences on the policy decisions that determine the geothermal energy production activity. First, is the debate if geothermal activity is producing anthropogenic environmental contamination that determines health negative consequences on the local population. Second, is if the geothermal activity has negative effects on Mount Amiata's aquifer.

The relationship between environmental pollution produced by the geothermal power plants and the health of the local population is debated and explained with contrasting statements:

A. If the presence of contaminants in the water and in the soil such as mercury, arsenic, antimony, sulphur, boron are produced (or referable to) from ENEL's geothermal power plants.

B. If the presence of these contaminants in soil and the water is harmful (causally linked) for the health of the local population and if the emissions of the power plants, mainly Hg, As, H2S, NH3, are harmful for the health of the local population.

In relation to question "A", ENEL's technical experts declare that it is entirely due to the geological nature of Monte Amiata. A similar position is the one asserted in the study conducted in 2008 by a team of researchers of the Università degli Studi di Siena leaded by Prof. Carlo Gaggi which individuates the causes of this phenomenon in geological reasons and in the past mining activity. Completely contrasting instead is the study of the Association EDRA leaded by the Geologist Andrea Borgia in 2006. EDRA's study individuates the causes of an augmented presence of the mentioned contaminants in the power plants activity. This problematic issue is strictly connected

with the first main problem of the relation between geothermal energy production and the state of the aquifer.

According to EDRA the increase in the high level of concentration of polluting elements in water is due to the reduction of the spring flow, which is in turn caused by geothermal activity. In relation to the question "B", the ARS Toscana (Regional Health Agency) commissioned an epidemiological study to the Fondazione Monasterio. In this study started in 2008 and published in 2010, 43.000 thousand people over 16 geothermal municipalities all over Tuscany were interested. The results of this study are well accepted by the different counterparts, what is strongly debated is the interpretations and the explanatory factors of the statistical correlations that the study individuates. For example, similarly to other previous studies, it is pointed out that there is a strong presence of mercury in the blood and urines of the local population on Mount Amiata.

Moreover the Fondazione Monasterio study shows how in the Amiata geothermal areas there is a 13% higher mortality rate for the male's population.However on what are the causes there is no agreement. According the ENEL experts and some experts of the ARS of Regione Toscana, for example explain this increase in mortality as the result of the past mining activity of the local population, of natural presence of the contaminant in the water and as result of specific habits and lifestyles. Environmental and civic groups instead denounce that this is the result of the power plants activity and that there is no statistical difference in terms of lifestyles with other areas in Tuscany where there is no geothermal activity.

The second scientific controversy is on the relation between geothermal generation activity and Mount Amiata's aquifer. This point has been first raised by the study of EDRA leaded by the Geologist Borgia, which indicated that the Mount Amiata water aquifer is connected with the geothermal basin. For this reason the geothermal generation creates a depression that leads to a depletion and a contamination with heavy metals of the water table. A similar thesis is supported by the study of Manzella. Moreover, Dott. Borgia finds support for his scientific statements in the first geological study on the Monte Amiata conducted in 1970 by Calamai. Calamai (1970) which was a geologist working for ENEL had the possibility of conducting the deepest drillings for the study of the Amiata system and his data indicated the connection between the water aquifer and the

geothermal basin.

Differently, the study conducted by the Università degli Studi di Siena (2008) individuates a reduction of the water table but it excludes that the causes can be found in the geothermal generation activity. They propose as explanation the reduction in rainfall, however they admit that this statement is only speculative as there are no historical series records that can support it. Further 2 studies have been commissioned by the Regione Toscana to the University of Florence, the study Macgeo on the modelling of the geothermal fields in Tuscany conducted by and the study Mobidic on the modelling of the hydrological system of Mount Amiata.

The discussion of these studies is beyond the scope of this paper, however there are two elements interesting to note. First both theses studies have expressed their conclusions invoking a high degree of scientific uncertainty. In particular the Mobidic study concludes saying that the there state of the art of the knowledge and quantitative observations does not allow to test in discriminatory way all the different hypothesis on the the relationship between superficial and deep aquifers. Second, it has been denounced by one of the member of the Technical Committee for the Geothermal energy on Mount Amiata that parts of these studies have been omitted and that Regione Tuscana did not make them available when they were requested creating an obstacle to public information.

5.7 Outcomes and Interactions

Following the specific policy-science action situation, I focus on two main outcomes that have resulted from the different interactions. As it has been described previously the main interactions that have been produced in order to proceed with the geothermal development expansion plan on the Mount Amiata have been between the Regione Toscana and different Tuscan Universities or research centers that have produced the technical scientific studied requested in order to advance with the geothermal expansion. Here an interesting problem is that during the in-depth interviews I have been been informed of many details but asked to keep them off the records about the interactions about Regione Toscana, ENEL and research centers or Universities.

Moreover it is clear that for certain reasons all of the technicians in Regione Toscana that have dealt with the Geothermal question on Mount Amiata and that have produced doubts on the

interpretations on the scientific studies, or on ENEL technical documentation have been removed from those specific duties to other tasks. Environmental activist clearly denounce that the science-policy interface has been biased and manipulated. One of the examples that Environmental groups publicly denounce is that one of the authors of Università degli Studi di Siena has often been hired by ENEL for technical consultancies.

What is important to highlight here is that there are two factors that emerge from the policy-science interface dynamics. First that all the studies (the three studies on the biophysical aspects from Siena and Florence Universities and the epidemiological study from Fondazione Monasterio) report scientific uncertainty, data limitations and necessity of further investigation but none of these studies recommends to respect the precautionary principle in terms of policy recommendations. It is not clear then why the pre-analytical assumptions of these studies, the hypothesis is that geothermal activity is not affecting the Amiata ecosystem (in terms of water depletion, contamination and health) and that this is accepted because there is not enough evidence to reject the null hypothesis instead of the other way round. However, also if scientific uncertainty and lack of information is stated in these scientific studies and the procedure is contested the Environmental Assessment office of the Regione Toscana has expressed favorable opinion on the expansion of the Bagnore 4 power plant which means that once some specific requirements will be accomplished ENEL has the right to proceed with the construction.

5.8 Evaluative Criteria

This complex policy-science situation has very strong conflicting perspectives. Defining 'adequacy of the science-policy process' as evaluative criteria, drawing from the interviewees it is possible to postulate three kinds of evaluations in relation to the Regione Toscana, ENEL and 'opposers' to the geothermal expansion. A simplified description of the 'official' evaluation of the Regione Toscana would be that the science-policy dynamics have been conducted in a positive way, that the Regione Toscana have commissioned well known Public Universities and research centers and that it has not been proved that the Geothermal development is affecting the Amiata ecosystem.

Moreover the process has been conducted in a transparent way and all the legislative requirements have been respected. The evaluation of ENEL would be somehow similar in the sense that they have

respected the Regione Toscana prescriptions and collaborated with their technical expertise in order to find the truth. The 'opposers' which include the different environmental groups, independent researchers, citizens, technical staff of the Regione Toscana in disagreement instead point at the fact that there have been several elements of bias and manipulation in the policy-science interface, that there is a high degree of scientific uncertainty, that the risks for the health and the importance of the watershed would imply the adoption of a precautionary principle. In the discussion it will emerge instead what is my evaluation of the policy-science dynamics of this case

6 Conclusive Discussion:

As I stated in the theoretical background, Policy makers that have to address complex sustainability issues in industrialized countries, due to environmental legislation, usually perform assessments based on the indications of scientific studies. While in the “best” cases policy makers implement decisions based on scientific studies that are conducted by unbiased and professional scientific experts, in the “worst” cases instead the policy-science interface is biased by other factors such as vested interests or other manifestations of influences of power. However, this case study aimed at showing that there is an epistemological problem in the way policy makers implement decisions in relation to the governance and sustainability of Social-ecological Systems both in the “best” and in the “worst” cases.

The reason why when the policy-science interface is biased and manipulated by power or second interests is straight forward and does not need explanation. In this case study the, level of controversy is such that in more occasions interviewees have denounced that this is the problem with Mount Amiata. However, my evaluation of this case is that there is an epistemological problem that precedes the issue of manipulation and power unbalance in SES governance and policy making. This epistemological problem has been well addressed by Funtowicz and Ravetz with their work on post-normal science. Funtowicz and Ravetz (1993; 1994a), recalling Latour’s (1993a), argue that sustainability problems have special social and epistemological characteristics, with high ‘decision stakes’ and high ‘system uncertainties,’ that make it unreasonable to expect the value neutrality and epistemological certainty that are typically associated with traditional, so-called (sic Kuhn, 1970) ‘normal’ science results.

For this reason, in the case of the Mount Amiata, which is an emblematic case of governance of complex SES, with technical and social incommensurability, high stakes, scientific uncertainty does not correspond well to the traditional environmental assessment and policy-making outcomes of Regione Toscana. Drawing from Munda's work on Social multi criteria evaluation (2004) the Amiata case should be reconsidered in the light of the possible improvements that the the policy-science interface could have in relation to :

1. an increase in public participation and extension of the peer community (Funtowicz et al. 1999, Kasemir et al. 2003)
2. transparency in the process
3. transparency in the pre-analytical assumptions
4. consideration that ethics matter and making explicit ethical tradeoffs
5. making explicit the hierarchical level of the policy problem
6. acknowledging the reasons of social conflict and contrasting perspectives
7. increasing the level of accountability

In conclusion the decisions of the expansion of the geothermal power production on Mount Amiata have been conducted without the necessary cautiousness that should be devoted to one of the most important watersheds of central Italy. The social conflict and scientific controversy that emerged should be understood by policy makers as a signal to reconsider autocratically the rationality and adequacy of the policy-science process that determined the policy outcomes related to the governance of the Amiata Social-ecological System.

[1] A mineral from which is produced mercury

[2] (the name of the area comes from the person Francesco de Larder

PART III – CONCLUSIONS

CHAPTER 10
CONCLUSIONS

In this dissertation, based on the study and elaboration of Institutional Analysis, Political Ecology and Societal Metabolism, I have modified and integrated the IAD framework. Starting from a critique that was introduced by Clement (2010), the gaps and connections between Institutional Analysis/Commons (in particular the Bloomington School) and Political Ecology were investigated. Moreover, following the work of Martinez-Alier (2003, 2009), The importance of understanding the metabolic aspects of environmental conflicts has emerged and as a consequence, the integration of Institutional Analysis, Political Ecology and Societal Metabolism discussed.

The integration of these three bodies of scholarship, apart from representing the basis for the theoretical discussion and background of this work, produced some direct methodological outcomes. Based on this theoretical elaboration and on the experience developed in the exploration/analysis of the case studies, I proposed a modification and re-elaboration of the IAD building blocks. The proposed analytical framework re-elaborated the IAD Framework by integrating the modifications of Clement (2010) and by adding the 'metabolic patterns' building block, which specifically draws on the work of Giampietro et al (2000, 2011) on societal metabolism. Therefore, the proposed modified version of the IAD Framework, is the result of both inductive and deductive processes that informed and has been informed by the case studies analysis in an iterative process.

The cases addressed in this dissertation have been tackled in an exploratory way. The specific problems addressed in this research are largely underinvestigated, and very few scholarly publications have studied them. In the case of Mount Amiata, some scholarly publications refer to the environmental or technical aspect of geothermal production, but no publications that specifically focus on the governance and decision-making aspects of the geothermal development plan are available. In the case of the resettlement programs in China's Tibetan areas, due to political constraints, there are very few publications, with little or no connection

to data gathered on the ground.

Therefore, an exploratory approach (Nagy et al. 2011) rather than testing preconceived hypotheses and determining 'truth', has been considered more compatible with the practical limitations in the field and the contextual characteristics of the addressed issues—high level of opposing interests, scientific uncertainty, and power bias. I also considered the exploratory approach to be coherent with the Post-normal science epistemological premises **(see Chapter 3)** on which this dissertation is based (high stakes, scientific uncertainty, conflicting values and perspectives).

The cases addressed in this dissertation deal with different issues in very different sociopolitical and ecological contexts. Although the intent of this dissertation, as has been stated since the beginning, was not a cross-national comparison, there are two reasons why it has been worth bringing these two cases together. First, it is interesting to relate the discussion and apply the same analytical and theoretical background to different cases (Hukkinen 1999). Second, there are some unifying characteristics that have emerged from the case studies that can contribute to the discussion on CPRs and conflict at the theoretical, methodological and empirical levels.

The work that has come together in this manuscript was originally scattered in different papers and essays. However, the emerging characteristics of the research activity, in iteration with the theoretical and methodological elaboration pushed towards the effort of tying together this work in an organic piece. For this reason the essays presented in Part II can stand alone but they lead to an organic methodological and theoretical discussion. In the next section of this chapter I emphasize both the specific outcomes of the different essays and review them individually; in the second section, the unifying characteristics are discussed; a methodological and theoretical final discussion on the integration of the IAD Framework proposed concludes this work.

1 Review of the chapters as stand-alone papers

In this section I synthetically review the central points of the stand-alone essays (Chapters 5, 6, 7, 8, 9).

Chapter 5 '*Discourse and practice in participatory conservation: exploring how it varies in different geopolitical settings'* This paper brought together a comparative analysis of the level of participation in NRM of CPRs in Kenya, USA, Zambia, the Tibetan Rangelands, and Italy. The cases of Kenya, USA, and Zambia were borrowed from the work of colleagues and co-authors of the paper, and they represented an interesting term of comparison for the Amiata and Sanjiangyuan cases that are addressed in this dissertation. In this paper, Clement's (2010) version of the IAD Framework is applied in order to add 'discourses' and 'political-economic context' to the traditional IAD. The integrated IAD showed how in different sociopolitical contexts the levels of participation vary and the importance of 'discourses' to identify the typology of participation as defined by Hobley (1996).

Chapter 6. *The sedentarization of Tibetan nomads: conservation or coercion*
This chapter introduced and presented an overview of the Sanjiangyuan environmental policies and the issue of Tibetan nomads' resettlement. The IAD Framework was not formally applied in the chapter, but analytical categories preparatory to the analysis were introduced. The main outcome points of the chapter were the introduction of the general development policy context in which the Sanjiangyuan resettlement programmes have been promulgated and an introductory description of the consequences of the application of these programmes in relation to sociocultural, economic, and metabolic dimensions.

Chapter 7 '*Neoliberism and metabolic patterns in the Tibetan rangelands: the resettlement transformation'* This chapter addressed the resettlement and sedentarization policies in the Sanjiangyuan area. Here there is little focus on the institutional factors, the elaboration was specifically on the relation between metabolic patterns (land-use change, human activity, herd sizes), the funds and the flows, and the political change. In this chapter, the political transformation was interpreted following Harvey's definition of neoliberalism with Chinese

characteristics. The major finding that is interesting to highlight is the crossroads at which the Tibetan nomads find themselves—between the decision of preserving their metabolic patterns or preserving their family and institutional structures. This paper investigated the dynamics of the resettlement of a traditional village and described the relationships between the 'funds' land and herd size and the 'flow' monetary flow for the different economic activities of the Tibetan nomads. It also discussed the transition towards off-farm non-traditional economic activities.

Chapter 8 '*A great transformation: resettlement policies, institutions and metabolic patterns in the Tibetan rangelands'* This chapter illustrated the analysis of resettlement and sedentarization policies in the Sanjiangyuan area adopting the final, modified version of the proposed IAD Framework with the integration of Institutional Analysis, Political Ecology, and Societal Metabolism. The paper addressed and discussed the following questions: (i) How are the Tibetan rangelands governance institutions changing as a consequence of central government policies? (ii) What are the main discourses and narratives behind the resettlement policies? (iìi) What socioeconomic and metabolic differences between a traditional village and a resettlement can be highlighted? and (iv) Is it possible to apply the evaluative criteria 'sustainability' to this complex issue?

Chapter 9 '*Some politicians only drink bottled water? A case study on the policy-science dynamics of the Amiata geothermal power plants development*' This chapter looked at the policy-science interface of the geothermal power plants' expansion program on Mount Amiata. It presented an exploration of a complex process of policy/politics deliberation. The results of this qualitative study pointed towards a critical discussion and the necessity of re-thinking the authorization procedures of industrial plants under *post-normal science* conditions. This essay argued that the geothermal plants development program and authorization process have all the characteristics of a complex SES governance with technical and social incommensurability, high stakes, and scientific uncertainty. For this reason, the traditional environmental assessment and policy-making outcomes of Regione Toscana appear as procedurally flawed and should be reconsidered.

Along this high level of methodological, theoretical, and empirical heterogeneity the different stand-alone papers/chapters highlighted specific research outcomes. Nevertheless, with the objective to produce an organic dissertation composed of heterogeneous parts, I identified some unifying features that lay the basis for an elaboration and discussion on the interface between the role of institutions, dynamics of power, and the constraints implied by the feasibility, viability, and desirability of metabolic patterns.

2 Unifying and emerging characteristics

The heterogeneity of the research contexts reflects positively on the elaboration of the analytical framework that has evolved during the progress of the investigation and that draws from different complementary bodies of literature.

The two case studies produced independent context/case-specific findings; however, bringing them together using the same analytical approach inspired the emergence of a general discussion based on a number of unifying problems in the case of CPR governance and conflict: First, *ecological complexity* and *scientific uncertainty*. Second, *political bi*as. Third, *imbalances in power*. Fourth, *science instrumentalisation* and *institutional manipulation*.

These five problems represent complex and complicated aspects of SES investigation. Dealing with these aspects not only means entering into a field of inquiry where 'normal' scientific protocols do not easily hold. Objectivity, neutrality, quantification and possibility of replication become unfeasible if not epistemologically flawed objectives. However, as argued in Chapter 3, sustainability research almost by definition overcomes the 'normal science' conditions. Moreover, natural CPR governance has to deal with the issue of conflict. Although institutional analysis, in particular the Bloomington School, does not explicitly acknowledge conflict as a fundamental dimension of CPRs, Political Ecology suggests how natural CPR governance cannot be disentangled from conflict (Forsyth 2005).

Conflicts can have different levels of intensity and involve very different actors. For example, they can range from armed violent conflicts between different nomadic tribes in

Tibetan rangelands, as used to happen frequently before 1999, or the western Africa violent conflicts in the Mano River basin area (Sawyer 2004), or the case of the Kilosa killings in Tanzania (Benjaminsen et al. 2009) to cases where there is no physical violence or the conflict is not directly made explicit because of a power asymmetry, like in the case of the Tibetan nomads' sedentarization policies or because of information manipulation as appears to be in the Amiata case.

However, to look at conflicts and CPR governance and exploitation through a politicized institutional analysis perspective (as in Clement 2010) the biophysical component does not receive enough attention. For this reason, the dimension of Societal Metabolism was added. Martinez-Alier (2009), for example, identifies the three-tier relation between the increasing social metabolism of human economies, ecological distribution conflicts, and the different languages of evaluation of the population groups involved in such conflicts as the common ground for human-nature contemporary disciplines such as political ecology, ecological economics, and sustainability science. This dissertation makes explicit the link between the institutional, political, and biophysical dimensions as a triadic base for an integrated analytical approach to CPRs and conflicts.

In both cases, human decisions have to face *social-ecological systems complexity*. In the Sanjiangyuan case, the central problem is that the hydrological stability of the Yellow, Yangtze, and Mekong rivers is considered as threatened by the Tibetan pastoralist mode of production. The main assertion is that Tibetan pastoralists naturally tend to increase their herds and overgraze, that overgrazing produces land degradation, and that the watersheds' instability is mainly caused by land degradation. In the Amiata case, the scientific narrative that is adopted is simply that geothermal energy production does not affect the watershed because the geothermal basin and water basin are disconnected. In both cases, complexity key words such as dynamics, tight couplings, feedback, non-linearities, history dependence, and self-organization are relevant.

Therefore, a clear unifying characteristic of the two cases is the presence of *scientific uncertainty*. In the Tibetan case, there is ground to question the 'scientific evidence' invoked

by the Chinese government. The studies that have been produced by the Chinese Academy of Science about the causal correlation between watershed degradation and pastoral activities are largely debated. In the Tuscan case, the physical measurement of the Amiata geomorphology is limited and the reconstruction of the geothermal and water basins and their interconnections is mainly based on models. The results of these models are strongly debated and subject to the accusation of scientific manipulation by the local stakeholders and population.

When policy decisions are taken within conditions of scientific uncertainty, the risk that *political bias* becomes a major driver is high. This is a theme largely debated in the development of the post-normal science, political ecology, and sociology of scientific knowledge arenas (Foucault 1980, Hajer 1997, Jasanoff 1996) discussed in Chapters 3 and 4. The presupposed separation between science and politics, which is a strong corollary of the positivistic belief that science can be objective and neutral (Forsyth 2003) is particularly difficult to defend in the Amiata and Sanjiangyuan cases. Chapter 9 addresses the scientific dynamic that preceded the authorization of the ENEL Bagnore 4 geothermal power plant on Mount Amiata and the large scientific controversy that has followed. Chapter 8, instead, highlights the absence of a scientific consensus on the drivers of environmental degradation in the Sanjiangyuan area and the "green discourses" on which resettlement policies have been justified. In both cases, what Jasanoff (1996) would describe as co-production of scientific knowledge and social order leans towards a particular direction that is defined by power.

Imbalance of power is present in both cases, a fundamental key issue that is difficult to address. In the Tibetan case, describing power opens a historical debate on the Sino-Tibetan historical dynamics that is beyond the scope of this dissertation. Nevertheless, also by focusing only on the Tibetan nomadic population, issues of power are recurrent and evident when looking at top-down policies that drastically reshape the lives of individuals without their participation in the deliberative process (Chapter 6). Power is more subtle in the Tuscan case, where democratic actors and organizations are in place and the official legislative and decision-making process is formally well balanced with stated inclusion of the different

stakeholders' perspectives and transparent and accountable deliberations. However, as illustrated, power issues emerge at the different levels of the decision-making process from the operational level to the constitutional level. In both cases, power emerges through the analysis of discourses. As observed in Chapter 6, discourses in different geopolitical contexts explain the different levels of participation in natural resource management and hold an important role in legitimizing or delegitimizing institutional change (Hajer 1997).

Moreover, both cases point at an *instrumental use of science through institutional manipulation.* Both in the Tibetan nomads' resettlement policies and in the Amiata case, scientific production is invoked to justify the policies and decisions. In the case of the Tibetan nomads' resettlement and sedentarization, policy makers and media consistently refer to the scientific rationale behind the program implementation. However, Chapter 8 describes how the ecological scientific rationale diffused by media and Chinese propaganda has changed in time and the main discourses used to justify the sedentarization programs evolved from scientific ecological concerns to development and education. This chapter highlighted how the scientific rationale can be used in an instrumental way. In the Amiata case, instead, it is not only an issue of invoking a scientific rationale, but is also about the role that scientific production formally covers in the environmental authorization process. As illustrated in Chapter 9, the scientific controversy is such that the local environmental committees denounced that the scientific studies had been tailored in order to provide the justification for the geothermal power plants to be built. Interviews with "white collars" in offices closely related to the authorization process similarly insinuate these doubts. This leads to a process of institutional manipulation. In both cases, the institutions (i.e. rules, norms, and strategies; Crawford 1995) that apply to the governance of the CPR "water" are transformed by external actors with defined objectives.

3 Conclusive final discussion on the integration of the IAD Framework

The first common aspect in the three bodies of scholarship integrated in this dissertation, institutional analysis/commons theory – political ecology – societal metabolism, is that 'case studies' represent a fundamental component for both theory development and empirical

knowledge. In the institutional analysis area there has been a debate between the values of an inductive approach vs. a deductive approach.

This is one of the elements that differentiate classical and new institutional economic epistemologies (Vatn 2005). A fundamental critique of the 'old,' classical institutionalist is that the deductive approach prevalent in classical institutional economics research leads to anecdotal work that is not generalizable nor contributes to theory development (Coase 1984). In the common-property field, authors such as Ostrom (1990) have used both inductive and deductive approaches but case studies have played fundamental roles for both specific and context-related knowledge.

In Political Ecology, the prevalent approach is deductive, and case studies represent a fundamental source of information. The methodology used in Societal Metabolism, instead, depends on the level of the scale of analysis. Because it is a multiscale approach (Giampietro et al 2000), it often uses at the same time case studies with locally gathered information and national or international large-N datasets and statistics. Therefore, as case studies reveal an important method for the three theoretical fields of reference, there is compatibility in adopting the modified IAD Framework to the case studies approach.

The second element of methodological compatibility is the issue of integrating multiscalar information. In this case, the methodological compatibility is particularly strong between Institutional Analysis and Societal Metabolism. In the case of Institutional Analysis, for example, several authors refer to the importance of looking at the rules, norms, and strategies at different levels. Looking at and integrating the information from operational rules, collective-choice rules, and constitutional rules, for example, is a central feature of the Bloomington School of institutional analysis (PSJ Special Issue 2011). Operational, collective-choice, and constitutional rules can correspond in a direct way to the individual, community, and national levels of agency (Clement 2010).

This is something that is extremely important in Societal Metabolism. In particular, in the work developed by Giampietro and colleagues on MuSIASEM, the multiscale component is

a sine qua non element of social and ecological metabolism assessments. In MuSIASEM for rural systems analysis, for example, the scales that are integrated and included in the analysis go from the individual to the national level, including dimensions such as household, community, and regional levels. Moreover, the work done by Clement (2010) emphasizes how Political Ecology can be integrated with multiscale IAD analysis by looking at discourses at the different levels of governance and rules.

The multiscale feature, therefore, is a compatible characteristic of the IAD Framework re-elaboration and the integration of the three theory fields included in this dissertation and the different papers connected to it. In both the Sanjiangyuan and Amiata cases, I look at different institutional arrangements on a plurality of levels and integrate information from the individual to national level.

The third compatible methodological aspect is the inclusion of multiple perspectives in the analysis. This is something that is not explicitly acknowledged in the three theoretical fields brought together but emerges as a compatible methodological approach. In Institutional Analysis/commons theory, strong attention is devoted to how formal and informal institutions at the local level shape management of CPRs and the importance of local and traditional knowledge for social-ecological dynamics. In Political Ecology, attention to the voices of the poor and the struggles of the excluded and oppressed is central. In Societal Metabolism, in particular in the work of Giampietro and colleagues, the integration of multiple perspectives starts from the pre-analytical phase, indicators are built in relation to the definitions of a specific population group, often with participatory methods, and it is made explicit that evaluation and assessment are always conducted according to a defining perspective in a semantically open way. In the case studies investigated in this dissertation, the perspectives and normative aspects of my interpretation and/or description are made explicit.

The fourth element of methodological compatibility is Interdisciplinarity. This methodological approach is directly embedded in the theory of the Institutional Analysis/Commons theory, Societal metabolism, and Political Ecology. Particularly in sustainability studies, there is an important debate on multi-, inter-, and transdisciplinarity

and how to approach research projects that incorporate these elements (Munda 2005). This dissertation draws from multi- and interdisciplinary literature and methods from different backgrounds are applied.

The fifth element is the explicit integration of biophysical and social dimensions. This is a particularly relevant trend in sustainability studies that relates to the necessity of addressing complex multidimensional systems with non-multidimensional approaches. In particular, sustainability studies and SES research have made an effort to integrate at least the "social" and "nature" dimensions. Institutional Analysis/commons theory have long devoted little attention to the biophysical characteristics of CPR analyses. In IAD studies, for example, the only biophysical characteristics that are included are the resource-use characteristics of rivalry and subtractability, which comprise information that can be considered useful only from a reductionist neoclassical economics theory point of view.

However, the IAD evolution and interest from scholars from hard and natural sciences disciplines led to the development of the SES Framework (Ostrom 2007; McGinnins and Ostrom 2012), which is more inclusive of the nature/biophysical dimension. In the case of Political Ecology, it has been debated that there is too little or fading attention to "ecology." The paper "Political Ecology: where is the Ecology?" (P. Walker 2005) reviews this element of criticism. It is in this debate that the work of Martinez-Alier (2005), by highlighting the metabolic aspect of environmental conflicts, shows the compatibility between Political Ecology and Societal Metabolism. The revised IAD Framework presented in this dissertation works to strengthen the analysis of the biophysical dimension of commons conflicts.

The great advantage of the IAD Framework is that it is considered a general framework that has the potential to draw from different theories and instrumentally draw from tools and methods that are considered useful by the researcher (Ostrom 2005). Therefore, following the steps of Agrawal (2001) that integrate the study of institutions with a Foucauldian approach to power and governmentality, the revised IAD version proposed by Clement (2010) was the starting point for my analysis. In this process, the biophysical component of that framework has been strengthened.

Although the four essays are elaborated as stand-alone works, they are related to the framework elaboration proposed in this dissertation. The final paragraphs of the dissertation will highlight specifically the result of the analytical and methodological elaboration and the genesis and limitations of the proposed revised IAD Framework.

In the essays "Discourse and practice in participatory conservation: exploring how it varies in different geo-political settings" (Chapter 5) and in "Some politicians only drink bottled water? A case study on the policy-science dynamics of the Amiata geothermal power plants development" (Chapter 9), Clement's revised IAD version (2010) is used.

Apart from looking at and organizing the information through the traditional IAD building blocks, the 'political-economic context' and the 'Discourse' categories are added. It might be argued that the Political-economic Context could be described in the original framework within the attributes of the community block. However, the literature on IAD applied to CPRs and NRM contains stronger emphasis on the local attributes of the community while the general political-economic context receives less attention. According to Ostrom (2005), the attributes of the community, as explicitly stated in the building block definition, is limited to the community level. Aspects to be included in this category are, for example, size and composition of the community, level of assets inequality, preferences, homogeneity, behaviour and values generally accepted, and common understanding of the specific action analysed.

It could be observed that the political-economic context is the background of the community attributes; however, looking at the literature on CPRs and NRM it is clear that the scholars who applied the IAD Framework generally did not go beyond the community (local) level. Clement (2010) motivates the necessity of explicitly adding the Politic Economic Context building block, referring to an extensive review of the 488 papers of the 2008 biannual conference of the International Association for the Study of the Commons (IASC) titled "Governing shared resources, connecting local experiences to global challenges." Clement (2010) found that, despite the title of the conference, only 108 papers went beyond the local

community level by addressing multiple levels of governance. This, in my opinion, is a surprising result because although it is true that the IAD Framework as presented by Ostrom focuses on the community level, one of her core concepts (2005), which is particularly central in Institutional Analysis, is the 'vertical approach', which considers the Operational, the Collective-Choice, and the Constitutional-Choice levels of analysis. This reflects in the fact that the multiscalar side of the legal analysis and the nestedness of the institutions is well theorized.

Nevertheless, I agree with Clement's critique on how, when it comes to CPR analysis there is a tendency to limit the focus only to the community/local level. For this reason I find useful Clement's explicit reference to the Political-economic Context in her elaboration. Therefore, in both the first and second essays, Clement's framework is applied and the Political-economic Context is used as a building block of the analytical framework. In the first essay, looking at the decision-making process for the authorization of the geothermal power plant Bagnore 4, understanding the political-economic context becomes fundamental. This is a case in which the governance of the natural resource (water) cannot be restricted only to the local or community level. The complexity of the case addressed requires looking into the different actors who are involved in the decision-making process, and this spans from the local communities to Enel Spa, which is multinational company.

The essay presented in Chapter 5, which is a collaboration with other researchers, brings together the Amiata and Sanjiaunguan case with three other cases from Zambia, Kenya, and USA and specifically addresses the level of participation of NRM for each case study. In this work, the political-economic context analysis is preparatory for the second building block proposed by Clement—the analysis of discourses across different governance levels. Looking into 'discourses' is not only central in the analysis of environmental policy processes (Hajer and Versteeg 2005) but also, at the theoretical level, connects institutional analysis with constructivist approaches and the stream of political ecology that highlights the politics behind environmental knowledge production (Forsyth 2005, Clement 2010). Including 'discourses' and 'political-economic context' as building blocks of the analysis reveals a picture different from the one that would be provided if referring only to the original

definition of the IAD Framework.

Looking at the level of participation in the NRM of the four cases in Zambia, Kenya, USA, and Tibet, restricting the analysis to only the institutional factors would indicate that participation is higher where property rights are clearly defined (i.e. USA case study). However, by adding a Political Ecology perspective, this comparison can be understood more clearly, and the power dimension complements the representation of the picture and strengthens its analytical capacity. For example, evaluating the level of participation looking only at the institutional factors (i.e. rules of the game) would not highlight that in the Tibetan case the definition of *voluntary participation* in the resettlement programmes, as stated by the Chinese government, is far away from the reality on the ground. In this case, including the political-economic context in the analysis means looking at both the historical aspects (often neglected in institutional analyses of NRM) and the larger political-economic context and make is easier to go beyond the optimistic descriptions of the resettlement programmes presented by the Chinese official media. This leads to the importance of analyzing the formation of discourses in shaping, and creating reality.

The urgency of the environmental protection of the main watersheds of China together with a description of the Nomadic pastoral system as backward has been widely promoted in the Chinese official media as a legitimate rationale for implementing the resettlement and sedentarization of the total nomadic population in Qinghai. The impact of narratives and discourses in promoting policy changes, in particular in the environmental sphere, is a central aspect of Political Ecology that gives the analysis of institutions the possibility of understanding not only which rules are applied and used, but also why specific rules have been developed, transformed, or created with a specific attention to power dynamics. Moreover, in the environmental policy arena, where the role of scientific research is generally considered a preparatory and necessary condition for policy and legislative development, the issues addressed by the Post-Normal Science debate become central. When it comes to policy informed by science, it is possible to scrutinize how and why concepts, categories, and beliefs are present (Hajer 1997, Jasanoff 1996) but is also necessary to look at the ontological features of the problems addressed.

In the case of social-ecological issues (or in other words, sustainability problems), systems uncertainty and high stakes (Funtowicz and Ravetz 1991, 1992, 1993) and often conflicting interests (Farrell 2008) further reinforce the need for a critical assessment of the science that informs policy and institutional development. Therefore, Post-Normal Science, Political Ecology, and Sociology of Scientific Knowledge can coherently complement the critical analysis of scientific production for environmental policy and institutional development. This reflects on both the assessment of policies and on the methodological and epistemological features of sustainability problems. This inevitably involves a paradigm shift from an objectivist, positivistic approach for the study of social-ecological dynamics to a self-reflexive, constructivist, and critical epistemology (as a result of different but complementary epistemologies).

However, as from the work of Harré (1972) and Bhaskar (1975, 1991), from which both Forsyth (2003) and Clement (2010) draw and set the basis for building their contributions, the critical approach does not in any way undermine the recognition of the assessment of the biophysical reality. Therefore, Critical realism (and the Political Ecology authors who share its epistemological perspective) is coherent with Post-normal science in creating the basis for a critical assessment of scientific production and democratization of environmental knowledge without falling into post-modern deconstruction (Forsyth 2001) and without promoting anti-scientific positions nor forgetting to recognize the "existence of a real world out there" (Forsyth 2003: 11).

There is, however, a line of criticism that both Institutional Analysis of NRM and Political Ecology (Vayda and Walters 1999) do not give the necessary attention to—the biophysical dimension of social-ecological dynamics—by either overshadowing it with the institutional or power factors. Although this is a debated critique (Walker [2005], for example, states, based on a review of the literature, that biophysical ecology is gaining increasing centrality in Political Ecology works), it points to a critical aspect of our field of investigation: the difficulties of integrating biophysical and social sciences.

Specifically, in the case of the IAD literature, I agree that biophysical conditions building block of the framework, by restricting its extension to the subtractability (or rivalry) and excludability definitions of natural resources, has not acknowledged or has been very limited in the integration of the biophysical complexity into the analysis. In the first and second essays, which for the biophysical dimension only refer to the biophysical conditions building block, this limitation is particularly evident. In the Mount Amiata case and in the comparative cases essay, the absence of a thorough analysis of the biophysical dimension reduces the capacity to evaluate the critical aspects of the policies that are implemented. In the Mount Amiata case, for example, it would be crucial to include in the institutional analysis data that confirm or deny the policy and political statements of the effects of the geothermal production on the Amiata watershed and water basin pollution and depletion.

The inclusion of the biophysical component in the analysis of socioeconomic systems is a critical node of debate in economics (Daly 1997; Solow 1997; Stiglitz 1997; Mayumi and al. 1998). The branch of Ecological Economics has been developed on the critique that the biophysical conditions have to be included in the analysis of economic production and that the constitutive assumptions of Neoclassical Economics are challenged by the integration of the entropy law in the analysis of the economic process (Georgescu-Roegen 1971, Mayumi 2001).

Moreover, the recent development of Social-ecological Systems and Sustainability Studies has strengthened the awareness of the importance of integrating the biophysical and social dimensions. As criticized in the previous chapters, the IAD literature on CPRs has mainly focused on very limited resource attributes. For this reason, integrating societal metabolism with institutional analysis and political ecology fills a theoretical gap and produces interesting methodological outcomes. As described in Chapter 4, the biophysical analysis of the metabolism of human societies, or Societal Metabolism, has been developed since the mid-19th century by authors such as Liebig, Boussingault, Moleschott, Jevons, Podolinski, Arrhenius, Ostwald, Lotka, White, and Cottrell and later applied starting from the 1970s to economic and farming systems and in more general to the study of the interface between environment and society, with the works of authors such as Georgescu-Roegen (1971), Odum

(1971), Pimentel and Pimentel (1979), and Fischer-Kowalski (1998) in Giampietro et al. (2008: 2).

By adding the metabolic patterns building block to the proposed version of the IAD Framework, this work refers in particular to the theorization of Georgescu-Roegen (1971) on the flow-fund model as the basis for a form of *bioeconomics* that explicitly recognizes the biophysical constraints of economic development. Specifically, this dissertation draws from the operationalization of Georgescu-Roegen's flow-fund scheme, introduced by Giampietro and Mayumi (1997, 2000a,b) defined as MuSIASEM.

As described in Chapter 4, MuSIASEM, by referring to the concepts of endo- and exosomatic metabolism, as illustrated by Georgescu-Roegen's flow-fund scheme, introduces energy and material flows analysis as a pillar of sustainability assessment. Moreover, understanding metabolic patterns (size and pace) of economic change involves looking at the transformation and reallocation of energy, land use, and human activity in the different economic sectors. The distinction between fund and flow coordinates, as defined by Georgescu-Roegen (1971), is a central tenet of Societal Metabolism (special issue of *Population and Environment* 2001). Fund coordinates refer to the Capital, People, and Ricardian Land. Fund coordinates are production factors that enter and exit the economic process and that transform input flows into output flows. On the other hand, flow coordinates are factors that either only enter or only exit the economic process. According to this analytical perspective, factors such as Labor and Energy gain central importance in the explanation of how societies change and produce and reproduce themselves when looking at the dialectic between economic production and nature (considered both as source and as sink).

The integration of the metabolic patterns analysis, which is first independently addressed in the essay in Chapter 7 and then integrated into the modified IAD Framework in Chapter 8, represents a fundamental aspect of CPR governance dynamics. There is a stark difference in understanding the issue between the Amiata case, where the biophysical component is limited to the traditional attributes of subtractability and rivalry as defined in the IAD

literature, and the Sanjiangyuan case, where Societal Metabolism is included. The Amiata and Sanjiangyuan cases are very different in terms of the biophysical characteristics and metabolic patterns that would need to be addressed. In the case of the Sanjiangyuan resettlement policies, although due to the size of the sample it is not to possible to generalize the results, looking at how human activity and land-use change relate to the crucial decisions of the pastoralist involved in the resettlement programmes seriously complements the analysis of institutional and political factors.

In the Amiata case, instead, a metabolic patterns analysis would require a kind of data gathering that was beyond possible in this study. Moreover, in the case of Mount Amiata, where the fund would be water rather than land, hydrological data are largely absent. This issue has been strongly discussed in the process of authorization of the geothermal power plant Bagnore 4. Until June 2012, there was no water budget for the Amiata system due to lack of direct flow measurements. Afterwards, the "Mobidic" study (Caparrini et al. 2012) modeled the water budget, raising controversial debates about the direct measurements on which the model is based. Critical reviews of the Mobidic study, for example, point out that the lack of historical precipitation data and the absence of historical records of observation well records completely undermines the modeling effort.

This issue raises the problem dealt with in Chapter 9 about the critical role of scientific co-production and its relationship with power and decision making. It is clear that without the integration of the representation of the biophysical analysis, the critique of the policy implementation is weaker. Nevertheless, in the Amiata case, as illustrated in Chapter 10, several studies point out that the biophysical representation of the Amiata water system is inaccurate. The problem is that where there is a high level of scientific uncertainty, if not ignorance, due to both the complexity of the ecosystem studied and the lack of historical biophysical measurements, the definition of an "objective truth" depends on the power position. With this problem, which directly connects to the elaboration of Post-Normal Science, the necessity of democratization of environmental knowledge and the paradigmatic shift, as described in Chapter 3, is clearly present also in the Sanjiangyuan case.

In conclusion, in the case of governance of CPRs in conflict situations, institutions, power and politics, and the metabolic patterns are ontologically interdependent. This reflects directly in the necessity of a methodological adaptation that includes the integration of these three dimensions in the analysis. Looking at the five essays in Chapters 5, 6, 7, 8, and 9, in my opinion, Chapter 8, which attempts to include the three dimensions and analyze the internal interdependent dynamics between metabolic patterns, creation of institutions, and definition of *reality*, is more complete.

Although the proposed revision of the IAD Framework has limitations, and the complexity of social-ecological issues can put researchers in epistemologically and methodologically problematic positions, this dissertation shows that politicizing Institutional Analysis and strengthening the importance of the biophysical dimension represent an important base from which to proceed in sustainability research and SES analysis in conflict contexts.

11. REFERENCES

Adisu, M., Croll, J., 1994. Human and Social Imperatives for Environmental and Resource Management in Southern Africa. In *IUCN Proceedings of Round Table Conference*, Kwa Maritime Camp, Pilanesberg National Park, Northwest Province, South Africa, August 14–18.

Aghion, P., Williamson, J.G., 1999. *Growth, Inequality, and Globalization: Theory, History, and Policy*. Cambridge University Press, UK.

Agrawal, A., 1999. *Greener Pastures: Politics, Markets, and Community among a Migrant Pastoral People*. Duke University Press, Durham, NC.

Agrawal, A., 2001. Common property institutions and sustainable governance of resources. *World Development* 29:1649–1672.

Alchian, A.A., 1996[1961]. The economic and social impact of free tuition. In *Privatization: Critical Perspectives on the World Economy*, ed. G.K. Yarrow, P. Jasinski. Routledge, London.

Allen, T.F.H., Starr, T.B., 1982. *Hierarchy: Perspectives for Ecological Complexity*. University of Chicago Press, IL.

Anderies, J.M., Janssen, M.A., Ostrom, E., 2004. A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society* 9(1):18 [online]. URL: http://www.ecologyandsociety.org/vol9/iss1/art18/.

Axelrod, R., Hamilton, W.D., 1981. The evolution of cooperation. *Science* 27:1390–1396.

Ayres, R.U., van den Bergh, J.C., Gowdy, J.M., 1998. *Viewpoint: Weak versus Strong Sustainability*. Center for the Management of Environmental Resources, Fountainebleau, France. URL: http://papers.tinbergen.nl/98103.pdf.

Banerjee, S.B., 2001. Corporate citizenship and indigenous stakeholders: exploring a new dynamic of organisational-stakeholder relationships. *Journal of Corporate Citizenship* 1:3 [online]. Available by purchase.

Baumgärtner, S., Becker, C., Frank, K., Müller, B., Quaas, M., 2008. Relating the philosophy and practice of ecological economics: the role of concepts, models, and case studies in inter- and transdisciplinary sustainability research. *Ecological Economics* 67:384-393.

Berkes, F., 1999. *Sacred Ecology: Traditional Ecological Knowledge and Management*

Systems. Taylor & Francis, London.

Berkes, F., 2004. Rethinking community-based conservation. *Conservation Biology* 18:621–630.

Berkhout, F., Leach, M., Scoones, I., 2003. *Negotiating Environmental Change: New Perspectives from Social Science*. Edward Elgar, Cheltenham, UK.

Birnbaum-More, P.H., Rossini, F.A., Baldwin, D.R., 1990. *International Research Management: Studies in Interdisciplinary Methods from Business, Government, and Academia*. Oxford University Press, New York.

Blaikie, P., 2006. Is small really beautiful? Community-based natural resource management in Malawi and Botswana. *World Development* 34:1942–1957.

Boix Mansilla, V., Feller, I., Gardner, H., 2006. Quality assessment in interdisciplinary research and education. *Research Evaluation* 15:69-74.

Boix Mansilla, V., Gardner, H. 2003. Assessing interdisciplinary work at the frontier: an empirical exploration of "symptoms of quality." In *Rethinking Interdisciplinarity*. An online seminar supported by the Centre national de la recherche scientifique project "Society of Information," December 1. URL: http://www.old-pz.gse.harvard.edu/interdisciplinary/pdf/VBM-Gardner_AssessingSymptoms_2003.pdf.

Botes, L., van Rensburg, D., 2000. Community participation in development: nine plagues and twelve commandments. *Community Development Journal* 35:41–58.

Bradburd, D. 1987. Tribe, state and history in southwest Asia: a review. *Nomadic Peoples* 23:57-71.

Bromley, D.W., 1989. *Economic Interests and Institutions: The Conceptual Foundations of Public Policy*. Basil Blackwell, Oxford, UK.

Bromley, D.W., 1991. *Environment and Economy: Property Rights and Public Policy*. Blackwell, Malden, MA.

Bromley, D.W., ed., 1992. *Making the Commons Work: Theory, Practice, and Policy*. ICS Press, San Francisco, CA.

Brown, K., 2003. Three challenges for a real people-centred conservation. *Global Ecology and Biogeography* 12:89–92.

Bryant, R., Bailey, S., 1997. *Third World Political Ecology: An Introduction*. Routledge, New York.

Buchy, M., Race, D., 2001. The twists and turns of community participation in natural resource management in Australia: What is missing? *Journal of Environmental Planning and Management* 44:293–308.

Burkett, P., 2009. *Marxism and Ecological Economics: Toward a Red and Green Political Economy*. Haymarket Books, Chicago, IL.

Burns, M., Audouin, M., Weaver, A., 2006. Advancing sustainability science in South Africa. *South African Journal of Science* 102:379-384.

Caffentzis, G., 2004. *A Tale of Two Conferences: Globalization, the Crisis of Neoliberalism and Question of the Commons*. Alter-Globalization Conference, San Miguel de Allende, Mexico, August 9. URL: http://www.commoner.org.uk/wp-content/uploads/2010/12/caffentzis_a-tale-of-two-conferences.pdf.

Campbell, L. M., 2000. Human need in rural developing areas: perceptions of wildlife conservation experts. *Canadian Geographer / Le Géographe canadien* 44:167–181.

Carter, M.R., Barrett, C.B., 2006. The economics of poverty traps and persistent poverty: an asset-based approach. *Journal of Development Studies* 42(2):178–199. doi:10.1080/00220380500405261.

Cash, D.W., Clark, W.C., Alcock, F., Dickson, N.M., Eckley, N., Guston, D.H., Jäger, J., Mitchell, R., 2003. Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences of the United States of America* 100:8086-8091.

Chomsky, N., 1999. *Profit Over People: Neoliberalism and Global Order*. Seven Stories Press, New York.

Clark, W.C., 2007. Sustainability science: a room of its own. *Proceedings of the National Academy of Sciences of the United States of America* 104:1737-1738.

Clark, W.C., Dickson, N.M., 2003. Sustainability science: the emerging research program, *Proceedings of the National Academy of Sciences of the United States of America* 100:8059-8061.

Clark, W.C., Crutzen, P.J., Schellnhuber, H.J., 2005. *Science for Global Sustainability: Toward a New Paradigm*. CID Working Paper No. 120. Center for International Development, Harvard University, Cambridge, MA.

Clement, F., 2010. Analysing decentralised natural resource governance: proposition for a "politicised" institutional analysis and development framework. *Policy Sciences* 43:129–

156.

Clement, F., Amezaga, J.M., 2008. Linking reforestation policies with land use change in northern Vietnam: why local factors matter. *Geoforum* 39:265–277.

Clement, F., Amezaga, J.M., 2009. Afforestation and forestry land allocation in northern Vietnam: analysing the gap between policy intentions and outcomes. *Land Use Policy* 26:458–470.

CMAVO (Comunità Montana Amiata Val d'Orcia), 2009. *Gestione associata pari opportunita': relazione attività anno 2009*.

Cooke, B., Kothari, U., 2001. *Participation: The New Tyranny?* Zed Books, London.

Cornwall, A., Brock, K., 2005. What do buzzwords do for development policy? A critical look at "participation," "empowerment" and "poverty reduction." *Third World Quarterly* 26:1043–1060.

Cottrell, F., 1955. *Energy and Society: The Relation between Energy, Social Change, and Economic Development*. McGraw-Hill, Columbus, OH.

Cox, M., Arnold, G., Villamayor Tomás, S., 2010. A review of design principles for community-based natural resource management. *Ecology and Society* 15(4):38 [online]. URL: http://www.ecologyandsociety.org/vol15/iss4/art38/.

Daily, C.G., Alexander, S., Ehrlich, P.R., Goulder, L., Lubchenco, J., Matson, P.A., Mooney, H.A., Postel, S., Schneider, S.H., Tilman, D., Woodwell, G.M., 1997. *Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems*. Issues in Ecology No. 2. Ecological Society of America, Washington, DC.

Dell'Angelo, J., 2012. The sedentarization of Tibetan nomads: conservation or coercion? In *Ecological Economics from the Ground Up*, ed. H. Healy, J. Martinez-Alier, L. Temper, M. Walter, J.F. Gerber. Routledge, London.

Dewey, J., 1966[1916]. *Democracy and Education. An Introduction to the Philosophy of Education*, 1966 ed. Free Press, New York.

Diamond, L., 2005. "Democracy, Development and Good Governance: The Inseparable Links." Annual Democracy and Governance Lecture, Center for Democratic Development, British Council Hall, Accra, Ghana, March 1. URL: http://www.stanford.edu/~ldiamond/papers/CDD_lecture_05.htm.

Dietz, T., Ostrom, E., Stern, P.C., 2003. The struggle to govern the commons. *Science*

302(5652):1907-1912.

Escobar, A., 1998. Whose knowledge, whose nature? Biodiversity, conservation, and the political ecology of social movements. *Journal of Political Ecology* 5:53–82.

Dong, Y.X., Chen, K.L., 2002. Status and driving force of sandy desertification in upper reaches of Yangtze River. *Resources and Environment in the Yangtze Basin* 1:

Dryzek, J.S., 1987. *Rational Ecology: Environment and Political Economy*. Basil Blackwell, London.

Escobar, A., 1995. *Encountering Development: The Making and Unmaking of the Third World*. Princeton University Press, Princeton, NJ.

Escobar, A., 1998. Whose knowledge, whose nature? Biodiversity, conservation, and the political ecology of social movements. *Journal of Political Ecology* 5:53-82.

Evans, J., 2002. Biodiversity conservation and brownfield sites: a scalar political ecology? Unpublished PhD Thesis, University of Birmingham, AL.

Farrell, K.N., 2008. The politics of science and sustainable development: Marcuse's new science in the 21st century. *Capitalism Nature Socialism* 19:68–83.

Farrell, K.N., 2011a. Snow White and the wicked problems of the West: a look at the lines between empirical description and normative prescription. *Science Technology and Human Values* 36:307-333.

Farrell, K.N., 2011b. The politics of science: has Marcuse's new science finally come of age? In *Critical Ecologies: The Frankfurt School and Contemporary Environmental Crises*, ed. A. Biro, 73-107. University of Toronto Press, Canada.

Ferguson, J., 1994. *Anti-Politics Machine: Development, Depoliticization, and Bureaucratic Power in Lesotho*. University of Minnesota Press, Minneapolis.

Fischer, A.M., 2004. *Urban Fault Lines in Shangri-La: Population and Economic Foundations of Interethnic Conflict in the Tibetan Areas of Western China*. Crisis States Research Centre, London School of Economics.

Fischer, A.M., 2005a. *Close Encounters of an Inner Asian Kin: Tibetan-Muslim Co-Existence and Conflict Past and Present*. Crisis States Research Centre, London School of Economics.

Fischer, A.M., 2005b. *State Growth and Social Exclusion in Tibet: Challenges of Recent Economic Growth*. NIAS Press, Copenhagen.

Fischer, A.M., 2006. *Subsistence Capacity: The Commodification of Rural Labour Re-examined through the Case of Tibet*. Development Studies Institute, London School of Economics.

Fischer, A.M., 2008a. “Population invasion” versus urban exclusion in the Tibetan areas of western China. *Population and Development Review* 34:631–662.

Fischer, A.M., 2008b. *Resolving the Theoretical Ambiguities of Social Exclusion with Reference to Polarisation and Conflict*. Social Exclusion DESTIN Working Paper No. 08-90. Development Studies Institute, London School of Economics and Political Science. URL: http://repub.eur.nl/res/pub/21677/_resolving.pdf .

Foggin, J.M., 2008. Depopulating the Tibetan grasslands. *Mountain Research and Development* 28:26-31.

Foggin, J.M., Torrance-Foggin, M.E., 2011. How can social and environmental services be provided for mobile Tibetan herders? Collaborative examples from Qinghai Province, China. *Pastoralism: Research, Policy and Practice* 1(1):21. doi:10.1186/2041-7136-1-21.

Forsyth, T., 2003. *Critical Political Ecology: The Politics of Environmental Science*. Routledge, London.

Forsyth, T., Leach, M., Scoones, I., 1998. *Poverty and Environment: Priorities for Research and Policy*. An Overview Study prepared for the United Nations Development Programme and European Commission. Institute of Development Studies, Sussex, UK.

Foucault, M., 1980. *Power/Knowledge: Selected Interviews and Other Writings, 1972-1977*., trans. and ed. C. Gordon, trans. L. Marshall, J. Mepham, K. Soper. Pantheon Books, New York.

Freire, P., 1970. *Pedagogy of the Oppressed*. The Seabury Press, New York.

Funtowicz, S., Martinez-Alier, J., Munda, G., Ravetz, J., 1999. *Information Tools for Environmental Policy under Conditions of Complexity*. Environmental Issue Report No. 9. European Environment Agency, Copenhagen.

Funtowicz, S.O, O'Connor, M., 1999. The passage from entropy to thermodynamic indeterminacy: a social and science epistemology for sustainabiliy. In *Bioeconomics and Sustainability: Essays in Honor of Nicholas Georgescu-Roegen*, ed. Mayumi, K., Gowdy, J.M. Edward Elgar, Cheltenham, UK.

Funtowicz, S.O., Ravetz, J.R., 1990. *Uncertainty and Quality in Science for Policy*. Kluwer

Academic Publishers, Dordrecht, the Netherlands.

Funtowicz, S.O., Ravetz, J.R., 1991. A new scientific methodology for global environmental issues. In *Ecological Economics: The Science and Management of Sustainability*, ed. Robert Costanza, 137-152. Columbia University Press, New York.

Funtowicz, S.O., Ravetz, J.R., 1992. The good, the true and the post-modern. *Futures* 24:963-976.

Funtowicz, S.O., Ravetz, J.R., 1993. Science for the post-normal age. *Futures* 25:739–755.

Funtowicz, S., Ravetz, J.R., 1994a. Emergent complex systems. *Futures* 26:568-582.

Funtowicz, S.O., Ravetz, J.R., 1994b. The worth of a songbird: ecological economics as a post-normal science. *Ecological Economics* 10:197–207.

Funtowicz, S.O., Ravetz, J.R., 1997. The poetry of thermodynamics - energy, entropy/exergy and quality. *Futures* 29:791-810.

Garfinkel, H., 1967. *Studies in Ethnomethodology*. Prentice Hall, Englewood Cliffs, NJ.

Geertz, C., 1973. Thick description: toward an interpretative theory of culture. In *The Interpretation of Cultures: Selected Essays*. Basic Books, New York.

Georgesçu-Roegen, N., 1971. *The Entropy Law and the Economic Process*. Harvard University Press, Cambridge, MA.

Georgescu-Roegen, N., 1984. Feasible recipes versus viable technologies. *Atlantic Economic Journal* 12:21–31.

Georgescu-Roegen, N., 1986. The entropy law and the economic process in retrospect. *Eastern Economic Journal* 12:3–25.

Giampietro, M., 1994. Using hierarchy theory to explore the concept of sustainable development. *Futures* 26:616–625.

Giampietro, M., 2004. *Multi-Scale Integrated Analysis of Agroecosystems*. CRC Press, Boca Raton, FL.

Giampietro, M., Mayumi, K., 2000a. Multiple-scale integrated assessment of societal metabolism: introducing the approach. *Population & Environment* 22(2):109–153. doi:10.1023/A:1026691623300.

Giampietro, M., Mayumi, K., 2000b. Multiple-scale integrated assessments of societal metabolism: integrating biophysical and economic representations across scales. *Population & Environment* 22:155–210.

Giampietro, M., Mayumi, K., Martinez-Alier, J., 2000. Introduction to the special issue on societal metabolism: blending new insights from complex system thinking with old insights from biophysical analyses of the economic process. *Population & Environment* 22(2): 97–108. doi:10.1023/A:1026646306462.

Giampietro, M., Mayumi, K., Ramos-Martín, J., 2008. *Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MUSIASEM): An Outline of Rationale and Theory*. Working Paper wpdea0801. Department of Applied Economics, Universitat Autonoma of Barcelona. URL: http://ideas.repec.org/p/uab/wprdea/wpdea0801.html.

Giampietro, M., Mayumi, K., Ramos-Martin, J., 2009. Multi-scale integrated analysis of societal and ecosystem metabolism (MuSIASEM): theoretical concepts and basic rationale. *Energy* 34:313–322.

Giampietro, M., Mayumi, K., Sorman, A.H., 2011. *The Metabolic Pattern of Societies: Where Economists Fall Short*. Routledge, Taylor & Francis Group, London.

Gillson, L., 2004. Testing non-equilibrium theories in savannas: 1400 years of vegetation change in Tsavo National Park, Kenya. *Ecological Complexity* 1:281–298.

Goldstein, M.C., 1991. Change and continuity in nomadic pastoralism on the western Tibetan plateau. *Nomadic Peoples* 28:105-123.

Goldstein, M.C., 1996. Nomads of Golok: A Report. Manuscript.

Goldstein, M.C., Beall, C.M., 1989. The impact of China's reform policy on the nomads of western Tibet. *Asian Survey* 29(6):619–641. doi:10.2307/2644756.

Goldstein, M.C., Beall, C.M., 1991. Change and continuity in nomadic pastoralism on the western Tibetan plateau. *Nomadic Peoples* 28:105–122.

Goldstein, M.C., Beall, C.M., Cincotto, R.P., 1990. Traditional nomadic pastoralism and ecological conservation on Tibet's northern plateau. *National Geographic Research* 6(2):139–156.

Gong, J.M., Yang, X.M., Lu, J., Lin, Z.J., Su, F.Z., Du, F.F., Jiang, Z., 2008. Land cover classification research at scale of 1:50000 in Sanjiangyuan study area based on spot-5 Images. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* 37(4):1835-1840.

Goodman, D.S.G., ed., 2004. *China's Campaign to "Open up the West": National, Provincial and Local Perspectives*. Cambridge University Press, UK.

Gordillo, G., Andersson, K., 2004. From policy lessons to policy actions: motivation to take evaluation seriously. *Public Administration and Development* 24:305–320.

Gowdy, J.M., Giampietro, M., Ramos-Martin, J., Mayumi, K., 2009. Incorporating biophysical foundations in a hierarchical model of societal metabolism. In *Post Keynesian and Ecological Economics : Confronting Environmental Issues*, ed. R.P.F. Holt, S. Pressman, C.L. Spash, 203-220. Edward Elgar, Cheltenham, UK.

Gramsci, A., 1971. *Selections from the Prison Notebooks*. International Publishers.

Grimble, R., Laidlaw, M., 2002. Biodiversity management and local livelihoods: Rio +10. *Natural Resource Perspectives* 73:1-4.

Hagedorn, K., 2008. Particular requirements for institutional analysis in nature-related sectors. *European Review of Agricultural Economics* 35:357–384.

Hajer, M.A., 1997. *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process*. Clarendon Press, Oxford, UK.

Hajer, M., Versteeg, W., 2005. A decade of discourse analysis of environmental politics: achievements, challenges, perspectives. *Journal of Environmental Policy & Planning* 7:175–184.

Hall, B., 1985. Research, commitment and action: the role of participatory research. *International Review of Education* 30:289-299.

Hardin, G., 1968. The tragedy of the commons. *Science* 162(3859):1243–1248. doi:10.1126/science.162.3859.1243.

Hardin, G., 1998. Extensions of "The Tragedy of the Commons." *Science* 280:682–683.

Harris, R.B., 2010. Rangeland degradation on the Qinghai-Tibetan plateau: a review of the evidence of its magnitude and causes. *Journal of Arid Environments* 74(1):1–12. doi:10.1016/j.jaridenv.2009.06.014.

Harvey, D., 2007. *A Brief History of Neoliberalism*. Oxford University Press, New York.

Hecht, S., 2010. The new rurality: globalization, peasants and the paradoxes of landscapes. *Land Use Policy* 27(2):161–169. doi:10.1016/j.landusepol.2009.08.010.

Henshaw, P., 2013. Complex systems. In *Encyclopedia of Earth*, ed. C.J. Cleveland. URL: http://www.eoearth.org/view/article/151405/.

Hess, C., Ostrom E., eds., 2007. *Understanding Knowledge As a Commons: From Theory to Practice*. The MIT Press, Cambridge, MA.

Hickey, S., Mohan, G., 2005. Relocating participation within a radical politics of development. *Development and Change* 36:237–262.

Himley, M., 2008. Geographies of environmental governance: the nexus of nature and neoliberalism. *Geography Compass* 2(2):433–451.

Hirsch Hadorn, G., Bradley, D., Pohl, C., Rist, S., Wiesmann U., 2006. Implications of transdisciplinarity for sustainability research. *Ecological Economics* 60:119–128.

Hobley, M., 1996. *Participatory Forestry: The Process of Change in India and Nepal*. Overseas Development Institute, London, UK.

Hobsbawm, E., 1965. *Primitive Rebels*. Norton, New York.

Holbig, H., 2004. The emergence of the campaign to open up the west: ideological formation, central decision-making and the role of the provinces. In China's Campaign to "Open Up the West": National, Provincial and Local Perspectives, ed. D.S. Goodman. Cambridge University Press, UK.

Holt, R.P.F., 2010. Post Keynesian and Ecological Economics: Confronting Environmental Issues. Edward Elgar, Cheltenham, UK.

Hope, N.C., Tao Yang, D., Yang. M., 2003. *How Far Across the River? Chinese Policy Reform at the Millennium*. Stanford University Press, Stanford, CA.

Hoselitz, B., 1952. Non-economic barriers to economic development. *Economic Development and Cultural Change* 1(1):8-21.

Hulme, D., Murphree, M., 1999. Communities, wildlife and the "new conservation" in Africa. *Journal of International Development* 11:277–285.

HRW (Human Rights Watch), 2007. No One Has the Liberty to Refuse.

Humphrey, C., Sneath, D.A., 1999. *The End of Nomadism? Society, State, and the Environment in Inner Asia*. Duke University Press, Durham, NC.

Huntley, B., Jager, J., Jodha, N.S., Kasperson, R.E., Mabogunje, A., Matson, P., Mooney, H., Moore III, B., O'Riordan, T., and Svedlin, U., 2001. Environment and development: sustainability science. *Science* 292:641-642.

Hurley, J.M., Ginger, C., Capen, D.E., 2002. Property concepts, ecological thought, and ecosystem management: a case of conservation policymaking in Vermont. *Society & Natural Resources* 15:295–312.

IMF (International Monetary Fund) (2005) *The IMF's Approach to Promoting Good*

Governance and Combating Corruption – A Guide. IMF, Washington DC.

Jasanoff, S., 1996. Beyond epistemology: relativism and engagement in the politics of science. *Social Studies of Science* 26:393–418.

Jevons, W.S., 1865. *The Coal Question: An Enquiry Concerning the Progress of the Nation, and the Probable Exhaustion of Our Coal-mines*. Macmillan, London.

Jones, S., 2006. A political ecology of wildlife conservation in Africa. *Review of African Political Economy* 33:483–495.

Kajikawa, Y., 2008. Research core and framework of sustainability science. *Sustainability Science* 3:215-239.

Kanamaru, H., Hiepe, C., Ramasamy, S., 2012. *Pastoral Risk Management in Qinghai Province* (China) [WWW Document]. URL: http://www.fao.org/climatechange/china/qinghai/70247/en/.

Kasemir, B., Jäger, J., Jaeger, C.C., Gardner, M.T., eds., 2003. *Public Participation in Sustainability Science: A Handbook*. Cambridge University Press, UK.

Kastenhofer, K., Berchtold, U., Wilfin, H., 2011. Sustaining sustainability science: the role of established inter-disciplines. *Ecological Economics*, article in press.

Kates, R.W., Clark, W.C., Corell, R., Hall, J.M., Jaeger, C.C., Lowe, I., McCarthy, J.J., Schellnhuber, H.J., Bolin, B., Dickson, N.M., Faucheux, S., Gallopin, G.C., Grubler, A., 2001. Sustainability science. *Science* 292:641-642.

Kay, C., 2008. Reflections on Latin American rural studies in the neoliberal globalization period: a new rurality? *Development and Change* 39(6):915–943. doi:10.1111/j.1467-7660.2008.00518.x.

Kelly, P.F., 2011. Migration, agrarian transition, and rural change in Southeast Asia. *Critical Asian Studies* 43(4):479–506. doi:10.1080/14672715.2011.623516.

Kepe, T., Bissonnette, J.-F., Roberts, D.J., 2008. Why are students attracted to political ecology? *Environment and Planning A* 40, 2539–2543.

Kiser, L., Ostrom, E., 1982. The three words of action: a metatheoretical synthesis of institutional approaches. In *Strategies of Political Inquiry*, ed. E. Ostrom, 179–222. Sage, Beverly Hills, CA.

Klein, J.T., 2008. Evaluation of interdisciplinary and transdisciplinary research: a literature review. *American Journal of Preventive Medicine* 35:116-123.

Klute, G., 1996. Introduction. *Nomadic Peoples* 38:3-10.

Komiyama, H., Takeuchi, K., 2006. Sustainability science: building a new discipline, *Sustainability Science* 1:1-6.

Kuhn, T.S., 1970[1962]. *The Structure of Scientific Revolutions*, 2nd ed. University of Chicago Press, IL.

Ladner, J.A., 1971. *Tomorrows Tomorrow: The Black Woman*. University of Nebraska Press, Lincoln.

Lambin, E.F., Turner, B.L., Geist, H.J., 2001. The causes of land-use and land-cover change: moving beyond the myths. *Global Environmental Change* 11:261-269.

Lankford, B., Beale, T., 2007. Equilibrium and non-equilibrium theories of sustainable water resources management: dynamic river basin and irrigation behaviour in Tanzania. *Global Environmental Change* 17:168–180.

Lassailly, V., 1998. *Communautés deracinées dans les pays du Sud*. IRD Editions.

Latour, B., 1993a. *The Pasteurization of France*, trans. A. Sheridan. Harvard University Press, Cambridge, MA.

Latour, B., 1993b. *We Have Never Been Modern*. Harvard University Press, Cambridge, MA.

Latour, B., 2004. *Politics of Nature: How to Bring the Sciences into Democracy*. Harvard University Press, Cambridge, MA.

Leach, M., Mearns, R., 1996. *The Lie of the Land: Challenging Received Wisdom on the African Environement*. James Currey, Oxford, UK.

Lenhart, L., Casimir, M.J., 2001. Environment, property resources and the state: an introduction. *Nomadic Peoples* 5:6–20.

Leontief, W.W., 1982. Academic economics. *Science* 217:104-107

Lotka, A.J., 1956. *Elements of Mathematical Biology*. Dover, UK.

Lybbert, T.J., Barrett, C.B., Desta, S., Coppock, D.L., 2004. Stochastic wealth dynamics and risk management among a poor population. *The Economic Journal* 114(498):750–777. doi:10.1111/j.1468-0297.2004.00242.x.

Malthus, T., 1798. *An Essay on the Principle of Population*. J. Johnson, in St. Paul's Church-yard, London. Presented online by Library of Economics and Liberty, http://www.econlib.org/library/Malthus/malPopCover.html.

Martinez-Alier, J., Munda, G., O'Neill, J., 1998. Weak comparability of values as a

foundation for ecological economics. *Ecological Economics* 26:277-286.

Max-Neef, M.A., 2005. Foundations of transdisciplinarity. *Ecological Economics* 53:5-16.

Meadows, D.H., Meadows, D.L., Randers, J., Behrens, W.W. III, 1972. *Limits to Growth*. New American Library, New York.

Mery, G., IUFRO (International Union of Forest Research Organizations), 2005. *Forests in the Global Balance: Changing Paradigms*. IUFRO, Vienna, Austria.

Meyers, R., 2009. *Encyclopedia of Complexity and Systems Science*. Springer, New York.

MEA (Millennium Ecosystem Assessment), 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.

Miller, D., 2000. Tough times for Tibetan nomads in western China: snowstorms, settling down, fences and the demise of traditional nomadic pastoralism. *Nomadic Peoples* 4:83-109.

Mingxu, X., Feng, Y., 2006. The Tibet question: a new cold war. In *Contemporary Tibet: Politics, Development, and Society in a Disputed Region*, ed. B. Sautman , J.T. Dreyer. M.E. Sharpe, New York.

Munda, G., 2003. Multicriteria assessment. *Internet Encyclopedia of Ecological Economics*. URL: http://isecoeco.org/pdf/mlticritassess.pdf.

Munda, G., 2004. Social multi-criteria evaluation: methodological foundations and operational consequences. *European Journal of Operational Research* 158:662–677.

Neumayer, E., 2010. Weak versus Strong Sustainability, 3rd ed. Edward Elgar Publishing.

Neurath, O., 1973. Empiricism and Sociology. Reiedel, Dordrecht.

Norbu, N., Simmons, M. 1997. *Journey among the Tibetan Nomads. An Account of a Remote Civilization*. Library of Tibetan Works & Archives, Dharamsala.

North, D.C., 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge University Press, UK.

NRC (National Research Council), 1999. *Our Common Journey: A Transition toward Sustainability*. National Research Council Policy Division Board on Sustainable Development. National Academies Press, Washington, DC.

NRC, 2002. *The Drama of the Commons*. Committee on the Human Dimensions of Global Change. National Academies Press, Washington, DC.

Oakerson, R.J., 1992. Analyzing the commons: a framework. In *Making the Commons Work:*

Theory, Practice, and Policy, ed. D.W. Bromley. San Francisco, CA: Institute for Contemporary Studies.

O'Connor, M., 2000. Pathways for environmental evaluation: a walk in the (hanging) gardens of Babylon. *Ecological Economics* 34:175-193.

Odum, E.P., 1953. *Fundamentals of Ecology*. Saunders, Philadelphia, PA.

Odum, H.T., 1971. *Environment, Power, and Society*. Wiley, New York.

O'Rourke, K.H., Williamson, J.G., 1999. *Globalization and History: Evolution of a Nineteenth-Century Atlantic Economy*. MIT Press, Cambridge, MA.

Ostrom, E., 1982. *Strategies of Political Inquiry*. Sage Publications, Beverly Hills.

Ostrom, E., 1990. *Governing the Commons : The Evolution of Institutions for Collective Action*. Cambridge University Press, UK.

Ostrom, E., 1999. Institutional rational choice. an assessment of the institutional analysis and development framework. In *Theories of the Policy Process*, ed. P.A. Sabatier, 35–71. Westview Press, Boulder, Colorado.

Ostrom, E., 2005. *Understanding Institutional Diversity*. Princeton University Press.

Ostrom, E., 2007. A diagnostic approach for going beyond panaceas. *Proceedings of the National Academy of Sciences of the United States of America* 104:15181-15187.

Ostrom, E., 2009. A general framework for analyzing sustainability of social-ecological systems. *Science* 325:419–422.

Ostrom, E., 2010. Beyond markets and states: polycentric governance of complex economic systems. *American Economic Review* 100:641–672.

Ostrom, E., 2011. Background on the Institutional Analysis and Development Framework. *Policy Studies Journal* 39:7–27.

Ostrom, E., Gardner, R., Walker, J., 1994. *Rules, Games, and Common-Pool Resources*. University of Michigan Press, Ann Arbor.

Ostrom, E., Walker, J., 2005. *Trust and Reciprocity: Interdisciplinary Lessons for Experimental Research*. Russell Sage Foundation, New York.

Pastore, G., Giampietro, M., Mayumi, K., 2000. Societal metabolism and multiple-scale integrated assessment: empirical validation and examples of application. *Population and Environment* 22:211–254.

Pearce, D.W., Atkinson, G.D., 1993. Capital theory and the measurement of sustainable

development: an indicator of "weak" sustainability. *Ecological Economics* 8(2):103–108.

Peavey, F., 1995. Strategic questioning: an approach to creating personal and social change, *In Context: A Quarterly of Humane Sustainable Culture* 36:1-24.

Pereira, A.G., Funtowicz, S., 2005. Quality assurance by extended peer review: tools to inform debates, dialogues & deliberations. *Theorie und Praxis* 14:74-79

Pimentel, D., and Pimentel, M., 1979. *Food, Energy and Society*. Edward Arnold, London.

Pirie, F., 2005. Segmentation within the state: the reconfiguration of the Tibetan tribes in China's reform period. *Nomadic Peoples* 9:83-103.

Poteete, A.R., Janssen, M.A., Ostrom, E., 2010. *Working Together: Collective Action, the Commons, and Multiple Methods in Practice*. Princeton University Press, Princeton, NJ.

Potts, D., Bowyer-Bower, T.A.S., 2004. *Eastern and Southern Africa: Development Challenges in a Volatile Region*. Pearson Education, New York.

Ptackova, J., 2011. Sedentarisation of Tibetan nomads in China: implementation of the Nomadic Settlement Project in the Tibetan Amdo area; Qinghai and Sichuan Provinces. *Pastoralism: Research, Policy and Practice* 1:4 [online]. URL: http://www.pastoralismjournal.com/content/1/1/4.

Ravetz, J.R., 1971. *Scientific Knowledge and Its Social Problems*. Clarendon Press, Oxford, UK.

Ravetz, J.R., 1990. *The Merger of Knowledge with Power: Essays in Critical Science*. Mansell, London.

Rhoten, D., Parker, A., 2004. Risks and rewards of an interdisciplinary research path. *Science* 306:2046.

Ribot, J.C., Magalhães, A.R., Panagides, S.S., 2005. Climate Variability, Climate Change, and Social Vulnerability in the Semi-Arid Tropics. Cambridge University Press, UK.

Ricardo, D., 2004[1817]. *On the Principles of Political Economy and Taxation*. Dover Publications, Mineola, NY. Unabridged republication of 1911 edition by J.M. Dent & Sons, London.

Richard, C. 2005. Developing alternatives to resettlement for pastoralists on the Tibetan plateau. *Nomadic Peoples* 9 (1/2):103–106.

Richardson, H.M., 1984. *Tibet and Its History*. Shambhala, Boulder.

Rinzin, C., Vermeulen, W.J.V., Wassen, M.J., Glasbergen, P., 2009. Nature conservation and

human well-being in Bhutan: an assessment of local community perceptions. *The Journal of Environment Development* 18:177–202.

Robbins, P., 2004. *Political Ecology: A Critical Introduction*. Blackwell, Malden, MA.

Robbins, P., 2011. *Political Ecology: A Critical Introduction*, 2nd ed. Blackwell, Malden, MA.

Robinson, J., 2004. Squaring the circle? Some thoughts on the idea of sustainable development. *Ecological Economics* 48:369–384.

Rodgers, G.B., 1979. Income and inequality as determinants of mortality: an international cross-section analysis. *Population Studies* 33(2):343-351.

Roe, E., 1991. Development narratives or making the best of blueprint development. *World Development* 19(4):287–300.

Roe, E. 1994. *Narrative Policy Analysis: Theory and Practice*. Duke University Press, Durham, NC.

Roe, D., Nelson, F., Sandbrook, C., IIED (International Institute for Environment and Development), 2009. Community Management of Natural Resources in Africa : Impacts, Experiences and Future Directions. IIED, London.

Rosen, R., 1991. *Life Itself: A Comprehensive Inquiry into the Nature, Origin and Fabrication of Life*. Columbia University Press, New York.

Russett, B.M., 1975. *International Regions and the International System: A Study in Political Ecology*. Praeger, Santa Barbara, CA.

Rutherford, M., 1996. *Institutions in Economics: The Old and the New Institutionalism*. Cambridge University Press, UK.

Sabatier, P.A., 1999. *Theories of the Policy Process*. Westview Press, Boulder, CO.

Sabatier, P.A., Focht, W., Lubell, M., Trachtenberg, Z., Vedlitz, A., Matlock, M., eds., 2005. *Swimming Upstream: Collaborative Approaches to Watershed Management*. The MIT Press, Cambridge, MA.

Salih, M.A.M., 1990. Pastoralism and the state in African arid lands. an overview. *Nomadic Peoples* 25-27:7-18.

Sandron, F., 1998. L'immobilité forcée: la sédentarisation des nomades dans le Sud Tunisien. *Autrepart* 1998(5):63-77.

Scheidel, A., 2013. Flows, funds and the complexity of deprivation: using concepts from

ecological economics for the study of poverty. *Ecological Economics* 86(February):28–36. doi:10.1016/j.ecolecon.2012.10.019.

Scherr, S.J., 2000. A downward spiral? Research evidence on the relationship between poverty and natural resource degradation. *Food Policy* 25:479–498.

Sen, A., 1999. *Development As Freedom*. Oxford University Press, UK.

Shen, X., Tan, J., 2012. Ecological conservation, cultural preservation, and a bridge between: the journey of Shanshui Conservation Center in the Sanjiangyuan Region, Qinghai-Tibetan Plateau, China. *Ecology and Society* 17(4):38 [online]. URL: http://www.ecologyandsociety.org/vol17/iss4/art38/.

Simsik, M.J., 2002. The political ecology of biodiversity conservation on the Malagasy Highlands. *GeoJournal* 58:233–242.

Siurua, H., 2006. Nature above people: Rolston and "fortress" conservation in the South. *Ethics and the Environment* 11:71–96.

Smil, V., 1991. *General Energetics: Energy in the Biosphere and Civilization*. Wiley-Interscience, Hoboken, NJ.

Smith, A.T., Foggin, M., 2006. The plateau pika (*Ochotona curzoniae*) is a Keystone species for biodiversity on the Tibetan plateau. *Animal Conservation* 2(4):235-240.

Sneath, D., 1998. Ecology: State Policy and Pasture Degradation in Inner Asia. *Science* 281, 1147–1148.

Sneddon, C., Howarth, R.B., Norgaard, R.B., 2006. Sustainable development in a post-Brundtland world. *Ecological Economics*, 57:253-268.

Solow, R.M., 1974. Intergenerational equity and exhaustible resources. *The Review of Economic Studies* 41:29–45.

Solow, R.M., Wan, F.Y., 1976. Extraction costs in the theory of exhaustible resources. *The Bell Journal of Economics* 7:359–370.

Sterman, J., 2000. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin/McGraw-Hill, Boston

Stiglitz, J.E., 2003. *Globalization and Its Discontents*. Norton, New York.

Stringer, L.C., 2009. Testing the orthodoxies of land degradation policy in Swaziland. *Land Use Policy* 26:157–168.

Sullivan, S., Homewood, K., 2004. Natural resources: use, access, tenure and management.

In *Eastern and Southern Africa: Development Challenges in a Volatile Region*, ed. B. Potts, T. Bowyer-Bower, 118-166. Pearson Education, Essex, UK.

Swift, J., 1986. The economics of production and exchange in West African pastoral societies. In *Pastoralists of the West African Savanna*, ed. M. Adamu, A.H.M. Kirk-Greene. Manchester University Press, UK.

UNDP (United Nations Development Programme), 2004. *Regional Project on Local Governance for Latin America*. UNDP, New York.

UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific), 2006. *What is Good Governance?* UNESCAP, Bangkok.

Van den Bergh, J.C.J.., Ferrer-i-Carbonell, A., Munda, G., 2000. Alternative models of individual behaviour and implications for environmental policy. *Ecological Economics* 32:43–61.

van der Sluijs, J.P. , Craye, M., Funtowicz, S., Kloprogge, P., Ravetz, J., Risbey, J., 2005. Combining quantitative and qualitative measures of uncertainty in model-based environmental assessment: the NUSAP system. *Risk Analysis* 25:481-492.

Vatn, A., 2005. *Institutions and the Environment*. Edward Elgar, Cheltenham, UK.

Veblen, T., 1898. Why is economics not an evolutionary science? *The Quarterly Journal of Economics* 12:373–397.

Vercelli, S., Borghesi, A., 2005. *La sostenibilità dello sviluppo globale*. Carocci Editore, Rome.

Videira, N., Antunes, P., Santos, R., Gamito, G., 2003. Participatory modelling in environmental decision-making: the Ria Formosa Natural Park case study. *Journal of Environmental Assessment Policy and Management* 5:421 - 447.

Walker, B., 2005. A resilience approach to integrated assessment. *The Integrated Assessment Journal* 5:77-97.

Walker, P.A., 2005. Political ecology: where is the ecology? *Progress in Human Geography* 29(1):73–82.

WCED (World Commission on Environment and Development), 1987. *Report of the World Commission on Environment and Development: Our Common Future*. Also known as *The Brundtland Report*. Oxford University Press, UK.

Wickson, F., Carew, A.L., Russell, A.W., 2006. Transdisciplinary research: characteristics,

quandaries and quality. *Futures* 38:1046-1059.

Wilson, A., Howarth, R.B., 2002. Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. *Ecological Economics* 41:431–443.

Winkler, D., 2008. Yartsa gunbu (*Cordyceps Sinensis*) and the fungal commodification of Tibet's rural economy. *Economic Botany* 62(3):291–305. doi:10.1007/s12231-008-9038-3.

World Bank, 1991. *Managing Development: The Governance Dimension*. The World Bank, Washington DC: WB.

Wynne, B., 1996. May the sheep safely graze? A reflexive view of the expert-lay knowledge divide. In *Risk, Environment and Modernity*, ed. S. Lash, B. Szerszynski, B. Wynne. Sage, London.

Xu, J., Yang, Y., Li, Z., Tashi, N., Sharma, R., Fang, J., 2008. Understanding land use, livelihoods, and health transitions among Tibetan nomads: a case from Gangga Township, Dingri County, Tibetan Autonomous Region of China. *Ecohealth* 5:104–114.

Yeh, E., 2004. Property relations in Tibet since decollectivisation and the question of fuzziness. *Conservation and Society* 2:111-126.

Yeh, E., 2005. Green governmentality and pastoralism in western china: "converting pastures to grasslands." *Nomadic Peoples* 9:9-41.

Zimmerer, K.S., 2006. Cultural ecology: at the interface with political ecology - the new geographies of environmental conservation and globalization. *Progress in Human Geography* 30:63–78.

Zipf, G.K., 1941. *National Unity and Disunity: The Nation As a Bio-Social Organism*. Principia Press.

Annex A

As discussed in the methodological sections of the dissertation, the in depth interviews were conducted in an exploratory way following a Grounded Theory methodological approach. Every interview guide was tailored for the different respondents. However some broad general questions were used consistently throughout the qualitative interviews. In the case of the Traditional Village and Resttlment interviews at the HH level the interview guide was consistent throughout.

GUIDING QUESTIONS FOR IN DEPTH INTERVIEWS IN THE TIBETAN CASE.

Government leaders and civil servants

1. Can you describe the features of the environmental programs in the county?
2. What is the main gain of the Sanjiangyuan policy?
3. How is the policy organized?
4. What is the structure of the policy?
5. At what government administrative level are
6. the decisions taken?
7. How do they choose the households to move?
8. Is the resettlement voluntary?
9. What kind of job the nomads will do after resettlement?
10. Can you describe the compensation system?
11. What will happen to the animals of the resettled families?
12. Are resettled nomads included in the activities of the environmental projects of the policy?
13. What changes in the nomadic life style is resettlement going to provoke?
14. What are the main projects of the Sanjiangyaun programme?
15. Are resettled nomads happy of the program?
16. Could I receive an official document that summarizes the policy guidelines?
17. Could I receive official data on the resettlement projects?

Tibetan and Chinese Scholars/Scientist/NgOs members

1. Do you know about the existence of scientific studies on environmental degradation in the area?
2. What are the environmental benefits of the resettlement polices?
3. Are studies on the socio-economic consequences of the policy available?
4. Why are nomads resettled?
5. What are the effects of resettlement policies?
6. Are Nomads unhappy about the resettlement policies?
7. How do they choose the households to move?
8. Is the resettlement voluntary?
9. What kind of job the nomads will do after resettlement?
10. What will happen to the animals of the resettled families?
11. What changes in the nomadic life style is resettlement going to provoke?
12. What are the main projects of the Sanjiangyaun programme?
13. Are resettled nomads happy of the program?
14. Can nomads refuse to resettle?

Resettled nomads

1. What do you know about the Sanjiangyuan programme?
2. What do you think about the degradation of the pastures?
3. Your pasture was degradate?
4. What did you do with the animals after you moved?
5. When and how were you told to resettle?
6. What did government explained and offered you?
7. Do you receive compensation?

8. Does the government respect the terms of the agreement?
9. What are the rules you need to comply with?
10. For how long you cannot use the land?
11. Is the land still yours?
12. Do you collect bu?
13. How is your life style now? and how was it
14. before?
15. What support do you receive from the
16. government?
17. Your children go to school? And Before?
18. Did your life improve because of the
19. resettlement?
20. Are you happier now?

Interview guide in Traditional Village and Resettlement, information at the Village level:

1. General info
    a. Name of village
    b. Name of township
    c. Number of families
2. Description geographical
3. Institutional structure (leaders)
4. Cooperation
5. Conflict Resolution
6. Land Sharing
7. Time sharing-> amount, how it works
8. Nearest school
9. Nearest hospital
10. How was the private land divided
11. Was the village asked to move to the Resettlement?
12. Main activities in the village (economic/non economic)
13. Better or worse than before?
14. What progress?
15. Electricity?
16. Water?

Interview guide in Traditional Village and Resettlement, information at the HH level:

1. General info
    a. Age
    b. Name of village
    c. Years of school
    d. Gender and position in family
2. HH structure:
    a. How many people lives in family?
3. Size of the land:
    a. Winter land, cultivated land and Summer land size.
4. Do you rent land to/from others?
5. Activities:
    a. Describe your working normal day in summer
    b. Describe your holidays, what you do, when you don't work? When you have holidays
    c. Some for A for winter
    d. Some of B for winter
6. Assets:
    a. How many animals do you have? Yak, Sheep, Horses
    b. How many motorcycles, cars,etc?
    c. Other assets: (tv, solar panel, stove)
7. Expenditures

   a. Describe your daily expenditures summer?
   b. Describe your daily expenditures winter?
   c. Describe your monthly expenditures summer?
   d. Describe your monthly expenditures winter?
8. Income: (understand income)
   a. Describe your monthly income summer?
   b. Describe your monthly income winter?
9. Describe other sources of income?
10. Cooperation with other families?
11. Food:
   a. Food you buy/Food you auto-produce?

GUIDING QUESTIONS FOR IN DEPTH INTERVIEWS IN THE AMIATA CASE

As discussed in the methodological sections of the dissertation, the interviews were conducted in an exploratory way following a Grounded Theory methodological approach. Every interview guide was tailored for the different respondents. However some broad general questions were used consistently throughout the interviews

1. General questions on role and responsabilites of the intervieweed.
2. What is the first thought that comes in your mind when I say the word water?
3. Who are the main actors in the water management on the Amiata?
4. What are the main rules, legal acts related to the Amiata water resources?
5. What is the role of your organization/institution?
6. What is your role?
7. What are the general critical aspects of the water management in the area?
8. What are the threats for water resources on Amiata?
9. What do you think about renewable energies?
10. What do you think about geothermal power production?
11. What is the relationship between geothermal energy production and water?
12. Are you aware of the current scientific debate on the physical connection between the water and the geothermal basin?
13. Could you please tell me the story of the legislative process of authorization of the Geothermal power plants and how you/your organization were involved
14. What are the main rules/legal acts related to the Geothermal enegy production?
15. Do you have any writtend records?
16. If yes can I get a copy?

Annex B

Curriculum Vitae
Jampel dell'Angelo
September 2013

The Vincent and Elinor Ostrom
Workshop in Political Theory and Policy
Analysis - Indiana University
513 N. Park Avenue, Bloomington,
IN 47408 USA

Tel: (812) 347-8285530
Fax: (812) 855-3150
Email: jdellang@indiana.edu

EDUCATION:

2013 (expected) Joint Ph.D.
Sapienza University of Rome (International Development) – Universitat Autònoma de Barcelona (Environmental Sciences and Technology)
Advisors: Mario Giampietro, Kathrine N. Farrell, Vincenzo Naso

Dissertation: *Abusing the Commons? An Integrated Institutional Analysis of Common - Pool Resource Governance in Conflict Situations*

2008 Master in Energy and Environmental Management, Sapienza University of Rome, Italy (with Distinction)

2007 Master of Science in Environment and Development, London School of Economics and Political Science, UK (with Merit)

2006 Graduate Certificate in International Health, Curtin University of Technology, Australia (with Distinction)

2005 Bachelors of Science in Environmental Economics, Università degli Studi di Siena, Italy (110/110)

EMPLOYMENT:

2013–present Research Associate, The Vincent and Elinor Ostrom Workshop in Political Theory and Policy Analysis, Indiana University

2012 External researcher for the MSOCA project on Social Metabolism and Ecological Distribution Conflicts, Universitàt Autonoma de Barcelona - Spanish Ministry of Science and Innovation, Barcelona, Spain

2012 Energy Project Manager, Biopharma, Rome, Italy

2010 External consultant, RomeYork, Rome, Italy

2008–2011 Researcher energy and environment international cooperation unit, Interuniversity Research Center on Sustainable Development (CIRPS), Rome, Italy

2008	Energy Manager Assistant, Biopharma, Rome, Italy
2007	Research Intern, Third Generation Environmentalism, London, UK
2006–present	External Consultant, Association for the Solidarity in Asia, Rome, Italy

RESEARCH AREAS:

- Socio Ecological Systems
- Institutional Analysis and natural resource management
- Environmental Conflicts
- Sustainability Participatory Assessment – Participatory Video Making

FIELDWORK EXPERIENCE

- Qinghai, PRC: August – September 2007; September – October 2011
- Mount Amiata, Italy: March, August, September 2011
- Laikipia, Kenya: March 2013; May – September 2013

SPOKEN LANGUAGES:

- Italian (Native)
- English (Fluent)
- Spanish (Fluent)
- French (Intermediate)

FELLOWSHIPS AND GRANTS:

2011	UMB-Thor Heyerdahl Summer School fellowship, 1500 Euro
2011	Sabota Foundation research travel grant, 1000 Euro
2008- 2012	Italian University Ministry PhD full sponsorship, 40915 Euro
2008	Italian Energy Economist Association best Master thesis award, 2500 Euro
2008	CIRPS Master support fellowship, 2500 Euro
2007	Regione Lazio Master support grant, 5000 Euro
2006	Università degli Studi di Siena International Relations Fellowship, 7500 Euro
2002	Erasmus Program, 3300 Euro

PUBLICATIONS:

Edited Journal Issues

Gamboa G, Ravera F, Scheidel A, Dell'Angelo J, eds. 2014. *Pathways of rural change: An Integrated assessment of the Metabolic patterns of emerging ruralities.* Special issue of Environment, Development and Sustainability (in progress)

Peer-Reviewed Chapters in Edited Volumes

Dell'Angelo, J. 'The Sedentarization of Tibetan Nomads: Conservation or Coercion?' In "Ecological Economics from the Ground Up" Edited by Joan Martinez-Alier and Hali Healy. Routledge (Earthscan) 2012, London

Conference Proceedings

Dell'Angelo, J 2012, 'Some politicians only drink bottled water? A case study on the policy-science dynamics of the Amiata geothermal power plants development" The Vincent and Elinor Ostrom Workshop in Political Theory and Policy Analysis Mini Conference, December 2012

Dell'Angelo, J., Bixler, P., Hassan, R., Mfune, O., (2012) 'Discourse and practice in participatory conservation: exploring how it varies in different geo-political settings'. Proceedings of the Thor Heyerdal Summer School of Environmental Governance, Aas, Norway, 20 June -1st July

Chianese F. & Dell'Angelo J. (2010) 'Qamiri: what lessons can be learnt from indigenous people', Proceedings of the Second International Conference on Degrowth, Barcelona 26-29 Marzo, 2010

Dell'Angelo, J., Farioli. F., Naso, V., & F. Orecchini (2009), 'Sustainability Science: State of The Art and Future Perspectives', Proceedings of the 5th Dubrovnik Conference on Sustainable Development of Energy, Water and Environment Systems, September – October 2009, Dubrovnik, Croatia

Dell'Angelo, J. (2009), 'The Millennium Development Goals: A Critical Analysis', Proceedings of the Green Economics Institute Conference, November 2009, Oxford, UK

Manuscripts under review or to be submitted

Dell'Angelo, J., Farrell, KN., and I. Iniesta 'Neoliberism and metabolic patterns in the Tibetan rangelands: the resettlement transformation'. Accepted in the Special issue of *Environment, Development and Sustainability* 'Pathways of rural change: An Integrated assessment of the Metabolic patterns of emerging ruralities' (in progress).