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Work streaming / Mainstreaming Gendered Land Use and Land Cover Change (GLUCC): Afro-descendant Communities in the Pacific Region of Colombia

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Work streaming / Mainstreaming Gendered Land Use and Land Cover Change (GLUCC): Afro-descendant Communities in the Pacific Region of Colombia

by

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Dedication

Esta disertación es para mi esposo Arturo Brun-Martinez, y mi mascota Pascal, quienes con su amor e infinita paciencia endulzaron mi vida

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With fulfilment of this last step of a long commitment, I feel I did not have all words to Thank You! … but I'm walking on the Moon….

Work streaming / Mainstreaming Gendered Land Use and Land Cover Change (GLUCC): Afro-descendant Communities in the Pacific Region of Colombia

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Abstract: This dissertation addresses gender dimensions of Land Use and Land Cover Change (GLULCC) in the last few decades in a collective land titled to Afro-descendant communities in the Pacific region of Colombia, South America, and examines socio-economic and political signifiers affecting land use decisions, rights, and responsibilities. It shows how contrasting but complementary subfields of investigation, Political Ecology and Land Use Science, have contributed ontological, epistemological and practical scholarly works to help better understand the Gender Dimensions of Land Use and Land Cover Change (GLULCC). Historical and current information on environmental, socioeconomic and settlement processes provided a comprehensive portrait of the study area. The remote sensing process (a mainstream method for identifying land use and land cover change) helped exploring the spatial setting of land

cover/use, and to reflect on the opportunities and constrains of the steps undertaken during this procedure under the lenses of researching their gendered dimensions. Statistical analyses on both census data (secondary data) and survey sample data (fieldwork data) allowed to establish a set of three groups of gendered land uses, namely, women-akin, men-akin, and gender-blind uses. Exploratory statistics, pairwise correlations, and binary and multinomial logit regression models helped to reassert the latter gendered categories' assertions. A concluding narrative perspective of GLULCC seeks to further contribute to work streaming/ mainstreaming what I consider may be a scholarly-fertile research line. It hopes to bond, with another perspective, previous theoretical, spatial and quantitative outcomes, under the lenses of the practical experience of fieldwork, which also by way of participatory observation and semi-unstructured interviews brought to the researcher (me) valuable insights and information besides the previous outcomes. Empirical evidence allowed identifying gender-based time allocation, resource-use power relations, and reproductive strategies. Finally, the found rearrangement of settlement spaces and production systems provides practical indications that women´s role on LULCC is well beyond the establishment of small gardens and orchards, or the collection of fuel wood to provide for their families. In contrast, inside this collective title, women's decisions/strategies have also restructured settlement patterns, and thus, land use dynamics of larger areas at heterogeneous spatial and temporal scales.

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Chapter 1: Overview

"Is it possible to use for emancipatory ends sciences that are apparently so intimately involved in Western, bourgeois, and masculinist projects?" (Harding 1986).

My dissertation addresses gender dimensions of Land Use and Land Cover Change (LULCC) in the last few decades in a collective land titled to Afro-descendant communities in the Pacific region of Colombia, South America, and examines socio-economic and political signifiers affecting land use decisions, rights, and responsibilities. Literature review has evidenced fewer scholarly contributions that critically examine the gender dimensions of Land Use and Land Cover Change (LULCC).

The general working hypothesis of my research is that changes in gender relations, among other acknowledged causes of change, significantly contribute to land use and land cover dynamics, patters, and decision making. Currently, in the Colombian Pacific region, for example, these other causes of change are also related to the effects of increasing mobilization of groups within global environmental-development and ethnic rights agendas, and the incentive to develop and/ or maintain their cultural identities. I refined the above hypothesis by unfolding it into three sub-hypotheses: 1) Increased Afro-Colombian women's participation in political and social organizations to support women's interests, believes and perceptions, could have prompted changes in household and community relations and thus encouraged modifications or the creation of new settlement patters, gendered land uses and responsibilities; 2) Relevant causes of LULCC (Geist and Lambin 2002) may include changes in land tenure resulting from the establishment of collective land titles to Afro-Colombian communities after Law 70 of 1993, armed conflict, social triggering events, changes in public attitudes- values and beliefs, out-migration, and new government technologies taking place in the last few decades; and 3) In the last few decades institutional changes from the international to local levels, particularly fostered by external interventions including those of the World Bank, for potentially financing large extractive and infrastructural projects in this Colombian region (i.e. biodiversity mining; natural resource extraction; Pan-American Highway and secondary road infrastructure; inter-oceanic channel and new ports in the Pacific), could have prompted changes in gender relations with respect to LULCC.

This dissertation seeks to answer the following questions: 1) Is land use and land cover change gendered? and 2) If yes, how is it gendered?

The Pacific region encompasses roughly ten percent of the Colombian territory, is mainly covered by tropical rain forests, and has the world´s largest plant biodiversity (IGAC, 2002; UNDP, 2000). Law 70 in 1993 recognized collective land rights of rural areas in use by Afro-Colombian communities with traditional production practices in the Pacific region. As of March 29, 2010 according to INCODER (*Instituto Colombiano de Desarrollo Rural* – Colombian Institute for Rural Development), 161 collective lands comprising 5'215.547 hectares have been titled to these communities in the Colombian Pacific region (personal communication). An ongoing process, "this novel collective land titling project is among the most ambitious and radical territorial reordering ever attempted in Latin America" (Offen, 2003, p.44). Colombia's new Constitution of 1991 redefined the country as a multiethnic and pluricultural nation, and upon it, Law 70 in 1993 calls for establishing mechanisms for protecting Afro-descendant communities' cultural identity and promoting their economic and social development (Diario Oficial, No. 41.013, August 31, 1993.). Notwithstanding, this titling process may have raised important issues on the communities' gendered resource access, property rights, and conservation and development initiatives, among others, these at present are not sufficiently investigated. Gendered land use and land cover changes (GLULCC) are yet to be elucidated.

My theoretical framework is informed by the LULCC literature, which is fundamentally a 'technical-scientific' spatial examination of landscape change; commonly using spatially explicit models to either statistically explain or predict such a spatial outcome (Walker, 2004). Yet, this literature has not addressed to any significant extent the gender dimensions of these changes. Therefore, I also draw from broader perspectives of the Political Ecology literature, which critically analyzes asymmetrical entitlements to resources, and gendered structural-environmental positions as the consequence of socio-political and development frameworks (Rocheleau et al 1996; Ribot and Peluso 2003; Leach, Mearns, and Scoones, 1999).

Upon this literature corps, I reflect on the knowledge that may be produced or constrained by way of LULCC surveys, particularly those that are based on image processing and interpretation (i.e. remote sensing RS) for visualization and representation, and on the collection of 'data' by way of structured surveys/interviews where the household head is often pivotal. By deconstructing the LULCC process -from the selection and bounding of the study area, to the collection and categorization of imagery and data, and the change detection itself-, I suggest that these knowledge claims that are based on universalism, apparent political neutrality, and masculinist gaze (Rose 1993, Harding 2006), have important social implications on acknowledging wider contributions of women to land use and land cover dynamics. Ideas on reflexivity, imaginary, and representation (Haraway 1991, Cosgrove 2008), are examined in relation to questions on spatial and temporal resolutions, statistical significance of data, local heterogeneity, or proximal interactions (Jensen 2007) for gendering the LULCC process. By doing this, I hope that the present critical analysis of the LULCC process could contribute/add to new research agendas. Given that gender relations have not been widely recognized/ acknowledged into mainstream land use and land cover ‘causes of change’ (Lambin et al. 2001), or classification schemes (e.g. Anderson et al. 1976; UN Land Cover Classification LCCS; IGBP classification; the CORINE classification), gendering these practices through their creative re-construction may open avenues for empowering/ endowing women, especially from developing countries.

On the other hand, implications on the use of technologies in LULCC surveys such as cartography, Remote Sensing (RS) and Geographic Information Systems (GIS) have been less commonly acknowledged in the social arena of sciences (Turner 2003). Seminal works uncovered how maps have served as “cartographic discourse,” and shown their centrality to “geographical imaginary” and to legitimating power (Harley 1988). It was contended too that the categorization of mapping units derived from satellite images could be “fixing certain interpretations” to serve particular institutional interests (Robbins 2001). More recent works, instead, have focused on the cultural and political significance of high-resolution remote sensing. For example, on the “visual representation of current issues such as political violence” using Google Earth (Parks 2009). More general, social research with similar questions as geography has added new insights to theories on globalization and remote sensing technologies (Aday and Livingstone 2009).

Despite the above contributions, in the last decades the bulk of GIS and RS applications have focused more on data collection and processing, and much less on critically examining knowledge production. Likewise, with the rise of commercial data providers such as Google Earth, more people have engaged with geography, first relying on media and communication, and lastly (if at all) on spatial analysis. The rising availability of free and open software, geospatial information and data, has significantly increased the use and communication of geography, particularly impacting developing countries with more limited information access. But again, increasing geographical data availability has not been fully coupled by knowledge-increased, particularly on the participation of women on environmental change and more specifically on the gender dimensions of LULCC. The latter pertinent knowledge could progressively support novel policy drafting on gendered land use planning, among others, to increasingly empowering women.

Empirical evidence for my research on gendered land use and land cover (GLULCC) was obtained at a subdivision of the collective land “Delfines”, named “El Cedro”, which comprises a large agricultural floodplain surrounded by tropical rain forests. This rural area, where traditional land uses and livelihoods still prevail, is currently almost uninhabited (but still essentially in use) and locals are now clustered inside a small village. In the field, I ‘surveyed’ this area using satellite images, maps, and global positioning systems walkthroughs/exploratory, and by way of both structured and unstructured interviews, as well as participatory research. But I also conducted participatory observation, structured interviews with men and women at the individual and household levels, and unstructured/semi-structured interviews with open ended questions to many local community leaders, and governmental and nongovernmental organizations’ officials working in this region. Empirical evidence allowed identifying gender-based time allocation, resource-use power relations, and reproductive strategies.

It was evident, however, that the found rearrangement of settlement spaces and production systems was not only explained as the transformation of gender division of labor, authority and resource management as showed/proposed by some feminist political ecologists (Rocheleau, Thomas-Slayter, and Wangari 1996). Nor it could be elucidated only by off-farm employment opportunities or changes in agricultural prices (Angelsen and Kaimanovitz 1999). Instead, in the following chapters I seek to show how locally, this resettlement could also be attributed in part to women's separatist movements, which pushed for the community's relocation to the intersection of fluvial and coastal environments where a new school was established. Women envisioning better livelihoods by way of their children's education clustered on what three to four decades later had become a small village. Although recent theoretical insights on the co-production of land use and livelihoods acknowledges 'changes in each as reflective of changes in the other' (Carr and McCusker 2009), I suggest, that women's imaginary, in part encouraged by the Catholic Church running the school while acting as a second state, (may) also resulted in novel spatial rearrangements of land tenure and use in the study area. On the other hand, practical evidence also shows that current gendered LULCC have resulted from historical events previous to the last few decades in which my research is focused; GLULCC might be embedded, and thus could be further explained, under broader and longer traditional societal processes leading to particular customary laws and practices related/linked to LULCC. My research provides empirical evidence that women´s role on LULCC is well beyond the establishment of small gardens and orchards, or the collection of fuel wood to provide for their families. In contrast, inside this collective title, women's decisions/strategies have also restructured settlement patterns, and thus, land use dynamics of larger areas at various spatial and temporal scales.

Based on the above, core chapters of my dissertation focus first on describing empirical evidence on gender dimensions of LULCC (GLULCC); second, on critically examining the LULCC process as a technical-scientific method producing knowledge claims; and finally on how a narrative perspective of GLULCC based on data provided both by remote sensing/GIScience and statistical analysis could be applied to geographies concerned with knowledge production particularly on gender questions.

Chapter 1 is the Introduction and Statement of the Research Problem. Chapter 2 comprises the first theoretical framework informing this dissertation which incorporates the field of examination of political ecology literature, which has contributed indirect evidence to understanding the gender dimensions of land use and land cover change, and of resource access more generally. Notwithstanding that many of these scholarly related contributions are theoretically based and empirical case studies often address different perspectives on resource use, access and control.

Chapter 3 portrays my study area which is a subdivision of “Los Delfines”, a collective land legally titled to Afro-Colombian communities in 2002, located in the municipality of “Bahía Solano” in the coastal area of the Department of Chocó, Pacific region of Colombia.

Chapter 4 comprises the second theoretical framework informing this dissertation which incorporates the field of examination of the Land Use and Land Cover Change (LULCC) literature, which has developed theories and methods seeking to identify the aerial extent of land use dynamics in a given period of time, and the factors and causes guiding pertinent patterns and decision making. it also tackles the Gendered aspects of the LULCC process as a scientific approach. This section critically analyzes the traditional Land Use and Land Cover Change (LULCC) process, including research methods, and epistemologies with the objective of highlighting gendered aspects of LULCC (GLUCC). Feminist theories, and Science studies/ philosophy shape perspectives on the basic steps undertaken during the LULCC process including the definition of the study area; the collection and use of geospatial data; the classification process; and change detection / modeling. This chapter seeks answering the research question: How is LULCC gendered?

Chapter 5 includes the statistical analyses of both primary and secondary data (structured interviews). It comprises results of statistical analyses of both secondary and primary information including binary logit and multinomial regression models on land use based on data gathered during my fieldwork campaign. Pertinent findings on gendered land use are highlighted.

Chapter 6 aims at grounding gender and LULCC. This section presents a narrative perspective of gendered land use as well as gendered strategies on land use, access, and control (partly based on Ribot and Peluso's theory of access). Findings are largely based on structured and unstructured interviews (with open and ended questions), and participatory observation. Concepts on gendered structural positions, gendered knowledge and responsibilities on the environment, and everyday practice inform the examination and presentation of pertinent results. This chapter seeks answering the research question: How is LULCC gendered?

Chapter 7 is the concluding chapter.

Chapter 2: Political Ecology

Since its early developments in the 1970s Political ecology has evolved in terms of specific concepts and theories (i.e. ecological science, power-knowledge field, political economy), and of the research objects the subfield has embraced (i.e. ecosystem/ cybernetics, ecological anthropology/ cultural ecology, natural hazards / disaster research) (Watts and Peet 2004).

The definitions of political ecology have varied accordingly: Bryant (1998) states that “Political ecology examines the political dynamics surrounding material and discursive struggles over the environment in the third world. The role of unequal power relations in constituting a politicized environment is a central theme.” (p.79); Robbins (2004) defines political ecology as describing “empirical, research-based explorations to explain linkages in the condition and change of social/ environmental systems, with explicit consideration of relations of power” (p.12); And Watts and Peet (2004) claim that “political ecology… seeks to understand the complex relations between Nature and Society through careful analysis of social forms of access and control over resources- with all the implications for environmental health and sustainable livelihoods” (p. 4). These definitions evidence as well a progressive contextualization and coherence within this field of inquiry.

The bulk of political ecology literature has been attentive on poststructural philosophy (and cultural and social theory) to understanding a “new post-modern era” (Peet and Watts 1996, Watts and Peet 2004). Inside these scholarly works, Feminist Political Ecology (Rocheleau et al 1996) brought new gendered perspectives to the field, but arguably, still not represent a remarkable proportion of this literature (Elmhirst 2011a) and has been particularly blamed for a limited theorization on race (Mollett and

Faria 2013). More general, political ecology has strongly focused on the third world and rural areas, yet more recent 21st century contributions have been increasingly concerned with the first world as well as on urban and global dimensions including climate change (McCarthy 2002 and 2004, Toly 2004, Neumann 2004, Forsyth 2004, Goldman 2004, Emery and Pierce 2005, Schroeder et al 2006, Robbins 2008, Birkenholtz 2011, Davidson 2012).

Key contributions to political ecology during the last few decades are shortly highlighted below, including core (foundational) concepts of political ecology, and case studies that embody these notions.

FOUNDATIONS OF POLITICAL ECOLOGY

Foundational concepts of political ecology focused on themes of marginality, and the pressure on production of resources (Watts and Peet 2004) traced more clearly by contributions of influential authors in the 1980s (Watts 1983, Hecht 1985, Blaikie and Brookfield 1987). While early research interests included critical interpretations of Darwinian evolutionary theories (Malthus 1978, Desmond and Moore 1991); and issues on property, population and populism (Hardin 1968, Chase 1975, Macpherson 1978); or policy decision-making and practice (Hecht 1985, Brohman 1996, Peet 1999); these were subsequently nurtured with contributions on environmental narratives and colonialism (Leach and Mearns 1996, Grove 1997); and crisis accounts (Hellden 1991, Sprugel 1991, Scoones 1999), among numerous others. Critical reflexivities on ideological frameworks, development, environment, and social change were the key concepts cross cutting the bulk of works of the 1990s and early 2000s (Escobar 1995, Brohman 1996, Peet 1999, Kirby 2001, Pickles 2001, Watts 2001).

Pioneering works of the 1980s

Political ecology of the 1980s is broadly represented by founding scholarly contributions of key authors such as Watts (1983), Hecht (1985), and Blaikie and Brookfield (1987) that helped building new concepts on environmental narratives and colonialism; the political ecologies of crisis narratives; and the importance of the new ecologies respectively.

A critical examination of the studies on natural hazards (its theory, ideological and epistemological claims), raised awareness on the inadequacy of some analytical frameworks for environmental threads and perturbations (e.g. biological adaptation, general purpose social systems), and the need for a careful insight on the 'status of environmental knowledge', the impacts of colonialism on nature-society relations, and the structure of social relations of production based on interpretations of society, nature, and change (Watts 1983).

Likewise, analysis of land degradation's main 'theoretical confusions' caused by opposing theories of social change, and failure to view degradation through a wide historical and geographical framework, gave rise to proposing a 'regional political ecology' based on historical approaches that allowed relating the role of the land manager and his/her decision making process, with land management in terms of recognizing society and economy as continually in transition (Blaikie and Brookfield 1987). Thus, the relationships between society and land degradation were characterized by these authors as having interactive effects through time at different geographic and socio-economic organization scales; among the influential terminology proposed by them are: a) Landesque capital being the works and improvements made to land to create capital for future maintenance of land capability; and b) sensitivity and resilience of land (respectively, land systems' extent to undergo changes from natural forces, and ability of land to reproduce its capability after interference).

Similarly, it was claimed the necessity of creating models on environmental degradation that combine development and environmental issues into one analysis -of national and international processes- with historical and political economy approaches (Hecht 1985): based on the conversion of forest into agricultural landscapes in the Brazilian Amazon after the military coup of 1964, it was evident that environmental questions were analyzed based on inadequate frameworks, which should include deforestation and environmental degradation as resulting of political and ideological functions (e.g. legitimization of the military regime, national security and national integration, great push towards ranching in Latin America). Hecht's approach showed how the roles of land in inflationary economics and of government subsidies for land markets and speculation led land itself to be a commodity (not its productivity), and to assert the necessity of including 'dynamics of speculative economics' into models of environmental degradation.

Of these seminal political ecology contributions, it was claimed that overstated themes on poverty could be 'neglecting the power of capital in degradation', with a bias towards rural, agrarian, third world issues; and the attention for land at the expense of other resources (Watts and Peet 2004). In spite of the above, these works represent significant path-breaks for many political ecology researchers (Robbins and Monroe 2008).

Theories and concepts of the 1990s and 2000s

Within few decades, earlier interests of scholarly research in political ecology were superseded by new or in depth theories and topics. Political ecology of the 1990s and early 2000s are marked in one hand by a more theoretical impulse in which many authors propose, re-define and contest notions and philosophical backgrounds; and on the other by a more profuse empirical work and thematic propositions, including Marxism and ecology, nature-society and political economy, and political economy and the environment (Watts and Peets 2004). Works concerned with re-theorizing development were particularly relevant (Escobar 1995, Brohman 1996, Peet 1999, Kirby 2001, Pickles 2001, Watts 2001. Below are a few of those that I consider more representative.

First, the "Liberation ecology" contribution (Peet and Watts 1996) based on the awareness on 'environmental imaginary' (from Marxist and post-structural ideas) and 'environmental determinism' (from early modern geography) proposed broader notions (i.e. class struggle, social movements, and everyday resistance) and deeper thoughts on these notions (e.g. resource ownership, control over human imagination).

Second, the poststructural political ecology based on the principle that 'nature is socially constructed' and on the discourses of sustainable development and biodiversity conservation (linked to the discursive nature of capital) (Escobar 1996). In words of Escobar, the reinvention of nature that links the discourses of science and capital is the articulation of knowledge and power, of statements and visibilities, in which social reality inevitably comes into being.

Third, the concept of 'environmental entitlements' that explores how social actors 'command' environmental goods and services for their well-being under arbitration of institutions at different scales (from the local, to national or global levels) who mediate people-environment relations (local ecologies), and resource access and control more general (Leach, Mearns and Scoones 1999). Moreover, these institutions could include both traditional forms of production, property rights, ideological models, politics, developmental theories, or policies.

And fourth, presents the advocation for inclusion of 'things that are clearly more than social' into political ecology frameworks (Mitchell 2002). Based on his study of World War II - Egypt, Mitchel (2002) describes the connections between war, disease and agriculture; which led to a malaria epidemic brought by anopheles mosquitoes traveling through 'wartime traffic'. He argues that those events were not only connected at a social level but instead their linkages were hydraulic (construction of dams and irrigation systems), chemical (intensive use of fertilizers), military (war traffic), political (power relations), etiological (anopheles mosquito) and mechanical. It was, Mitchel (2002) argues, the heterogeneity of these elements that pose a difficult explanation, thus contending that social theory, instead of addressing such interactions "is still largely trapped in the methods and division of labor of the nineteenth century" (p.28).

Case studies on core themes of political ecology

Some empirical case studies represent particularly well the core themes of political ecology, and are grouped into five pieces: 1) environmental narratives, and 'new ecology' in policy decision-making and practice; 2) environmentalism, corruption, and social control; 3) Social Justice / nature; 4) Political ecology and the new technologies; and 5) Community-based resource access. These contributions either sought new theoretical or methodological perspectives, or alternatives to what is being criticized.

Environmental narratives and new ecology

'Environmental narratives', and the 'new ecology', have played particular roles in policy decision-making and practice (Leach and Mearns 1996, Blaikie 2001, Scoones 1999).

It has been asserted that (powerful) images of environmental change from development institutions, professionals and media vocabulary that have acquired the status of 'environmental wisdom' may have often led to mistaken development policy on themes such as desertification, deforestation, soil erosion and biodiversity (Leach and Mearns 1996). More so, both the (contradictory) ways in which environment is interpreted and explained by those in charge of its management, and how these different views inform policy-making in the development world suggest to take alternative approaches to environmental policy including: incorporation of marginalized voices; deconstruction of authoritative truth claims about nature; and building democratically negotiated knowledge about the environment (Blaikie 2001). In addition, ecological perspectives of balance in nature (i.e. static/in equilibrium ecological systems) have pervaded long and profoundly in disciplines and sciences such as anthropology, geography, environmental history, or sociology, which require: to overcome both the nature-culture divide and dichotomizations (e.g. realist-idealist; objectivism- relativism) towards more integrative approaches; to undertake environmental change analysis as a multi-sited and multiple actor issue; and to include 'principles of adaptation management, learning, and inclusive deliberation' into fields that study policy processes, and institutional and organizational design (i.e. complexity and uncertainty) (Scoones 1999).

Environmentalism, corruption, and social control

Environmentalism, corruption, and social control, have also been influential themes in political ecology (Peluso 1993, McAfee 1999, Robins, 2000).

Resource conservation and control between national governments and international agencies, in some cases could either contribute to the exclusion of indigenous people with resource claims or legitimate the use of force in resource management (Peluso 1993). The commoditization of nature through 'green developmentalism' of supranational institutions, which abstract nature from its spatial and social contexts, have led opponents to advancing counterdiscourses and alternative practices (McAfee 1999). More so, 'natural resource corruption' has been defined as a system that profits from dishonest forms of social capital following existing classed and gendered power to create selective landscape effects, acting on certain features of natural systems while evading others (Robbins 2000).

Social Justice / nature

Based on the above, and on the themes of Social Justice and Social Nature, it has been further asserted, for example, how extractivism historically has been built on the commodification of indigenous/ traditional communities through production relations including slavery, (inheritable) debt, bondage (labor in payment), and serfdom (tenant bound) (Hvalkof 2000), with harsh consequences to the survival and development of many of these communities even to the date. Grounded on the prerogative that conflict is more related to resource value and wealth than to poverty (and thus may need to be traced in global rather than in local levels) (Peluso and Watts 2001), it has been evidenced how using environment to explain conflict often seeks to draw attention away from national and international commercial interests, political economy, or control over valuable resources, towards ‘environmentally marginalized’ people who are the least to blame of particular environmental degradation (Fairhead 2001).

Political ecology and mapping technologies

The political and philosophical implication of the social construction of concepts such as ‘nature’ and ‘the physical environment’ are culturally and historically specific, and may include both ‘denaturalizing’ arguments, situated knowledge, and ontological claims (Demeritt 2001). Thus, the causes and consequences of the use of new technologies such as cartography, remote sensing and Geographic Information Systems (GIS), in geographical and political ecology research merit further attention.

Key authors to these discussions are Harley (1988); Schuurman (2000); Robbins (2001a); Turner (2003); Kwan (2002); and Rocheleau (2005).

By evidencing how maps as a special form of knowledge (‘cartographic discourse’ and ‘ideology’) have been central throughout the history of ‘geographical imaginary’ and served the interests of political regimes, property rights and power legitimating (with uses of them including warfare, boundary making, or the preservation of law and order), Harley (1988) concluded that “The iconology of the map in the symbolic treatment of power is a neglected aspect of cartographic history” (p. 303).

New broadly used technologies such as Geographic Information Systems (GIS and Remote Sensing (RS) have popularized map production at unimaginable rates thus extending map uses to more ‘democratic’ and personalized manners.

Notwithstanding, historiographic examination of critiques of GIS has distinguished three periods of divergent argumentations (Schuurman 2000) p.1) from

1990 to 1994, debates emphasized positivism, cartographic representation, and epistemology; 2) from 1995 to 1997 critiques focused more on the effects of digital surveillance, the ontological implications of interoperability and the means of democratizing GIS; and 3) from 1997 onwards, critiques expressed a greater commitment to technology; with later critiques accommodating joint efforts between social scientists and scientists within geography.

More so, deepened insights on map production using satellite images (RS) have reflected on the process of categorization (and meanings) of varying mapping units between experts and locals of a given community, which allow labeling these classification schemes as 'impartial tools', 'fixing certain interpretations' for the sake of particular institutional interests (Robbins 2001a). Thus, feasible ways of incorporating RS and GIS into research frameworks in which this is less common including political, human, and cultural ecology have also been addressed (Turner 2003).

As an example, GIS methods could as well be used to enrich feminist geographic research by: 1) linking geographical context to women's everyday lives; 2) supporting women's activism through GIS-based research methods; 3) using qualitative data to construct cartographic narratives; 4) mapping women's life paths in time-space; and 5) revealing the gender biases of conventional quantitative methods (Kwan 2002).

Rocheleau (2005) is concerned by the potential simplification, 'fixing' capacity, and exercise of power, involved in mapping every complex social-environmental relation in a 'two dimensional surface'. Even, in her words, if mapping aims at making visible the needs and knowledge of disenfranchised local people, as is the case of community-participatory mapping (counter-mapping). She suggests alternative maps and ways to map including: to map what is *desired*, *needed* or *possible,* and *'what if'* scenarios (instead of what is there), out of the 'imagery of people's livelihoods and landscapes'; and to map the complexity of plants and animals' condition and composition, and their 'networks' with people, physical features, or technologies, for access rights research for example.

Community based resource access

Case studies of Ostrom (1990), Agrawal and Gibson (1999), and Kumar and Corbridge (2002), are relevant in illustrating the 'community-based resource access' core-theme in political ecology. Communities' actors are not homogeneous, they have varied roles and interests in resource use and conservation that may impact decision making, whilst institutions may in turn affect their decision-making processes; this have led to re-consider development strategies and policy making (Agarwal and Gibson 1999). Based on analysis of myriad case studies on common pool resources (CPR) -by many authors and disciplines- it was easier to understand how institutions both help and effect users of CPR (Ostrom 1990). Indeed the outcomes of many development institutions and projects may not always result as expected due to lack of insight of the community's heterogeneous characteristics. Kumar and Corbridge (2002) study on the Eastern India Rainfed Farming project, a development project conducted by a joint venture of the governments of UK and India exemplifies the above assertion: The project was directed towards the poorest of the poor; however the non-poor farmers were the ones who acquired planning knowledge and learned how to manipulate it; This in turn led to the accumulation of household social capital which was positive in farm productivity. Thus, the above authors argue that the project should not be considered a failure, as this "cannot be expected to change local systems of politics or stratification" (p.73).

More recent literature and lacunae in political ecology

As drawn from above, the bulk of political ecology works has focused in third world and rural geographical spaces. However, more recent research directions denote increasing interest in first World political ecology; in urban dimensions including the political ecology of water; the concept of environmentality; environmental social movements; garbage and the politics of sanitation; political ecology and civil society; globalization (i.e. epistemic communities; global struggle over contested resources; global governance institutions; global commons); bio-prospecting; and the merging of land change science and political ecology, among many other important concerns. Some influential literatures on the above referred new themes are acknowledged below.

Goldman (2004, 2005) looks at the greening of development institutions specifically the World Bank. He explores concepts such as the construction of global projects of 'green neoliberalism' or 'eco-governmentality' controlling the environment and natural resource use. He shows an empirical case in Laos People's Democratic Republic where a 'model' project of the World Bank was developed, displaying some of its failures and paradigms. The author seeks to answer how "knowledge/power relations run through scientific and legal practices of the World Bank new green work, and become concretized through loan conditionalities, environmental assessments, scientific reporting, methodologies, classifications, policy papers, decrees, legislation, and large-scale foreign investments" (Goldman 2005 p.185). Goldman's book "Imperial Nature" (2005), in the author's words, tries to explain how transnational structures of power, knowledge, and capital are produced; how they become hegemonic; and how they are challenged.

Similarly, McCarthy (2004) argues that the recent multilateral trade agreements which are part of the neoliberal agenda (i.e. NAFTA) are redefining property rights and environmental governance, triggering processes such as privatization, 'or primitive accumulation' in two cases (USA and Mexico respectively). "the doctrine of 'regulatory takings' or 'measurements tantamount to expropriation' allows firms to bypass the tremendous risky circuits of capital entirely…by relying directly on the power of states to tax their populations…(this) business plan…falls squarely within the repertoire of primitive accumulation" (p.339). In the latter authors' words this implies freezing conditions of production to the firms, while "tying the state's hands in regulating these nearly guarantees environmental degradation" (p.340).

More so, Toly (2004) focuses on globalization as a technological and economic phenomena driving environmental change, and 'capitalizing nature'. "One result of this process in Mesoamerica is that biodiversity is being associated with particular discourses and political-economic institutions such as intellectual property rights and sustainable development" (p. 52). He also demonstrates the emergence of grassroots efforts to challenge "bioprospecting as the colonization of both the biological and intellectual commons" (p. 53).

Agrawal's (2005) book 'Environmentality, Technologies of Government and the Making of Subjects', in the authors words, is an investigation of a long process of changes in environmental politics, which helps extend contributions from common property, political ecology, and feminist environmentalism. He calls 'environmentality', the new approach to the study of environmental relationships which links power/knowledges, institutions and subjectivities in the last 150 years in Kumaon and India (1850-2000). He examines the extension of colonial states in this part of India, how are the technologies of government carried out (i.e. colonial state, decentralized regulatory rule, constitution of environmental subjects), and how they worked and are working. Concepts of strategic ignorance and neoliberalism path dependence are discussed. “A focus on technologies of government and their application helps undermine the tendency to view institutions, power, or subject locations as the unquestionable starting point from which to gain an understanding of environmental change and politics” (p.230). Also in the context of comparative historical analysis Roderick Neumann (2004) presents a comparison between national parks in the United States and in Tanzania to address notions such as ‘commons enclosure’ by the state. Parks are defined by the author as the ‘fortress conservation’ model that forbid human occupation, and are part of the construction of the modern nation state.

On social movements, Forsyth’s (2004) work on industrial pollution and urban social movements in Thailand examines the ‘brown’ environmental agenda of cities and factories, and “explores important epistemological challenges for liberation ecologies that may be more prevalent in the ‘brown’ agenda than in ‘green’ environmental topics” (p.422). Among these challenges in the author’s words, is the necessity to assess the interrelations between urban social movements and a greater representation of local livelihoods. This is analyzed by the author in the context of discourses on lead and lignite pollution in Thailand which had become ‘hegemonic constructions of reality” (p.436) which not always help vulnerable people to cope with industrialization.

Besides the above, it has also been acknowledged that both political ecology and a parallel approach, land-change science (Chapter 4), provide understanding about changes in the coupled human-environment system (and in the development of sustainability science) albeit their different emphases on causes and consequences of land transformations (Turner and Robbins 2008, National Research Council 2010). Indeed, merging of political ecology and land change science has aided explaining deforestation as resulting from the interaction of varied and antagonistic agents as opposed to as consequence of independent actions of land managers (Aldrich et al 2012). Air pollution and health in cities have been analyzed under the lens of coupled land use regression, urban political ecology and environmental governance (Buzzelli 2008). And a framework of land use change, cultural and political ecology has helped examined spatially homogenized landscape implications due to cooperation adopted by politically less powerful groups in historical contexts in China (Jiang 2003). Similarly, Political ecology of land reform programs in South Africa and analysis of provincial land-use change led the investigation of subnational land-redistribution efforts (Moseley and McCusker 2008). And community political ecology of resource use and land cover dynamics in the Brazilian Amazon was found to integrate the decisions of peasant producers (Porro 2005). Likewise, this merging of subfields has helped to untangle how 'hidden landscapes' are produced in communal landscapes as "the result of overlapping and conflicting rules, knowledge of environmental governance, and mechanisms of enforcement" (King 2013 p. 201). And further more, the integration of land change science and feminist political ecology have recently exposed how migrant daughters enable the purchase of assets and participate in land-use decision making, thus shaping land change at the household level (Radel et al 2013). Indeed, the ample fusion in problem framing and methods of land change science and political ecology led Turner and Robbins (2008) to raise the concept of a 'hybrid land change' or ecology as a sound perspective to the analysis of the coupled human-environment / nature-society relationships.

Feminism and Political Ecology

As briefly articulated above, incorporation into a single framework of feminist perspectives combined with analysis of ecological, economic, and political power relations (and derivation of theory from practical experience), gave rise to feminist political ecology FPE (Rocheleau et al 1996). Albeit this subfield has been criticized for it holds a limited theorization on race (Mollet and Faria 2013). On the other hand, feminist theory and its history has been contended for being a modern and western invention (Connell 1987): the ways in which other civilizations dealt with human sexualities and interrelations; from medieval reformation, socialist sex division of labor, sex difference (sex roles) in the United States, feminism and gay liberalization in the 1970's, and the internal divisions of gay theory and feminist theory in the 1980's chains the examination of theoretical frameworks such as the Dual systems, Sex role, Categorical, and Practical based theories.

None the less, crosscutting themes and theoretical insights of the emerging FPE subfield included: 1) linkages between environment and survival; 2) the impact of economic and political systems in localities; 3) gender-based asymmetrical entitlements to resources; 4) value of local knowledge; 5) gendered space; and 6) realignment of rural-urban space and production systems (Rocheleau et al 1996). Likewise, Rocheleau et al (1996) proposed four core theoretical discernments for feminist political ecology: a) the 'interconnectedness of all life' in decision making about the environment (i.e. between the immediate and broader survival concerns; and the effective use of non-violent methods); b) questioning the presumption of technological progress and domination of nature (i.e. question the nature of environmental knowledge and of technologies); c) recognizing that ideologies shape relationships among gender knowledge, environment, and development; and d) addressing the different structural positions occupied by women and men. A historical account of how FPE came into being is proposed below.

The Chipko movement emerged in India in the mid 1970's symbolizing a feminized ecological consciousness that challenged current approaches to development (Guha 1989, Shiva 1988). This movement was "an icon of grassroots environmentalism" (Rangan 2004, p.382), and at the same time a cornerstone in the recognition of gender relations with respect to resource use and control. Since the 1970's an increasing interest for understanding gender relations in various fields resulted in a wealth of theories and case studies related with gendered environmental change. The seminal work on women and development by Boserup and Lijencrantz (1975) is one example. However, it is after the late 1970's when publications on ecofeminism, 'women, environment and development', and feminist theory are more profuse (Anupama and Tripathi 1978, Connell 1987, Shiva 1988, Guha 1989, Jackson 1993, Sachs 1996, Rocheleau et al 1996).

A broader and empirically detailed gender analyses, which recognized woman-environment relations – not in isolation – from men were later proposed as a reaction to theorizations such as ecofeminism, and Women, Environment and Development (WED) literature. On one hand ecofeminism theory (Shiva 1988) was blamed for its biological determinism, essentialism and absence of historical context; and on the other, the WED literature was critiqued for its portrayal of women in their special relationship with nature as 'carers' of the environment (Jackson 1993). Considering that all sexes could be interested in protecting nature but with different concerns and responsibilities, as well as dependence on resources, feminist environmentalist perspectives as opposed to ecofeminist perspectives were suggested as an alternative to previous questions about gender equity (Agrawal 1997).

More recently, it was introduced a New Feminist Political Ecology and pertinent research works (Elmhirst 2011a) by pondering challenges that may explain the relatively limited number of works that 'self-identify as feminist political ecology' and highpoints ways in which recent feminist thinking could enhance work in this field. These include feminist conceptualizations of scale (Elmhirst 2011b, Ge et al. 2011, Nightingale 2011, and Truelove 2011); the power of a corporeal feminism in feminist political ecology (Grosz 1994, Nightingale 2011, Sultana 2011); and the merging of feminist considerations of scale and embodiment to understand gender as a constitutive power at all scales of analysis (Wright 2010).

Gender, the Household and the Community

The development of household theories and emergence of the household in economic analysis in the 1960's (namely unitary models and dual system models), and the subsequent politicized concepts of the household (feminist critics) (Hart 1992) have points of convergence with feminist literature including political ecology. Whereas unitary models define the household as a "unified economic actor … (or) … undifferentiated unit" (Hart 1992) p.111), a politicized concept of the household "invokes strong assumptions about intra-household power relations" (Hart 1992 p.125). "Households are not bounded units and their internal structures and workings produce and are produced by larger scale cultural, economic and political processes." (Moore 1992 p. 131, Wolf 1990).

Certainly, men have been often taken as heads of idealized "households" whereas women regularly have only been characterized as wives in landholding systems with their actions considered secondary or inconsequential to the changes within these systems

(Place et al. 1994 p. 37). Indeed, women heads of households are frequently not analyzed as a distinct category (Yngstrom 2002), particularly when researchers depend on the household as its basic element of analysis with implicit assumptions of a unitary utility function model. Notwithstanding, it has been increasingly recognized that the household is a complex unit of analysis affected by multiple factors, with concerns of "gender-analysis frameworks (that) focus on gender as the dimension of difference within the household (arguably alongside age)" (Bolt and Bird 2003 p. 1-2). As Bermant (2008) puts it, relations of inequality rules access to and control of assets in the household while migration as well as kinship structures are fundamental to intrahousehold allocation. Indeed, differential provisions are found in patrilocal/patrilineal and matrilineal systems. Under the former systems, where men often control most assets, women do not generally have property rights unless mediated by men whilst in contrast, under matrilineal systems, women have more independence and are granted greater decision-making: An increased awareness on household resource flows and exchanges allows recognizing household economic connections and decision-making dynamics (Bermant 2008).

Similar to theorizations in gender and the household, in many cases the community has been conceptualized by scholars following unitary models. Otherwise, it has been argued that the concept of community is often not defined or examined, as in many resource use and management related projects where the multiple interests and actors within communities and their decision-making processes are neglected (Agrawal and Gibson 1999, 2001). The latter suggests to alternatively focusing more on institution rather than on community when studying community-based natural resource management (Agrawal and Gibson 2001 p. 2).

In this same line of examination, Agrawal (1997) draws attention to the gender equity of rights and empowerment within community institutions, contending that women are often excluded from participation in these institutions due to some constraining factors such as the rules governing these bodies, and the cultural construction of gender roles. Conversely, the author points out that the establishment of women's associations, and the presence of a critical mass of women in community's activities, could critically foster more participation on the part of women.

Gender, environment and development

In the 1990s feminist political ecology emerged to analyze environmental issues through varied gendered dimensions (Watts and Peet 2004).

Key works on these themes are those from Carney and Watts (1990); Carney (2004); Rocheleau et al (1996); Agrawal (1997); and Schroeder (1993, 1999).

Carney and Watts (1990), show how in the Mandinka rural society's (Gambia) new 'production regime' that institute double-cropping for rice fields led to "struggle over gender roles, labor obligations and property rights" (p. 211). "Female rice farmers were the focus of donor interest in the project" (p.223), because they were perceived as being more efficient workers than men. This led to gendered changes in "household property and family relations" (p. 226). The authors contend that "the transformation of land rights in conjunction with a radically new labor process has given rise to contradictory and deeply gendered developments with respect to domestic access to, control over, and definition of resources". (p. 231). Based in the latter research and other case studies, a broader analysis includes relations between female social movements and household gender conflict, linking property rights, gender conflict, and environmental change in the analysis (Carney 2004). More so, gender stratification affects participatory environmental policy-making (Gupte 2004).

Scholarly contributions on the politics of resource stabilization in the River Gambia, west Africa, shows how and why women's groups in the Gambia intensify fruit and vegetable production in communal garden projects, becoming their only significant activity during dry seasons (Schroeder 1993). This author analyses how and why, male landholders plant orchards in the same locations while taking advantage of the unpaid female labor and land improvements: According to customary law, trees belong to the person who plants them. Thus, it is portrayed how gender division of labor cannot be reduced to task allocation, for in this case, "trees can be used as a means for claiming both material and symbolic control over garden lands" (Schroeder 1999 p.360). Schroeder (1993) also draw attention on the matrilineal and patrilineal land rights that arose from customary laws: women's landholdings are almost exclusively swamps which are heritable from mothers to daughters; whereas patrilineal lands are almost all arable lands and part of the swamplands where rice is grown by women.

Case-studies on gender and the environment

Some relevant case studies and methodologies represent particular well research interests on feminism and political ecology worldwide.

For example, the struggle over gender roles, labor obligations and property rights that arose from transformed land rights and new labor processes in the Mandinka rural society (Gambia) where a new 'production regime' instituted a double-cropping for rice fields: female rice farmers were the focus of donor interest in the project as they were perceived as more efficient workers than men, which in turn led to gendered changes in household property, domestic and resource access, and family relations (Carney and Watts 1990). In other contexts however, male-female differences in agricultural productivity based on production analysis estimates, shows that female farmers are equally efficient as male farmers, "once individual characteristics and input levels are controlled for" (Quisumbing 1996 p.1590).

Hovorka's (2005) work on the role of urban agriculture in addressing food security highlights the effects of gender on the 'quantity and types of foodstuffs' produced for the urban markets in Botswana. She also stresses the importance of gender in the analysis of unequal terms and power relations in which men and women participate in agricultural production and urban economies.

Moreover, Jackson (1993) contends that 1) women's variability of incentives is a consequence of inequalities at the household level, class-gender systems, and differences of age; 2) environmental knowledge is a social product, and 3) a gender analysis of property relation is more crucial in understanding women and men incentives for resource use. With respect to the third point, the author stresses that women are less inclined to conservation than men, as land represents for her a temporary nature (i.e. controlled by men), and they won't invest to benefit the land owner.

On the other hand, it has been described how women living in forests are more concerned with fuelwood, fodder and non-timber products to provide for their households; likewise, in rural areas in which most property rights are held by men, women are more dependent on communal resources because of their limited private property access: men are more interested in timber and cash benefits, and have greater access to economic resources and to the 'public-decision fora' (Agrawal 1997). In this author's words, as a consequence of the responsibilities and nature of dependence on resources, men tend to have more environmental knowledge related to trees, whereas women are more knowledgeable in medicinal plants.

Focus on the interaction between gendered property relations and gendered resource uses, user groups, landscapes, and ecosystems helped to analyze the gender dimensions of resource use and access to trees and forest, based on literature review of case studies in Africa (Rocheleau and Edmunds 1997). “Tree tenure is characterized by nested and overlapping rights, which are products of social and ecological diversity as well as the complex connections between various groups of people and resources” (Rocheleau and Edmunds 1997 p. 1351).

Based on the land use changes which have occurred since the early 1980s in Java, Indonesia, especially the expanded cultivation of commercial fruit trees, Schroeder and Suryanata (1996) note that apples in the author’s words are the most important temperate fruit crop in Indonesia; however in the tropics they require intensive labor and chemical input to bear fruit, and often are intercropped with vegetables. “Unlike Gambia, customary law in Java does not distinguish land tenure rights along gender lines …and conflict developed along class lines (the richest 15 percent controls 80 percent of the apple harvest)…without apparent land accumulation” (p.197). Thus, the authors evidenced that trees are valuable assets that could be exchanged independently from land; they could be transferred and leased. In this case, class differences are more important in the political ecology of apple tree cropping in Java, and tree resources more significant than land tenure.

Valdivia’s (2001) paper shows another perspective from her work in Indonesia, the Andes of Bolivia and Peru, Western Province, and the Coast of Machacos in Kenya. Her work centers on the role of small ruminants in poor rural households and their interaction with gender, resource management, markets and welfare; this author evidenced that small ruminants under the control of women contribute to the household welfare purchases in Kenya and the Andes. The cases reviewed by this author, in her words, shows that women are the major managers of small ruminants in most production systems, and of their related inputs; more importantly, the resource access and control of the small ruminants, together with grazing areas, and feed resources, improve equality and empowerment of women. Notwithstanding, the analysis of the roles of Bedouin women in producing and marketing sheep and goats products in regional markets in the Easter Desert of southern Egypt, demonstrate that "In some societies, women may not have a clear sense of their own interests as something separate from the family unit" (Sharp et al 2003 p.293).

There are many other scholarly works related with gender dimensions, which are more theoretical in nature, thus lacking a spatially explicit explanation on gendered resource use. Works on gendered policy to foster women's participation in natural resource management (Locke 1999); women's land security (Agrawal 2003, Jackson 2003, Rao, 2005); or gender and development (Moore et al 2001, Sharp et al 2003, Mohanty 1991, Salleh 1984, Dehart 2005), are all important contributions on gendered resource access, use and control. However, as these works are more theoretically driven, their spatial dimension is more difficult to elucidate with respect to the present aim of theorization.

THEORY OF ACCESS

Key scholarly contributions on access, use and control of natural resources, include MacPherson's (1978) definition of property, a review of the conception of environmental entitlements (Leach, Mearns and Scoones 1999), and the 'theory of access' by Ribot and Peluso (2003). These three works relate to each other, as property and entitlements are component parts of the broader theory of access.

Property is Rights

Macpherson (1978) theorized that the meaning of property is not constant over time, and that changes in its meaning are consequence of what (the society or) the dominant classes in society expect the institution of property to serve. For him property is an institution that could potentially be transformed by dominant classes (with different expectations) within time. Property is a political relation between persons (and that empowers proprietors). At the end, property right is the individual right to a (good) life, with common property involving the right of the natural individual person. In sum, according to Macpherson property is a right; is an enforceable claim, which enforceability makes it a legal right, and depends on the society's belief that it is a moral right (human right). In order to be an enforceable claim, and to continue being property, property in one's life, leads to property in labor itself, and to the justification of any of the other kinds of property.

Environmental Entitlements

The concept of property as an institution or a political relation between persons is approached by Leach, Mearns and Scoones (1999) under a different conceptual framework focused on the roles of institutions: an extension of entitlements analysis with emphasis in the relations between society and the environment (Leach and Mearns, 1991, Mearns 1995 and 1996).

Under the notion of 'environmental entitlements' are analyzed the ways social actors appreciate and use environmental goods and services for their well-being. It is acknowledged that social actors have a wealth of different interests or expectations. In this sense, a set of institutions at different scales (from the local, to national or global levels) is developed in order to arbitrate people-environment relations and to affect access by different persons. Thus, in the authors' words, diverse institutions will have different roles in mediating the relationships between different social actors and different local ecologies.

Leach, Mearns and Scoones (1999) define both the 'socially sanctioned' and the 'formal legal mechanisms' of institutions as the 'commanders of resources'. Entitlements are the legitimate effective command over alternative commodity bundles; and people's capabilities are what people can do or be with their entitlements. These might include more recent forms of common property (rights) in environmental/ecosystem services (i.e. food, water, fuel); and the utilities derived from these services. Thus, the 'environmental entitlements' framework requires a historical perspective, and its analysis reflects on the different type of information potentially gathered in diverse spatial scales.

In sum, 'environmental entitlements' framework uses specific 'definitions' for property rights and command over commodity bundles, namely endowments, entitlements, and people's capabilities. In turn these three definitions depend on the 'empirical context and on time' and involve power relations. Whereas enforceability in Macpherson (1978) is accomplished by the state, in Leach et al. (1999) command over resources is performed by a 'statutory system' or by 'customary' rights of access, use and control.

But there is a central component to the environmental entitlements framework: the (formal and informal) institutions. In the authors' words "Institutions are thought of as the rules of the game in society (or rules in use Watts and Peet 2004)… (and) organizations may be thought of as the players, or groups of individuals bound together by some common purpose to achieve objectives" (p.237). Individuals or groups of people gain access and control over natural resources (i.e. food, water, fuel, market value, rights, environmental services), with aid of the 'institutional mechanisms' for resource access and control.

Mapping Access

Ribot and Peluso's (2003) theory of access "define access as the ability to benefit from things (by all possible mechanisms)" (p.155) differs from Macpherson's definition of property as rights (to exclude or be excluded from something). For these authors, ability is power (i.e. to affect the practices and ideas of others; and is emergent from people) in contrast with property, which recognizes claims or rights 'by law, custom or convention'. Access, in their terms, do not need to be socially legitimated by these means (i.e. law, custom or convention), nor can be completely explained by them. "Access, following this definition is more akin to a 'bundle of powers' than to property's notion of a 'bundle of rights'…" (p.153). But both definitions implicitly refer to social relations and social change according to historical moments. These social relations include ideological /discursive manipulations, production, appropriation, accumulation, transfer, and distribution.

The authors recognize that although many of the notions or dimensions of access have been included in property and tenure studies, property is only “one set of access relationships among others” (p.154). How do they explain this? Access analysis requires attention to property as well as to illicit relations, relations of production, entitlements relations, and the histories of all of these”(p. 157). Therefore, theory of access includes property and environmental entitlements and another set of access relationships, among others.

On the other hand, pertinent definitions of this Theory of Access include: access control, which is the ability to mediate other’s access; access maintenance which are the powers needed to keep a particular sort of resource access opened; and gaining access or the general process by which access is established. The mechanisms used by social actors to control and maintain access are defined as means, processes and relations. Hence, the changing patterns of access are defined as processes. However, in the authors’ words, the ways in which mechanisms of access are embedded into political-economic moments must be determined empirically. This last notion is shared by ‘environmental entitlements’ analysis (above) as well.

“Access analysis is, thus, the process of identifying and mapping the mechanisms by which access is gained, maintained, and controlled” (p. 160) and includes the identification of particular flows of benefits from a resource; the identification of mechanisms for gaining, controlling, distributing and maintaining the benefit flow; and the analysis of the power relations underlying these mechanisms of access. This last analysis is explained more diffusely by the authors. The referred mechanisms are further subdivided into Rights-based access, and Structural/ Relational Mechanisms of Access.

Rights-based Access includes both mechanisms of legal access (i.e. laws, customs, and conventions); and of illegal access (e.g. theft, violence).

The ability to benefit from something using rights-based mechanisms may rely in the passing of policies or in the approval by customary laws of that benefit; however these abilities may also include powers such as purposely drafting ambiguities within laws, or the use of coercion, force or deception, for example. Likewise, the Structural/ Relational Mechanisms of Access are related to the constraints posed by specific political-economic and cultural settings. From these mechanisms, the influences of technology, capital, markets, labor, knowledge, authority, social identities, and social relations, are highlighted by the authors. According to the authors, the Structural/ Relational Mechanisms of Access are at the same time the power relations that affect Rights-based Access Mechanisms. The 'bundle of powers' notion of this Theory of Access is sustained by the mechanisms and powers within the social relations that influence the ability of people to benefit from resources. It portrays a complex arrangement that shape the ways in which people benefit from resources.

This Theory of Access acknowledges the dynamic nature of the 'bundles of powers' which are the result of historical changes in social relations in different places; as the authors put it, is explicitly concerned with environmental entitlements, illicit actions, relations of production, common property, environmental change, cultural and political ecology, and the histories of all these, among others.

Right-based mechanisms of access

The ability to benefit from something using rights-based mechanisms includes both the mechanisms of legal access (i.e. laws, customs, and conventions); and of illegal access (e.g. theft, violence, corruption).

On the legal access mechanisms, the following selection of pertinent research contributions aims to learn how parts of the 'resource access analyses' are conducted under fairly different perspectives, theoretical frameworks and research methods. This selection includes a rough synthesis of access related topics developed by scholars such as Ostrom (1990), Lu (2001), De Janvry et al. (2001), Ribot (2002), Sundberg (2003), and McCarthy (2004). Mechanisms and 'bundles of powers' evidenced by the above authors include among others, the 'bargaining' of rules or established laws with institutional agents, the drafting of ambiguities within laws, the contradictory and sometimes overlapping policies that could disincentive initiatives from the community, the importance of culturally sanctioned laws in common property management, the ways in which access mechanisms are embedded into political-economic social change according to historical moments, the global to local scales of social interrelations embedded in international trade agreements, and access change through land reforms, among others. Selected scholarly works exemplifying these mechanisms follow.

The origin of a set of institutions for groundwater basins management in Los Angeles metropolitan area, USA, involved processes of changing rules in three of the catchments which were based in 'negotiated settlements of water rights' as a means for beneficial transformations of the users' situation (Ostrom 1990).

Communities in Cameroon had to overcome a complex managing process when wishing to establish a community forest under the 1994 forestry law: They were required to make maps of their 'traditional territories', establish a simplified forest management plan, and lobby for approval of the management plan by local authorities and the central government, among other mechanisms (Ribot 2002).

The Huaorani Indians of the Ecuadorian Amazon have a common property management regime based on kinship ties of residence groups, mutual trust, reciprocity, and culturally sanctioned rules of behavior: "Now, confronted by powerful external forces… (and) intermarriage with non- Huaorani, the system is faltering" (Lu (2001 p.425).

It was evident that conservation and environmental protection intersect in 'uneasy ways' embedded in historical patterns of exclusion by way of exploring how individuals and collectives conceptualize and negotiate the linkages between conservation and democratization in the Maya Biosphere Reserve, Guatemala (Sundberg 2003).

Recent multilateral trade agreements (i.e. NAFTA) are redefining property rights and environmental governance, triggering processes such as privatization, 'or primitive accumulation' in two cases (USA and Mexico respectively) (McCarthy 2004).

Finally, a historical overview of eighty years of land reform in Latin America allowed concluding that these reforms left two tasks incomplete: "1) providing access to the land for the rural poor; and 2) securing the competitiveness of land reform beneficiaries on their individualized parcels" (De Janvry et al. 2001 p.300).)

Same as with right-based access mechanisms, some research contributions to the understanding of illegal access mechanisms include works by scholars such as Corbridge and Kumar (2002), Hecht et al. (2005), and Jeffrey (2001). Mechanisms and 'bundle of powers' acknowledged by these authors include coercion and corruption, threat and force from war conflicts, and the illicit use of power by official positions.

Corbridge and Kumar (2002) detail the mechanisms of corruption and 'colluding interests' in play when a tribal Villager in Jharkhand, India, tried selling according to the law ten Jack Trees off his private land. The villager had to distribute payments both to officials and community intermediaries in order to be able to sell his trees. This is a case "which link communities to the state by means of a network of unequal exchanges" (p.785) in questions of power and access. The villager at the end made only Rs. 2,000 of what should have been Rs. 50,000 out of his ten trees.

It has been evidenced how local processes of civil war led to forest resurgence in El Salvador, in contrast with most of the countries in Latin America where deforestation processes continue (Hecht et al. 2005). These authors argue that war in El Salvador "was characterized by guerrilla tactics, where forests were used as cover, and thus rural areas became war theatres" (p.311). Explanations from the authors on the dynamics of forest recovery include the international and urban migration, with subsequent limits to economic development, and the inhibiting effect of warfare on agricultural expansion, and cattle ranching.

It has also been described how everyday forms of corruption allowed rich farmers to obtain privileged access to lucrative market opportunities in Uttar Pradesh, India, where many rich farmers connive with state officials to obtain an inside track of sugarcane marketing (Jeffrey 2001): "These microtactics have the cumulative effect of isolating and further impoverishing the rural poor" (p. 38), indeed, the social position and networks allowed these farmers to benefit the most.

Structural/ relational mechanisms of Access

As shown above the structural/ relational mechanisms of access are related to the constraints posed by specific political-economic and cultural settings. From these mechanisms, the influences of technology, capital, markets, labor, knowledge, authority, social identities, and social relations, are acknowledged in the selected scholarly contributions. According to Ribot and Peluso (2003), the Structural/ Relational Mechanisms of Access are at the same time the power relations that affect Rights-based Access Mechanisms.

Ribot's (2002) case in Nicaragua relates with the establishment of a local government and the transfer of decision-making powers over resources as part of decentralization initiatives. In the author's words, local groups protested against mining concessions and convinced the local governments to take their side: "when local governments joint protesters it lends them credibility and force" (p. 9).

Existing gender relations structure women's paid work in South African deciduous fruit farms (i.e. recruitment and employment, division of labor, wage differential): the extension of labor legislation to the agricultural sector, and the farmer's changing perceptions of women, were critical in women farm workers gaining more power in the workplace (Kritzinger and Vorster 1996), in the authors' words.

The role of community in resource use and conservation which have led to re-consider planned development strategies and policy making suggests that "community must be examined (in this context)…by focusing on the multiple interests and actors within communities, on how these actors influence decision-making, and on the internal and external institutions that shape the decision-making process" (Agrawal and Gibson 1999 p. 629).

Wolf (1996) writes on the 'Issue of Power' in feminist fieldwork research. She acknowledges that "the most central dilemma for contemporary feminist fieldwork …is power and the unequal hierarchies…that are recreated during and after field research" (p .2). She stresses three types of power differences: 1) between the researcher and the researched (i.e. race, class, nationality, urban-rural backgrounds); 2) in defining the research relation, unequal exchange, and exploitation; and 3) power performed during post fieldwork period in writing and representing.

Indeed, the work on feminist visualization by Kwan (2002) emphasizes the important roles that women may play in the use of new technologies for thematic categorizations, and examines the convenience of approaching new GIS methods to enrich feminist geographic research. Kwan proposes an analysis of gender relations at different geographical scales (e.g. mapping women's life paths in time-space p. 652).

Gendered migration issues might also play a role in environmental change where women are defined economically as ′helpers' following a feminine model of versatility, in a customary model where men's earning ability is prioritized (Schroeder 1993 p.353).

More so, based on the multiple roles of gardens among the Maya of Highland Guatemala, it has been stressed how traditional and gendered knowledge is transferred in the garden through women's educating children, on how to use farm tools, how to manage crops, and the characteristics of plants species (Keys 1999). In the authors words these activities allow early childhood understanding of human-environment relations, and increases the importance of the gardens as the sites in which 'Maya women supplement household needs' (p.89).

Valdivia's (2001) paper evidenced that women are the major managers of small ruminants in most production systems (in Kenya and the Andes), and of their related inputs; thus making women's resource access and control of the small ruminants, together with grazing areas, and feed resources, to improve their equality and empowerment.

In addition, in an Eastern India Rainfed Farming development project, conducted by a joint venture of the governments of UK and India and directed towards the poorest of the poorer, the non-poor farmers were the ones who acquired planning knowledge and learned how to manipulate it (Kumar and Corbridge 2002): This in turn led to the accumulation of household social capital which was positive in farm productivity. Thus, the authors argue that the project should not be considered a failure, instead "development projects cannot de expected to change local systems of politics or stratification" (p.73).

Davis (2001) draws attention on the contributions of Blaikie and Brookfield (1987) towards identifying how farmers working in plots with different ecological and technological conditions have different abilities to adopt forms of intensification. These abilities are mediated in the author's words, by the ways in which production subsidies are captured and the effects of class-based landholding, among many other issues.

In the context of agricultural change, Doolittle (1988) evidenced how marginal lands with lower quality and environmental constraints "can be farmed intermittently, being brought into and taken out of cultivation periodically as conditions change and demands warrant…the reason for a gradual shift toward permanent cultivation involves capital improvements" (p. 265).

Analysis on a project to put 'back to work' ancient raised field agriculture in the Lake Titicaca basin has shown the inconvenience of using foreign models to develop agriculture (Erickson 1988): an experimental project to recover these ancient raised fields has ‘brought back’ to agriculture many hectares, and prompted the initiative from many individual farmers to build similar fields in their lands. However, it is not clear how the differences in social relations of the past and present could have potentially affected the project results.

With respect to the different technologies used for agricultural production there are important scholarly contributions related to: ancient terracing in Latin America (Beach and Dunning1995;); drained- field cultivation (Denevan 1970 and 2001, Wilken 1969); Agricultural terrace evolution (Williams 1990; Doolittle 1990); irrigation systems (Cressey 1958); and floodwater systems (Nabhan 1979).

A different approach acknowledging a combination of technology and discourse as mechanisms for obtaining particular benefits is that of Toly (2004). This author focuses on globalization as a technological and economic phenomena driving environmental change, and ‘capitalizing nature’.

The scholarly contributions acknowledged above are concerned in part with some of the right-based, and structural/ relational mechanisms of access proposed in Ribot and Peluso’s (2003) ‘Theory of access’. However, classification of mechanisms evidence that sometimes is difficult to separate the access mechanisms in distinct groups. Rather, as the theory’s authors admit, they are a set of mechanisms that cannot be ‘distinct or complete’. Moreover, the structural/ relational mechanisms of access according to the ‘theory of access’ are at the same time the power relations that affect right-based access mechanisms. Finally, I agree with the authors when they write that this ‘bundle of powers’ are embedded into political-economic moments that must be determined empirically. After all, embedded in this bundles of powers are the own researcher ‘powers and mechanisms’ in writing and representing that are suggested by Wolf (1996).

FINAL REMARKS

The bulk of contributions of political ecology to intricate themes such as corruption and social justice; or the possibilities of integrating its epistemology and politics with GIS and new technologies; and the feminist contributions to the analysis of gendered places, rights and responsibilities; denotes the great theorization potential of this field of Inquiry. An intellectual history of Annals of the Association of American Geographers publications in nature–society geography, as broadly defined, spanning the recent decades (1990–2010) and preceding periods (1911–1969, 1970–1989) shows environmental governance and political ecology as primary clusters emerging in the 1990s and 2000s (Zimmerer 2010).

Political ecology since its early developments in the 1970s has evolved in terms of specific conceptualization, theorization, and empirical investigation concerning the linkages between development, environment and social relations. The bulk of political ecology literature has strongly focused on the third world, and rural areas in the last three decades, leaving understudied the urban and global dimensions, and the first world more generally. Particularly relevant, the incorporation into a single framework of feminist perspectives combined with analysis of ecological, economic, and political power relations (and derivation of theory from practical experience), gave rise to feminist political ecology FPE (Rocheleau et al 1996).

However, most recent, 21st century initiatives are increasingly concerned with filling this research gaps. Mainly following a poststructural philosophy (and cultural and social theory), continued scholarly contributions and increasing numbers of case studies have led political ecology to what Watts and Peet (2004) assert “as one might expect of a mature science” (p.6). Of these is worth highlighting the many notions or dimensions of access included in property and tenure studies, also with attention to illicit relations of production, entitlements relations, and the histories of all of these, that led Ribot and Peluso (2003) to propose the theory of access, which includes property and environmental entitlements plus another set of access relationships, among others.

The theoretical and methodological steps followed by this field of inquiry from the 1970s to the 2000s may be roughly synthesized as follows: First, the re-theorizing of political economy and environment at different levels (e.g. debates over Marxism and ecology). Second, questioning the absence of serious treatment politics in political ecology (e.g. feminist political ecology). Third is linking political ecology with the institutions of civil society (e.g. environmental associations and organizations). Fourth, assessing discursive approaches to environmental and resource problems (i.e. critical studies of science; global environmental governance). Fifth is doing environmental history (e.g. long-term ecosystem changes). And finally is the concern on new ecological theorization (e.g. ecology of disequilibrium).

On the understudied areas two expert opinions must be acknowledged. Robins (2004) suggest three specific areas of concern that need more attention: population, genetic modification, and the cities. In contrast, Watts and Peets (2004) suggest more research on: long-term capitalization of nature; corporate sector and firm; environmental security; violence and mass conflict; racialized notions of nature; and urban and industrial social movements. I will further suggest drawing more attention on comparative studies, micro-politics of institutional change; political ecology of language; and even more interdisciplinary approaches.

Besides the above, it has also been acknowledged that both political ecology and a parallel approach, land-change science (Chapter 4), provide understanding about changes in the coupled human-environment system (and in the development of sustainability science) albeit their different emphases on causes and consequences of land transformations (Turner and Robbins 2008, National Research Council 2010). Indeed, merging of political ecology and land change science has aided better explaining deforestation, Air pollution and health in cities, the spatially homogenized landscape implications, subnational land-redistribution efforts, or the decisions of peasant producers. This merging of subfields has helped to untangle how ‘hidden landscapes’ are produced in communal landscapes as “the result of overlapping and conflicting rules, knowledge of environmental governance, and mechanisms of enforcement” (King 2013 p. 201). And furthermore, the integration of land change science and feminist political ecology have recently exposed how migrant daughters enable the purchase of assets and participate in land-use decision making, thus shaping land change at the household level (Radel et al 2013). Indeed, the ample fusion in problem framing and methods of land change science and political ecology led Turner and Robbins (2008) to raise the concept of a ‘hybrid land change’ or ecology as a sound perspective to the analysis of the coupled human-environment / nature-society relationships.

Chapter 3: Study area: "El Cedro"

Before focusing on my local study, is worth contextualizing the Pacific as a contested and imagined national region; and to contextualize Choco, as one of 31 Departments (First Level Administrative Boundaries of Colombia) comprised by this region. These geographies may help to better understand the different meanings of both Afro-Colombian communities, and ecologies, which underpin the different chapters comprised in this dissertation.

THE PACIFIC REGION

The Environment Today

Colombian territory encompasses five major regions: The Andean, Caribbean, Pacific, Amazonia, and Orinoquia regions. The Colombian Pacific region (PR) is bordered by the Pacific Ocean to the west, and the Western Andean mountain range (*Cordillera Occidental*) to the east. The area is approximately 1,300 kilometers long and 60 to 250 kilometers wide, flanked by Panama to the north and Ecuador to the south. Currently, around eighty percent of the area is covered by tropical rain forests that include the highest floristic diversity in the neotropics, endemic bird species ranking first in South America, and marine and coastal ecosystems of great ecological and economic value (IGAC, 2002; Renjifo et al 2002).

The Pacific region is parts of what is now known as *Choco Biogeografico* (Biogeographic-Choco) that comprises part of Ecuador, Panama, and Colombia, and includes four Departments (Choco, Valle del Cauca, Cauca, and Nariño) (Figure 1). Environmental variations, particularly in landforms, geology, topography, and climate (plus ocean-land interactions) in turn allow subdividing the region into two areas separated by *Cabo Corrientes* (Cape Corrientes): one to the north, which comprises part of the Department of Choco, and the other to the south of this cape including the rest of Choco and the other three Departments referred above. My study area is located in the Department of Choco to the north of *Cabo Corrientes*.

West (1957) introduced the regional perspective to the Pacific region. According to West (1957 p.3) "culturally the area is one chiefly because of its predominant Negroid population; because a common way of life based mainly on subsistence agriculture, fishing, and primitive mining; and because of similar historical development which differs from that of adjacent areas…this area, then, may be considered one of the major Negroid areas of Latin America." This perception/concept of nature and society of the Pacific region has remained fairly the same from West (1957) until the early 1990s, and may had contributed to the conceptual basis of Law 70/93 that sanctioned the collective land titling to Afro-Colombian communities, and will be treated with more detail below.

Regionally, the main geological feature is the Bolivar Geosyncline that extends from the Gulf of Uraba in the Colombian Caribbean to Guayaquil in Ecuador, forming a series of lowland basins and river systems separated by anticline structures perpendicular to the geosyncline's axis (West 1957; INGEOMINAS 1988). This geosyncline is bordered to the east by the Andean *Cordillera Occidental* (Western Mountain Range) and to the northwest by the *Serrania del Baudo* and *Serrania del Darien*. These *serranias* are low mountain ranges with elevations of 2000 to 4000 feet made of basic Mesozoic age intrusive rocks. *Serrania del Baudo* is located between the Pacific Ocean and the Atrato river valley, and is made of cretaceous-tertiary volcanic rocks of oceanic origin (basalts, peridotites and gabbros, with subjacent cherts and sedimentary rocks). *Serrania del Darien* is comprised mainly by intrusive rocks and sedimentary-volcanic rock complexes.

To the south, the geosynclinal axis is located at the shoreline as its flanks were destroyed by subsidence and erosion, leaving only few of these remnants visible. The above gives rise to two different coast types in the Colombian Pacific region: to the north of *Cabo Corrientes* is an erosional coastline of higher relief, with sea cliffs, and erosional landforms alternating with deep water sand beaches. To the south is a low (gentle relief) depositional coast with larger deltas, beaches, and depositional landforms. Both coastline types have tidal range means of 8 to 10 feet.

Landforms of the Pacific region may be classified into three main units: low plains of recent alluvium, hill lands of dissected tertiary sediments, and mountain areas of Mesozoic rocks. In general, land surface varies from swampy planes to hill lands. Lowlands are further subdivided into two distinct physiographic areas: low plains of recent alluvium, and hill sections formed by stream dissection of Tertiary and Pleistocene deposits (West 1957; IGAC 2006; INGEOMINAS 1988; IDEAM 1996).

Due to the Pacific region's geographic location (approximately between 1 to 8 degrees north latitude and 75 to 78 degrees west longitude), its tropical rainforest climate is mainly influenced by the Intertropical Convergence Zone (ITCZ), maritime air masses with orographic lifting rainfall produced both by the *Serranias* and *Cordillera Occidental*, and regional phenomena such as the La Niña / El Niño Southern Oscillation (ENSO). This tropical climate is characterized by low annual range temperature with an annual mean rarely exceeding 28 c (degrees Celsius), and high relative humidity (more than 80% year round). Mean annual rainfall is amongst the highest in the world, reaching 13,000 millimeters in some areas. Thunderstorm rainfall is intense, and there are periods of 2-4 days of continuous light rain, especially in the northern part. Lower precipitation months are February and March.

Forests in this region have been further classified into two main groups, namely, homogeneous and heterogeneous forests (Leal and Restrepo 2003). Homogeneous forests are common in the Pacific southern sub region and heterogeneous forests are frequent in the northern part of the Pacific. In homogeneous forests, one or two species are more abundant over the forest formation; as a result forests are named after these species, for example, *catival* is named after *Cativo* (*Prioria copaifera*); *manglar* after mangroves (seven species but predominantly red mangrove *R. harrisonii*), and *naidizal* after Naidí palm (*Euterpe oleracea*). In contrast, heterogeneous forests are known for having numerous different species and no species outnumbers the other. Therefore, these are classified according to altitude and climate, either into low/high hill, or mountainous forests. Although homogeneous forests have become very important for the logging industry, many of the most valued tree species, mainly used for carpentry, are found in Heterogeneous forests, for example; *Cedro* after Cedar (*Cedrela cf. agustifolia*), Mahogany (*Swietenia*), Oak (*Terminalia Amazonia*), or *Guayacán Amarillo* (*Buchenavia spp*) (Leal and Restrepo 2003).

History of human-environment interactions

It has been widely acknowledged that among the main 'historical drivers' of Land Use and Land Cover Change (LULCC) after the Pre-Hispanic period (or conquest) in Latin America and Colombia are the demographic collapse of indigenous population and land redistribution (Denevan 2001, Etter et al 2008, Marquez 2001). More so, from the beginning of the Spanish conquest to the mid-1700s depopulation lead to forest recovery, particularly in humid and sub humid areas. Most economic activities that took place during the colonial period required the indigenous labor force. But due to indigenous depopulation from 1580 to 1800s, the Spanish resorted to African slave trade, particularly for alluvium gold mining (Etter et al 2008, Marquez 2001, Sharp 1976). The land used for agriculture expanded significantly after 1700. By 1900, population growth, and an increase in cattle grazing all led to the disappearance of one third of the country's forests (Etter et al 2008).

Densely populated areas, such as the Andean and Caribbean regions, were significantly changed after the arrival of the Spaniards. Marginal areas with harsh conditions and less densely settled environments, such as the Amazon and Pacific regions, were the least influenced until the 1970s (Bray 1995; Etter et al 2008, Marquez 2001). Since the beginning of the colonial period, a pivotal change has been seen in the way land has been used. Currently, 75 percent of the land previously devoted to agriculture and other uses is now used for cattle grazing. Consequently, cattle grazing have become a major mechanism of both land control and political power (Etter et al 2008).

Besides indigenous population loss and cattle raising, main historical drivers of LULCC in Colombia have included: 1) export economy based on natural resource extraction and agriculture; 3) significant gold, platinum, and emerald mining until 1840; 4) land tenure concentration particularly of more fertile lands by few families; 5) transportation infrastructure development; 6) the separation of Panama from Colombia in 1903; 7) a growing foreign debt infrastructure, 8) an increased armed conflict; and 9) outgrowth of illicit crops (Etter et al 2008). In the last few decades, industrialization, urbanization, in migration to urban centers, globalization, and the illegal drug economy that increased after the 1970s have led to major changes in land use, access and control in marginal areas (Etter et al 2008, Kalmanovitz 1994, Marquez 2001).

Table 1 helps contextualizing this region's history framed within broader national level information. There were a series of 'historical drivers' critical during following 500 years after Spanish conquest, with a major population decline during 1500 to1600. From 1600 to 1850 colonial interests focused on mining, and thus the agricultural frontier was not significantly expanded. Cattle grazing was impacting mainly the Caribbean and open savanna landscapes. In contrast, in the Pacific region cattle grazing was not significant in any of the analyzed periods due to colonization revolving around gold mining/exploitation.

By 1740 the gold abundance and its exploitation determined settlement processes for more than three centuries in the tough areas where it was found, and was used to justify slavery as neither Spaniards nor indigenous were deemed suited to assume mine exploitation (Leal and Restrepo (2003). From 1740 to 1850, although gold exploitation continued in the Pacific region, forest cover was not drastically transformed. Indeed, by 1780 when gold began to be depleted, agriculture was scarcely developed due in part to the region´s harsh climate and poor soils conditions. It is from 1850 onwards that there is a change in the national politics under influence of the United Kingdom industrial revolution and hegemony, with nature perceived as an obstacle to be defeated as a sign of progress. Between 1850 and 1920 opening of the economy to international markets led to expansions of the agricultural frontier in the Andean and Caribbean regions, while the Pacific and Amazon regions were more prompted to natural resource extraction, particularly of plant ivory and rubber. At the same time, in 1851 slavery abolition was enacted by law, a situation that prompted paid labor-based plantations. However, in the Pacific region freed slaves continued performing gold and platinum mining but land cover transformation was still not systematic, and the black population increased. By the end of the 19th century, ivory plant and rubber were still being exploited.

The 20th century ends with civil wars, the colonization of Antioquia (*colonización antioqueña*), land tenure/property concentration, many peasants with no lands, substantial environmental/ecosystem changes, and an expansion in transportation infrastructure. World War II led to an economic recuperation, and more struggles for land and natural resources. Thus, between 1930 and 1950 rural to urban in-migration contributed almost half of the urban growth in Colombia (Marquez 2001 p. 364-388). But by the early 20th century in the Pacific region only Quibdó, Buenaventura, and Tumaco were settlements of importance.

Between 1920 and 1970, other extractive activities such as logging, the development of transportation infrastructure, and outgrowth of the illegal drug economy, triggered larger changes in land use, access and control in marginal areas such as the Pacific region. Thus, during the “Industrialization and Metropolitization” (1970 to 2000) period forest clearing transferred to the humid lowlands of the Amazon and Pacific regions (Leal and Restrepo 2003). As mentioned above, broad contemporary drivers of land cover change in Colombia include globalization, technological change, increased migration to urban centers, and the drug economy (Etter et al 2008). Nowadays widespread river networks are the focus of all economic, domestic and social activities in the Pacific region, which still endures physical and economic marginality with respect to the rest of the country (Oslender, 2001).

Land Tenure

"Between 1591 and 1592 the Spanish crown introduced the "*composiciones de tierras*" (land compositions) that legalized individual appropriation of occupied (by indigenous people) or Spanish dominated lands. The remainder of the indigenous population was regrouped in *resguardos* (indigenous reserves) and those lands that were not claimed or used were declared *baldíos* (state lands) belonging to the crown (Marquez 2001). "During the 17th century the hacienda system was established based on land appropriation and use, particularly in large river valleys. Still, successive labor force crisis during the 16th and 17th centuries consolidated the development of the big property; due to that land monopoly was the main mechanism of linking labor force. The State land (*baldíos*) appropriation process began in conjunction with cattle raising, a situation that has been prolonged throughout history. The period from 1740 to 1850 witnessed independence and early the Republican rule. Environmental change accelerated from 1850 onwards mainly due to international commerce, free trade, and metropolitan development. There was also economic depression and many lands were abandoned to the state; independence wars finished, and militaries were awarded state lands" (Marquez 2001 p.362).

Although the end of *resguardos* (indigenous lands) was progressive between the 1830s and 1840s, this was enacted by law in 1850 (Palacios and Safford 2002 p. 360 in Kalmanovitz 2010): This process translated into private land rights awarded to indigenous people, who in turn were harassed by *mestizos* (mixed blood) and landlords seeking to acquire their lands. Freed black slaves became workers (*aparceros*) of haciendas or de facto owners of *palenque* lands (lands that were occupied by slaves who fled from the Spaniard domination): some fled to the Pacific region's lowlands, including

Choco, basing their livelihoods in subsistence agriculture, fishing, hunting and mining; All property rights obtained by individuals during colony were maintained to the point that by mid-19th century 75% of lands were *baldios* (state lands) (Legrand 1988). Many of these were granted between 1820 and 1870 as payment to those who participated in the independence wars: After independence there was a relative abandonment of agricultural lands (Kalmanovitz 2010 p.79). The 19th century ended with a situation of land property concentration in the hands of more powerful elites, many peasants with no lands, and substantial environmental/ecosystem changes (Marquez 2001 p.383).

By the early 20th century, politics were oriented towards the constitutional reform of 1936 and on titling state lands. Fajardo (1990 in Marquez 2001) points out that from 1930 the State began stimulating colonization processes such as that occurred in Bahía Solano (Choco) which led to the establishment in 1941 of the Institute for Parcels, Colonization and In-migration (*Instituto de Parcelaciones, Colonización e Inmigración*); Law 200 of 1936 also played an important role in finishing the *aparcería* (a contract in which land owners lease part of their land to a person named *aparcero* asking in return a part of the agricultural products) and on legalizing State land process by establishing "*juicios de pertenencia*" (ownership - judgments/verdicts/trials) as a regular procedure for obtaining property titles; This Law established an acquisition prescription of five years for *colonos* (colonizers or settlers) cultivating state lands, which lead to expulsion of a great amount of population from the lands they occupied, a situation that persisted until passing of the Law on Agrarian Reform in 1961 (*Ley de Reforma Agraria 35 of 1961*) that eliminated that principle; Law 200 of 1936 unleashed the 'dispute for nature' (a term coined in Marquez 2001 referring to the different ways in which dissimilar actors have appropriated land, labor and natural resources historically), for land and resources, and for labor force to making these more productive (Marquez 2001 p. 389-393).

According to Kalmanovitz (1978), inside the country´s effectively conquered economic space during the 1920s, grand territorial property occupied the areas healthier and closer to urban centers and valleys, and flatter (low relief) lands: Besides being effectively occupied, most of the national territory (and natural resources in general) was already titled by the 20th century. Thus, the poor had to migrate to tropical rain forests or the great cities, so that between 1930 and 1950, rural to urban in-migration contributed almost half of the urban growth in Colombia (MOPU 1990 in Marquez 2001). Around the 1930s, opposite political parties were pushing on one side for a 'social function of property' (*liberales*) and on the other for 'property as a right' (*conservadores*) a situation that led to agrarian reform essays and finally to *la violencia* (during 1949 when armed conflict between liberal and conservative parties gave rise, among other social situations, to national violence and the conformation of guerilla groups that are still existing in Colombia) (Marquez 2001 p.393).

By 1950 the State had left only marginal tropical rain forest lands available for colonization: Thus, another period of great dynamic change began with the introduction of the modern concept of development that is understood as 'economic growth', mainly based on resource over-exploitation and ecosystems degradation; The 1961 and 1968 agrarian reforms passed with purposes of mitigating unemployment, but 'Pristine land' colonization was based on the debt (*endeude*) model that relies on peasant exploitation (who generally pay with the same land they cleared and made productive under this model); This pattern seemed to be exhausted by the 1980s but with drug trafficking new colonization incentives were introduced upon illicit crops, also based on *endeude*, so that the land concentration process continued to the point that it is now greater than ever, particularly in recent colonization areas (Marquez 2001 p.391-397)

During the late 20th century substantial change in policies toward the environment took place: the inception of the Colombian Natural Resources Code, the establishment of the National Parks System, and the recognition of indigenous and Afro-Colombian land rights which occurred during the late 1980s and 1990s (Etter 2008).

Social and Economic History

Territorial formation in the Pacific region witnessed processes of slavery and liberation during the 16th to 18th centuries when Spaniards brought African slaves as the principal labor force in gold mining (Sharp 1976, West 1957, Friedeman 1995, Vargas 1999). During the 16th century African enslaved labor was mainly brought from the African regions of Mali, Senegal, Gambia and Guinea; but from the 17th century until the 1890s the main black slave sources included the valleys of Congo, Niger, Volta and Cross rivers (Arocha and Maya 2008). The first known document authorizing black slaves into the Spanish colonies dates from 1501(Manuel Alzarez Nazario in Friedemann 1995 p. 50-51).

By 1538 Spanish expeditions from Cartagena to San Sebastián de Urabá carried black women and men -who outnumbered women- yet it is not clear how many of these voyagers were slaves and how many were free persons living in Spain: African descendants, shipped from Seville Spain to the New World between 1509 and 1559, were listed together including their origin from the Iberian Peninsula but their enslavement status was not described (Friedeman 1995 p.51). Although numerous studies exist on the transportation of Africans to the New World, it is still not clear how many persons were forcibly brought, how many people arrived, nor from where they proceeded exactly: Numbers range from 72,000 (Curtin 1969) to 120,000 (Colmenares 1979) or 169,000 (Castillo 1981), but these numbers are elusive (Friedemann 1995 p. 57-59).

In Colombia, abolition of enslavement was sanctioned by law in 1851 and all slaves were to be free by January 1st, 1852; however, juridical and philosophical controversies lasted for all the independence period wars in which black and 'colored' people allied first with Spaniards and later with *criollos* while seeking their liberty; upon their resistance (in *Nueva Granada)* for around three hundred years, many slaves would subdue to integration processes proposed by the dominant classes: "whitening" (socially and genetically) was the only feasible strategy for blacks to gain real emancipation and access to civil rights given by law but negated by social practice (Friedemann 1995 p.47-48). During the enslavement period it is possible to distinguish an ethnical reintegration process of Africans and their descendants in the Americas (Friedemann 1995 p. 60)

"Black slavery was a problem closely linked to the structure of the economy, social relations, and politics, understood as the result of the compromises between interest groups." (Colmenares 1991 p.28)… Although at initial stages of the enslavement period enslaved men outnumbered enslaved women, based on the Popayan[1] market, the proportion of women was increasing with time, and this could be explained by a need of equilibrating the labor force required both for harsh work (men), and for growing number of domestic jobs (women) in a society with increasing prosperity levels (Colmenares 1991 p.53). As the slave trade progressed with time, slaves of younger ages were preferred (11 to 21 years old) (Colmenares 1991 p.53). The most wanted slave age would

[1]Geographical names need to be understood in the context of respective historical period as most names describe a different administrative situation according to changes in administrative levels in Colombia.

range from 16 to 20 years old (both women and men); indeed, age range was a characteristic that was to evolve rapidly (e.g. The English company during its last trade period brought mainly younger than 21 years old slaves (Colmenares 1991 p.54). The predominant presence of black populations in the Colombian coasts and Andean valleys suggests that the bulk of the introduced slaves were dispatched to mines, fluvial transportation of goods, and *haciendas* (particularly for works in *trapiches*); however, most slaves were sold at mining areas -true frontier areas- where notary records are now inexistent (Colmenares 1991 p. 54) (e.g. Population accountings corresponding to rural Chocó in 1759 lists mining crews of 500 slaves evidencing there were big slave investments by some families): In contrast, in urban areas these records were exhaustively kept (records in Popayan, for example, evidence with detail that more than 8,000 slaves were sold there between years 1680 and 1800) (Colmenares 1991 p.56). Overall numbers of the slave trade exemplify that Popayan (located in the Southern Andes) embodied from 6% to 20% (globally 9.4% participation) of the slaves arriving to Cartagena (in the Caribbean coast) in all periods, and that its slave market evidenced the mining development of this area, and that of Chocó in a minor manner (Colmenares 1991 p. 56-57).

During the English slave market period (1716-1738) the enslaved population in Chocó grew from 1000 slaves in year 1711, to 4000 in year 1738; but a remarkable transformation on the slave trade from 1750 onwards (second half of the 18th century), was the growing equality in the proportion of slave women sold to slave men sold: until 1755 the total of slaved men sold was of 62% (1.6 men for each women sold), whereas the following five years (*quinquenio*) the proportion of slaves of both sexes sold was the same, and onwards the proportion of women sold was slightly higher than that of men sold (Colmenares 1991 p.58) (Figure 2).

Slave Crews and the Formation of the Black Family

The examination of the enslaved population demographic, economic, and social aspects have been focused in the crew, due to that social organization of labor in mines and haciendas was based on crews, and also because there is more archival information available on these (Friedemann 1995). The average number of slaves per crew was directly proportional to the increase of enslaved population: Slaves both arriving through official enslavement or through smuggling, were brought to settlements in the Caribbean and Pacific coasts, including Buenaventura, Chirambirá, Gorgona, and Barbacoas in the Pacific region (Friedemann 1995 p.55).

Gold mining in the Pacific region differs with the rest of Spanish America on that: 1) its tardy conquest was accomplished only by the end of the 17 the century; 2) these lands comprised the most productive gold mines in all the Spanish empire; and 3) other economic activities were least in contrast to gold mining (Leal and Restrepo 2003 p.5).

In Choco it was until 1670 when independent miners arrived with small crews of blacks (Sharp 1976, Friedemann 1995 p 83). They had crews from five to over 100 slaves in 1711 and of 500 slaves in 1759; initially crews were composed of just men (Colmenares 1979 in Friedeman 1995 p.84) but as these grew they comprised also women who supplied urgent necessities notwithstanding that for long time the proportion of women was lower than that of men: These women would later become the ‘medullar element of matrifocal families’ creating their own language of social and genetic kinship (Mario Diego Romero 1991 in Friedeman 1995 p.84-85). Colmenares (1979) suggest that crew members had more or less continuous nexus in mines and plantations; these crews would encompass members of various age generations, so that it seems that these didn't have so many breakages or *desmembramientos* that could lead to their identity loss (they would work with only one owner or with various owners of the same family).

The mines-and-*haciendas* economic complex required the mobilization of slaves from the coast to the interior of the country towards the production of gold/metal (these slaves were named *piezas de minas*) and also for supplying of food (slaves named *piezas de roza*). According to Romero (1991) the reference for these two enslaved groups were the ancestor original of the familiar group that could be a women –mother or grandmother. It is possible that some freed slaves ceased being itinerants after colonial mines and established at some places where they could continue practicing mining, and thus, they began to create a system that these days is known as *troncos* (logs): In the anthropological literature, *troncos* are cognitive groups of consanguineous relatives (blood relatives - *parientes consanguineous*) who trace their lineage via both the maternal and the paternal ancestor to a man or woman, founder of the descendence; whoever belongs to a trunk/log has working and inheritance rights on mining lands and crop plots claimed by the founder as the property of their offspring (Villa 1985, Friedeman and Briceño 1990).

"Still in practice in the XX century, with their origins in the mining crew the *troncos* or cognitive groups of consanguineous relatives, are still an answer of contemporary black groups to conditions of socio-ethnic and economic discrimination, and to the uncertainties of the Pacific habitat. These consanguineous relatives are offspring of one women and various different men-fathers who may have included blacks, Europeans or even indigenous. The *troncos* have organized giving rise to *sui* *generis* family relations that are fundamental to current black communities" (Arocha 1991 in Friedeman 1995 p. 87-88). Working conditions and technological progress are today similar than during colonial times; men and women had been socialized from early ages to work in the jungle, and eventually as proletariat in ports and cities, and kinship has been an effective social resource connecting social networks in both rural and urban areas (Friedemann 1995 p. 88-89). Besides, "…more than individual property, cleared lands are patrimony of a kin group, and this phenomena takes the form of a collective property" (Mosquera and April-Gnist 2001 p. 15)

Ethnic Social division

In Colombia enslavement abolition was sanctioned by law in 1851. Yet "whitening" (socially and genetically) was the only feasible strategy for blacks to gain real emancipation and access to civil rights given by law but negated by social practice (Friedemann 1995 p.47-48): Both during colonial and post-colonial periods, a vertical social division of society was based on race, with white Spaniards and their descendants at the top, and blacks, indigenous and other workers at the bottom, a situation that determined a caste categorization/order where phenotype was preponderant over socioeconomic or religious conditions. This gave rise to an ideology of "whiteness" and an uneven geographical socio-genetic process that led to what Peter Wade (1991) refers to as "racial regionalization". In the Pacific region both the scarceness of white people and displacement of indigenous communities led to a predominantly black demography (Friedemann 1995 p. 74-76)

Extractive economic model

Extractive economy was and continues being the economic model practiced in the Pacific region since colonial times; with black communities playing leading roles in market relations and indigenous communities being mediated by the former: In fact, this economic model is aimed at supplying natural resources to external markets due to that internal markets are usually very small (Leal and Restrepo 2003 p. 1-4). While the 'great colonial cycle of gold' was the foundation of this system (based on the slavery institution), which ended with Independence, and the abolition of slavery, the extractive model continued with boom and bust cycles of economic activity, each incorporating new products and social institutions as depicted in table 3 (Leal and Restrepo 2003 p.10; Oslender 2001).

These new cycles depicted included: the collection of plant ivory seeds and latex from rubber trees from the end of the 19th century and early 20th century, particularly aimed at US markets; logging of red mangroves for their bark tannin (*tanino*) extracted during the 1950s to 1970s mainly to supply the national leather industry (*curtiembres*); and wood extraction that became economically significant since the 1940s, and at present with the highest participation of national wood offer from these forests; during the 20th century (1916-1980s) foreign companies mainly from the US and France extracted gold again but this time using drags, water-bombs, chemical agents exposing people to health problems, and other technologies, which was the most recent version of gold mining in the Pacific region of Colombia; meanwhile, other plant species with lesser economic importance were also exploited such as *Naidí* palms (*Euterpe oleracea*) intended for European markets mainly: All of these have ended with exception of logging (Leal and Restrepo 2003).

On the other hand, manumission (the process of slave liberation after which the slave acquired his/her freedom) engendered a novel colonization process in the region that produced a new model of territorial appropriation (Aprile-Gniest 1993 p. 12, Villa 1998 p.11). Thus, the appropriation of wealth ceased being based on slavery and focused on the interchange and debt (*endeude*) model, which lies on previous payments made by traders to local people in return for the natural resources they seek to trade: Through interchange of imported commodities for natural products with black inhabitants, the business elite managed to monopolize the richness produced by these booms (Leal and Restrepo 2003, Marquez 2001).

During the colonial rule the Pacific region was considered a great gold mine; now it is considered as a great stock of natural resources (Leal and Restrepo 2003; Villa 1998). The extractive vision had resort to black settlers exploiting not only natural resources but also the local populations. Wood extraction inherited that logic of predecessor extractive cycles (Leal and Restrepo 2003 p. 24-30).

Today, industrial development is incipient, whereas food products and carpentry are salient; main economic centers are Quiddo (departmental capital), Istmina, Novita, Acandi, and Bahia Solano. Directly or indirectly, locals and other armed actors foster or benefit from the private investment from which long established multicrop sustainable agricultural systems have come to be replaced by monocrop industrialized cultivation of African oil palms, grasses to feed cattle, or plants for illicit use, mostly coca, in many places of the Pacific region (Arocha and Maya 2008 p. 401).

Settlement history and Demography

Early colonization took advantage of Pre-Hispanic indigenous settlements used by Spaniards both as administrative and resource extraction centers and colonization fronts; "In the Pacific region, colonial control was established in a few very small villages, and engaged in a number of miners, usually in motion, that were located in the upper and middle parts of gold rivers: Santa Maria de las Barbacoas and Santa Bárbara de Iscuandé in the south, and Citará and Nóvita in the north were the administrative axes pivotal to '*reales de minas*' (Leal and Restrepo p.8)". By the end of the 17th century there were nine settlements in the San Juan River, and six in the Atrato (Vargas 1993 a). Independence in 1810 and enslavement abolition in 1851 prompted free slaves to migrate to different locations occupying all the Pacific territory. Many of them continued living in mining areas initially, but others settled at the scarce populated centers, or searched for new places following river courses, coast lines, and old indigenous trails (Jiménez 2000 in Leal and Restrepo P. 12). Migration of black communities to the Pacific lowlands caused the retreating of indigenous peoples to upstream areas of many rivers (April-Gniest 1993, West 1957, Leal and Restrepo 2003).

By the end of the colonial period some small settlements in the coast such as Iscuande, Salahonda, Guapi, Tumaco, Charambira and Cupica already existed -in that there seemed to act a nucleus of Cimarron's Africans and *embera* indigenous group's members who fled from the '*reales de minas*'. Cimarron's, "produce a rudimentary society of close links between their members, in hidden lands, in small and invisible areas, that only produce subsistence means. It is possible that this is the origin of a customary management of lands, which perpetuates until the 21st century and continues operating, and being maintained in the midst of capitalism (Mosquera and Aprile 2001 p.20).

Second period is that of the Republican period. In 1851, slaves were granted freedom based on the national law on manumission. *Manumisos* could now follow the life paths of previously illegally freed Cimarron. Down streaming the rivers Atrato, San Juan and Baudo, they arrived to the pacific coast by the end of 19th century. Currently, the northern Pacific region population density is higher inlands than in lowlands and coastal areas; in contrast, at the southern part of the region population density increases at lowlands and decreases inlands (Mosquera and April-Gniset 2001). In the middle and lower parts of the Pacific region Black communities have developed different forms of production and resource access that were, and still are, strongly based on kinship relations (Friedmann 1974).

With respect to demographic figures, after a population decrease during the colonial rule, there was a demographic increase from the 17th century onwards with support of afro-aboriginal solidarity. African population by 1780 was around 10,000 to 12,000 persons, and in 1997 it was already close to 1,000.000. "The outstanding demographic development of this ethnic group has evidenced their dynamism and creativity" (Aprile and Mosquera 2001 p.19). Today, population estimates differ widely. Based on last census (DANE, 2006) and other authors' calculations, total inhabitants in the Pacific region are approximately 1.3 million from which 93% are Afro-Colombians, 2% are indigenous of various groups, and 5% are mestizos… Is worth noting that it was only until years 1993 and 2006 when national population censuses have inquired for the people's ethnic affiliation, origins and social trajectory. The International labor Organization's Agreement 169, which the Colombian Congress endorsed and thus converted into Colombian national law, requires that population surveys specify ethnic affiliation, and not racial type (Chang et al 2002) which at present had not sufficiently been put into practice.

Imaginary and Politics

Oslender (1999) suggests that current socio-political situation in the Colombia's Pacific region has presence of three main actors: the State; External Capital interests on wood and gold extraction; and the black communities' social movements. I will add indigenous communities and the Catholic Church, which has acted as a second state not only in this region but in the country as a whole. During the 1920-1930 period the Vatican established different "mission covenants" that were agreements with the national government which allowed the Catholic Church to play the role of a second government. All Choco was declared "*tierra de misiones*" (mission lands) with the exception of the municipality of Carmen de Atrato. Notwithstanding, the above may blur black communities as social actors in their everyday lives. These communities are comprised, as Losonczy (1999) puts it, inside a 'mythic mold' resulting from ontological rather than historical records where historical records become clear and precise again only in narratives of postcolonial periods: The myth has been replaced by history by erasing black people's collective memory on Africa and slavery. Leal and Restrepo (2003) suggests that there are two imaginaries of the Colombian pacific region: the region as natural depositary of great richness; and a wild region only good for extractive economy, neither for investment, nor for establishing a living. Another imaginary, one that I would like to support is the Pacific as a region where black women are medullar elements of matri-focal/ matrilineal families (Mina 1970?) who have played prime roles resulting in current territorial settings, settlements, family conformation, and land use practices.

In the early 1990s Colombia citizens voted for an approved a new constitution recognizing their societies as multicultural and pluri-ethnic (in Nicaragua and Brazil a similar process took place in the late 1980s (Arocha and Maya 2008 p.406).

"In Colombia, soon after July 8 1991, when the new constitution was approved, the government of past President Cesar Gaviria named the Special Commission for Black Communities with the purpose of changing the transitory article into what would become known as Law 70 of 1993. That law's main achievement was to recognize Afro-Colombians as ethnic people…and hence as subjects of those rights which convention 169 of the International Labor Organization defined for indigenous and tribal peoples. In May 1991, a few months before the new National Constitution was signed, the Colombian Congress ratified ILO Convention 169, thereby granting it the status of a national law …" (Arocha and Maya 2008 p.406).

Between 1997 and 2011, community councils in the Pacific coast were able to gain collective land titles to more than 5.2 million hectares, evidencing the recognition of new forms of democratic participation in the 1991 constitution: In a country with a renowned armed conflict, it is very significant that such a radical reform process was attained by nonviolent legal means (Almario 2004).

Law 70 in 1993 recognized collective land rights of rural areas settled by Afro-Colombian communities with traditional production practices in the Pacific region, and established mechanisms for protecting their cultural identity. This Law includes three basic components: collective land tenure, cultural identity protection, and improving quality of lives by means of development mechanisms. Since 1993, only collective land titling has been implemented, whereas very few pertinent policies and laws have fostered the remainder Law 70 provisions. On the contrary, obstacles to fully implementing Law 70 include land rights versus urbanization; and recent legislation passed by the national government, such as the laws of mines, water, forestry, and rural development, which may contravene the spirit of Law 70. Moreover, some of these new laws dealing with privatization and water resources and rural development have been denounced by human rights organizations because of their potential to facilitate legal appropriation of those lands now belonging to black and indigenous communities that members of illegal groups began to control through extortion and threats (Camacho 2004; Florez and Millan 2007 p. 194-200; Molano 2004).

"Since few decades ago the Pacific region has become to the convergence axis of conflicting actors including regular Colombian forces, left-wing guerrillas and right – wing paramilitary squads who directly or indirectly could benefit from the private investment from which long established multicrop sustainable agricultural systems have come to be replaced by monocrop industrialized" (Arocha and Maya 2008 p. 401). "The emergence of collective ethnic identities in the Colombian Pacific and similar regions thus reflects a double historical movement: the emergence of the biological as a global problem, and the bursting of cultural ethnic identities." (Escobar 2006 p.129): Collective titling as a collective project embodies strategies such as participation in transnational social movement networks, and global biodiversity initiatives; and the use of new information and communication technologies; among others.

The entire pacific is viewed as a region-territory of ethnic groups, and embodies a community life project. National government does allocate financial resources to collective titling, however, funding for project management and other initiatives for increasing quality of life of these communities is uncertain. On the other hand, Local Community Councils claim not having enough opportunities to participate at regional or national meetings of the organization "*Proceso de Comunidades Negras PCN*" (Black Communities process). Thus they don't envisage any other coherent initiative that could lead to the promised developmental objectives after collective titling (personal communication). More so, National laws and initiatives that contravene Law 70 are in many cases unknown by the LCCs throughout the region. As such, LCCs may have received funding from international organizations thus leaning to foreign interests on the region. In many places international cooperation show clear interests on wood resources and biotechnology property rights. LCCs are in disadvantage for dealing with international and even national negotiators, as they lack the minimum skill set for understanding cost-benefit relations of many initiatives proposed to black communities, as their people commonly have unequal access to education, health care, employment, transportation, housing, and other services. Whilst several policy initiatives potentially affecting these communities are proposed by the Nation, Departments and municipalities are not necessarily articulated to management plans drafted under Law 70 by LCCs.

THE DEPARTMENT OF CHOCO

Ecology

The Department of Choco is located at the most northern part of the Pacific region, limiting with Panama, and comprises 31 municipalities, among them Bahia Solano where my study area is located (see Figure 1). Out of a total of 32 departments nationally, Choco comprises the highest biodiversity in Colombia (25% of Colombian plant and bird species are found in Choco), and hydrological basins with rivers flowing both to the Pacific Ocean and the Caribbean Sea.

Main physiographic units from west to east include the *Serrania del Baudo* and Darien (N-S mountain chains); San Juan and Atrato Rivers' alluvial plains; and the western Andean *Cordillera Occidental*. Mean annual temperature ranges from 27 to 38 Celsius degrees. Currently it contains three national natural parks, one sanctuary of fauna and flora, around 115 indigenous *resguardos*, and approximately 52 collective titles to Afro-Colombian communities. In the national context Choco is considered one of most marginal departments, enduring amongst the poorer transportation infrastructure and lowest quality of life.

At the departmental spatial scale, vegetation cover is sub-grouped into two large types: 1) primary tropical rain forest in well drained areas, and 2) swamp forests and mangroves and other types of vegetation in poorly drained areas (both in coastal areas and river floodplains). Tropical rain forests are well drain areas covering the *Serrania del Baudo*, and the western slope of Cordillera Occidental; the first strata include tall evergreen trees sixty to 100 feet high (West 1957, Leal and Restrepo 2003): Main species families include *Lauracea*, *Bombacea*, *Moraceae*, *Bignonacae*, *Meliaceae* (cedar). Some deciduous trees are also found in this stratum (*ceibo*, rubber tree, tropical cedar); Second strata include shorter trees and many palms (20-30ft tall) including species families such as *Piperaceae*, *Rubiacae*, and common species such as palm milpeso, palm amarga, and the ivory nut palm. Understory grow is composed mainly by *bromelia* (spp); Swamp vegetation includes backswamp vegetation with palms such as jicara, chigua, naidi, and water tolerant tress such as cativos and higuerones. Along some lagoons with tidal influence, different types of mangroves are found, especially *Rhizophora Brevistyla*;

Fresh water swamp forest includes mainly *natos* (*Mora megistospherma*) and *cativo* (*Prioria copaifera*). The above vegetation cover is patched with grasslands; croplands; and mixed land use and land cover types. Since the 1950s most logging enterprises were established in this department (Leal and Restrepo 2003).

Settlement history and Demography

A group of Spaniards occupied an indigenous settlement in the Golfo de Urabá (Uraba Gulf) in the northern part of the Pacific region as early as 1510; however, gold mining centered by the time in Panama (Romoli 1988 p.6): Castilla de Oro, the new colonial settlement was the point from where the new exploration of the Pacific region took place in 1525. Sebastian de Belalcazar, another conqueror, opened the route of the Colombian Cauca River and established the *Gobernacion (Gubernator) de Popayan* in 1640 (which was reached from the Inca Empire in the south) from where the Spanish control was consolidated based on gold mining (Diaz 1994 in p.7). The province of Antioquia to the North of Colombia surged simultaneously and acquired political independence in 1586, thus, the above provinces tried to conquer Choco by military means but failed repetitively (Romoli 1975). It were missioners of the Catholic Church who opened the trail to the desired gold mines in Choco; Jesuits entered the upstream of San Juan river in 1624 and Franciscans were established in the Atrato river by the 1660s, notwithstanding that for various decades colonization was incipient (Sharp 1976). By the end of 17th century there were nine settlements in the San Juan river, and six in the Atrato river (Vargas 1993). Choco started paying taxes to the Spanish crown in 1692, which evidenced that this territory was gained by the Spanish colonizers (Leal and Restrepo 2003 p.7).

Settlement trajectories in Choco are described as the "*Colonia Negra del Pacifico*: (Black Colony of the Pacific); after 100 years of colonial practices both African slaves and indigenous peoples were displaced, thus forming few and small "*pueblos de indios*" (indigenous towns comprised of sailors (*bogas*) and human carriers (*cargueros*) who would "feely" circulate throughout the region, which in turn allowed assessment of the demographic development or the Pacific region (Mosquera and Aprile, 2001 p.17): Down streaming the rivers Atrato, San Juan and Baudo in the Department of Choco, they arrived to the pacific coast by the end of 19th century; during 1920 to 1930 more than 60 *aldeas* (small villages) were founded in the Choco coastal areas; fishing economy began to play an important role in their livelihoods; after 1930 no more villages were founded and current configuration of coastal settlements remains today basically the same.

During first half of 20th century (1920-1930), more than 60 small villages (*aldeas*) were founded in the Choco coastal areas (Fishing economy began to play an important role in their livelihoods); As evidenced by missioners during 1920 to 1922 the villages of Jella and El Valle, among others, the municipality of Bahia Solano and neighboring areas were already forming in: After 1930 no more villages were founded and current configuration of coastal settlements remains basically the same today; villages are 80 to 100 years old with few exceptions (Mosquera and Aprile, 2001). Exploitation of ivory plant and rubber (latex) during the second half of the 19th century until fist decades of the 20th century fostered the consolidation of migratory processes to these coastal areas in the Pacific region (April-Gniset 1993, Valencia and Villa 1992 p. 231).

Mosquera and April-Gniset (2001) propose a generalized settlement process from the mouth of San Juan River to Panama, particularly for the pacific lowlands: Collectors of ivory plant and rubber (mainly black settlers) arrived at a given location and established a small settlement with one or two families; other groups that were part of the latter families arrived to locations close to the previous settlement, and established their livelihoods there; each settlement core was connected to the other by way of their family members, which in turn participated in the formation of other settlements through 'reciprocal marriage exchange', and the 'inter-village circulation of spouses'. This pattern of "exchange of couples" probably guaranteed the permanent development of productive forces in the area, and the resulting demographic growth increased the pressure over available lands, and the transition from collection to agriculture.

EL VALLE, EL CEDRO

My study area is a subdivision of "Los Delfines", a collective land legally titled to local Afro-descendant communities in year 2002 (Figure 3). It is comprised inside the municipality of "Bahía Solano", *Corregimiento* of El Valle, at the coastal area of the Department of Choco. Multiple political administrative units overlap. "Los Delfines" encloses an area of 67,327 hectares titled collectively to 1,329 families or 5,846 persons (according to INCORA Resolution 03 of December 2002). "Los Delfines" is bounded by the Pacific Ocean to the west and the Western Andean Cordillera to the east. It is also delimited by another Afro-collective title named "Jurado" to the north, and the National Park "Utria" and the collective title "Los Riscales" to the South. Two indigenous *resguardos* are neighboring to the east.

Current total number of persons in "EL Cedro" cannot be estimated with precision. However, based on both a census conducted by Fundacion Natura in 2004 and on other census led by one local inhabitant in 1998 (Heriberto Florez Sanclemente

Prado), current total population in the study area could range approximately from 2,300 to 2,500 persons (with an average of five persons per family).

During my field research in 2006-2007 “Los Delfines”, which is presided by a General Community Council (GCC), was subdivided into 14 smaller subareas or sub-communities. Community councils perform administrative and regulatory duties related to territorial use of and governance inside the collective title. The sub-community of “*El Cedro*” inside the *Corregimiento* El Valle is the focus of my research, and is located at the southernmost part of “Los Delfines” neighboring the National Park Utria. Each of these sub-communities has designated Local Community Councils (LCC), notwithstanding that inner territorial subdivisions may reconfigure over time as the consequence of local decisions only. All Collective titles are established for rural areas only according to Law 70, whereas urban areas inside the municipality of Bahia Solano are administered directly by the municipality major. Local Community Councils (LCC) perform administrative and regulatory responsibilities related to the collective territory’s use and governance. However, the LCC territorial suggestions may or not be community-wide accepted, or consented, due to those other customary laws are also prevalent. The area under the LCC *El Cedro* has an extension of approximately from 15,000 HA. Notwithstanding that members of LCC “*El Cedro*” are not certain about the surface extension of their territory out of the wider collective title; nor of inherited areas, or private properties. The same is true for the extended “Los Delfines” Title. The study area comprises six (6) distinct management areas recognized by the local people (but mainly by LCC members) but their extensions and boundaries either are not clear or may change with time (Figure 4). The above will be discussed with more detailed in chapters 5 and 6 on fieldwork results.

El Cedro area has a total annual precipitation of 5000 to 7000 mm and is on top of cretaceous basaltic rocks, and quaternary deposits. Landforms include marine and fluvial plains, and low range hills with a maximum relief of 800m in some areas (but more commonly 300m). Poorly drained, acid soils, with low to moderate fertility are most common. Main rivers inside the study area are El Valle (the largest one), Boroboro, Tundo, and Nimiquia. The National Natural Park "Ensenada de Utria", was established in 1987 out of the area inhabited by these communities. Thus, El Valle limits with this National Natural Park, and with two legally established indigenous *resguardos* (i.e. Boroboro, and El Brazo and Poza Manza).

Exploitation of ivory plant and rubber (latex) during the second half of the 19th century until first decades of the 20th century fostered the consolidation of migratory processes to these coastal areas in the Pacific region (April-Gniset 1993, Valencia y Villa 1992: 231). Missioner Francisco Onetti in 1920, 1921, and 1922 traveled the northern Choco including El Valle where he stressed it was the region in which more, even excessive, ivory plant was being cut, and that Jurado (to the north) was a settlement in which most people were occupied in rubber extraction (*caucheras*). During those years small villages were forming in Bahia Solano and neighboring areas: Jella, Playita de los Cuesta (Junacito), El Valle, Nabugá, Paridera, Huaca, Mecana, Playita de los Potes, Huina. In 1935, the Central Government officially 'founded' Ciudad Mutis (previously Jella) as part of previously enacted (in 1928) Agricultural Colonies (Mosquera and April-Gniset 2001): In 1935 *Corregimiento* El Valle was the target of a governmental initiative for creating an 'agricultural colony', aimed at attracting people from the country's interior that could develop this part of the national territory; yet, incomers lacked the ecological knowledge required for this purpose, and agricultural efforts based on foreign seeds, crops, and technical experience, resulted in failure and consequent abandonment of worked lands in the short term (8 years), notwithstanding, this national project notably affected livelihoods and future perspectives; as in-migration processes both to Ciudad Mutis and to neighboring settlements such as El Valle were already fostered by the project, a modest market has grown since those days including the surrounding areas.

Land Use and Land Cover

Land use and land cover is perceived by locals as classified into three general areas: *monte bravo* (approximately corresponding to primary forest with different levels of fragmentation, and relatively less fertile soils); *monte viche* (approximately corresponding to secondary forest, mixed bushed, and shifting agriculture); and *rastrojo* (corresponding to agricultural lands, pastures (*potrero*), mixed agricultural lands, bushes and pastures and gardens). *Monte bravo* is basically a men space, whereas *monte viche* and *rastrojo* are both women (including children) and men spaces. *Potreros* (pastures) are gender inclusive spaces more general. Inside these chief subdivisions are included subunits resulting both from gender and kinship relations, and symbolic practices (Arocha 1999). However these boundaries ‘are porous and flexible, and patterns of usage change on a seasonal basis. Subsistence farming is still the most important occupation of the population.

These above general LULC could be further grouped into 4 terrain mapping units:

1. Denudational hills comprising most *Monte Bravo*, which is used for logging, hunting, and shifting cultivation (the latter mainly on hill slopes). Areas exclusively used for hunting and logging are primarily men’s spaces, whereas hill slopes which are often covered by *monte viche*, are also gender neutral or inclusive spaces.

2. Alluvial floodplains in which most *rastrojo* are found (including *potreros*) and patches of *monte viche*. These plains comprise a larger portion of *fincas* (farms). Natural levees and river terraces are best farm lands; whilst parts of *fincas* are cultivated for about 6 years and then abandoned. Alternatively these fincas are cultivated every other year if planted in maize or sweet manioc. Rice is often grown on backswamps.

3. There are two beach ridge areas of marine and fluvial origin included in the study area. To the north, beach ridges formed on top of Mesozoic rocks (erosional coastline). These are the preferred areas to private properties of inhabitants from the interior of the country who acquired those lands around 30 years ago for tourism and leisure purposes. 20 years ago, these beach ridges that are intersected by head shores and rock formations, were sites of abundant clams (shelve fish). To the southern part of the study area are found a larger extension of beach ridges (approximately 9km in length). These areas have been traditionally owned by locals with very few exceptions. Today its landforms comprise many *fincas*. Coconut, sweet manioc and pineapple are among main crops found. A natural reserve, *Estacion Septiembre*, is also found on these beach ridges.

4. Ciudad Mutis-El Valle village road corridor (on denudational hills and floodplains), comprise *monte viche, rastrojo* and many *potreros*. Mixed secondary forest, bush lands and pastures are found. This area is rich in fruit and palm trees such as ivory nut, *chontaduro, jicara, achiote, totumo*, and rubber, among others. Due to its high accessibility, this corridor is preferred by women and children for gathering of seeds, tree products, and medicinal plants.

Azoteas, which are elevated container gardens are found in all pacific lowlands next to rural houses, but are also found in villages and urban centers. *Azoteas* are an exclusively women activity where they grow food plants, cash crops, medicinal plants, and tree species, among other uses (Camacho 2001). This type of gardening is pivotal both to the consolidation and transfer of women's knowledge on their environment, and to their social coherence. Various functions of *azoteas* have been evidenced by scholars, among them, a source for primary food household needs, for food and seed interchange between the broader community members, and for keeping symbolic linkages to their extended families and lands (Leyton et al 2001, Mena 2001, Camacho 2001).

Livelihoods

Although subject to frequent flooding, widespread river networks are the focus of all economic, domestic and social activities of the pacific region populations that endure physical and economic marginality with respect to the rest of the country (Oslender, 2001). Main livelihoods include fishing and agriculture in lower to higher reliefs, and the combination of other activities in each of these areas including hunting, gathering and logging. Domestic animal breeding has been another element of all ecosystems (Moreno 1994 p.26) that has been conducted based on local interchange networks considering that most of these activities are seasonal.

Subsistence agriculture in *fincas* is an activity in which men and women participate. Pertinent activities such as slashing, cropping, and harvesting are shared both by women (children) and men. However, this activity seems to have been decreasing over time and thus, closely related to generational change. For younger women who seek to conduct urban type of activities, subsistence agriculture is becoming increasingly a secondary task. Whereas some of the younger men are inclined nowadays to activities such as fishing and logging that could increase their income.

Boom and burst cycles of cash crops have affected the cultivation of rubber, rice, maize, sugar cane, ivory nut, coconut, and plantain, throughout decades. Yet, other main crops that include *achin*, and manioc, among others, have been traditionally harvested for local consumption. Representative fruits include *borojo*, pineapple, avocado, *guayaba*, papaya, *anon*, cocoa, and *guanabana*. During the 1950s maize and plantain were the main starch foods. Today maize is not cultivated as much as before, and sweet manioc (yucca) that was a minor product, is increasingly becoming a main starch food.

Fishing (in rivers and the sea) is both a men's and women's activity, which products are destined both for own consumption and for cash. However, aquatic spaces of rivers and the Pacific Ocean include sites that are used specifically by women and/or men. Women are mainly river fishers and use their own tools for this purpose; but, they also fish in the ocean at bay areas, or close to the shore, at head shores, or near cliffs. At the study area women do not drive motored canoes, thus, open ocean spaces for fishing are commonly limited to men, who may also fish at rivers.

Livestock raising began in the 1970s. During the early to mid-90s cattle heads augmented while forest clearing increased in many areas resulting in transitions of the forest land cover into grasslands. New colonizers from the interior of the country fostered the above changes using paid labor for slashing, clearing forests, planting pastures, and raising cattle, among other activities. This deforestation took place mainly along the road to Ciudad Mutis and along a walking path to the Utria National Natural Park. Hunting of armadillo, *guagua*, and iguana, among others, which products are sometimes sell for cash, are all men activity. Turtles and their eggs are catch by men, women, and children, which is causing the lowering of the turtle's reproduction rate whereas the total numbers of turtle coming to these beaches is dramatically decreasing (personal communication).

Logging of *cedar, huina, guayacan, pantano, abarco, maroquendo,* among others, are exclusively a men's activity. Most part of the logged wood is sold for cash to intermediaries who transport it by ships to Buenaventura, in the Department of Valle del Cauca. Currently, logging is one of major cash source for men. Wood products are also used by locals for carpentry and construction.

Animal husbandry takes place close or within the local population's houses (mainly in corrals). Animals are more often raised by women, both for subsistence and for cash income. Notwithstanding, corrals are built largely with aid of men. As house location of most local inhabitants started to move from rural areas to villages around 30 to 40 year ago, so did animals and their corrals. One of the animals brought by Spaniards that was more rapidly domesticated by indigenous population was the pig who use to roam in *rastrojos* near inter harvest periods (West 1957), thus playing ecological functions. Traditional pig horde practices are currently disappearing in "El Cedro" thus pigs are now largely maintained inside corrals within houses. Other corral animals in the village include chicken and ducks.

Production of *Biche* and *vinete* is one important women's activity. These are liquors made of sugar cane that are both sold for cash and produced for family consumption. However, selling of locally made liquor '*biche*' is being dramatically reduced by increasing availability of foreign liquors. Production of *Panela*, a hardened sweet made of sugar cane juice used for family consumption and sell for cash, is also a persistently diminishing livelihood due in part to the increasing availability of industrial sugar, as well as a decreasing market.

Handcrafts (traditional and novel) are both a men and women livelihood, which products are sold for cash and/or used by households. Traditional handcrafts include weaving of motets, *sopladoras*, *hamacas*, *esterillas* and other related products aimed for their use on domestic and traditional subsistence and production activities. Motets were used for fishing and catching pichimarra (river shrimp). These traditions are increasingly being abandoned and only few old women and men still weave those items. In the mid-90s a group of 10 persons including men and women, were trained on the design and production of novel handcrafts made of ivory nut. Other few students were sent to Nuqui, a town located to the south of "El Cedro" in order to learn how to work on wood and natural seeds to produce new types of handcrafts. They in turn trained the previous group on these new techniques. Today there are about 15 artisans in El Cedro, who sell their handcraft products for local to international markets.

Collection of shellfish (mainly in beaches, and mangrove areas) is a women subsistence activity. Cativo trees are located close to the El Valle river mouth, and extents towards the limits of brackish areas. However these latter ecosystems are reported by locals to be not very productive nowadays.

During the 1970s the process of urban to rural transition increased. Nearly all urban areas have now electricity but most rural areas still lack this service.

Labor

Labor exchange or cooperative labor groups (minga, mano cambiada, and mateo) are main ways in which labor force is provided for agricultural purposes. Today, some paid labor is used specially for few days of slashing. Wealthier locals use additional paid labor for cattle raising, and construction, among other activities.

Few locals are part time employed in ecotourism hotels, and local commercial facilities. Current artisans' handcrafts are intended for local tourism mainly, although few artisans are now exporting their products to cities such as Medellin, Cali, or Bogota. A more traditional type of handcraft is the construction of '*chingos*', which are canoes made out of a single tree trunk such as 'balso' (*Ochroma pyramidale*, *Ochorona lagopus*). A small number of local men are involved on transportation services along Ciudad Mutis and El Valle using extremely deteriorated cars which may brake too often during or after each trip. Other income generation activities include very small businesses run by women and men inside the village.

Settlement process

After 1930, the number of aldeas from the north of river San Juan to Jurado has remained basically the same. Nearby the study area, some villages are 80 to 100 years old. The exception is the town of Cupica which existed some years after the national independence of 1820 (Mosquera and April-Gniset 2001): Missioner Francisco Onetti in 1920, 1921, and 1922 travels the northern Choco area and arrives at Nuqui, by then a municipal capital. His photographs showed coconut palms of 20-30 years; he then travels to El Valle where he stressed it was the region in which more/ excessive tagua was being cut; then he continues to la Jella, "caserio de raza acholada", and visited the villages of Huina, Nabugá, which had less than 20 houses; at Jurado with 40 houses most people were occupied in rubber extraction (caucheras); everywhere during his visits he highlighted the role of rubber and ivory nut (tagua), and the presence of coconuts and natural food plants; he further noted that rice was imported from Panama; during those years small *aldeas* (villages) were forming in Bahia Solano and neighboring areas: Jella, Playita de los Cuesta (Junacito), El Valle, Nabugá, Paridera, Huaca, Mecana, Playita de los Potes, Huina; Any of these cases reflect what happened in the others, the same processes took place in the entire Chocoan littoral, leading to a generalized settlement from the mouth of San Juan River, to Panama.

As proposed by April-Gniset (2003), from one *aldea* to the other, biographies were the same: Collectors of ivory nut and rubber arrived to Mecana, and established a small settlement with the Bocanegra and Medina families. Soon after in Huina same collectors of two families arrived: the Medina and the Potes. Other groups that were part of previous ones arrived to other locations and established their livelihoods there. The *aldeas* of Playita de los Potes and Playita de los Cuesta born or grew as such. Each settlement core was connected to the other by way of their members, which in turn participated in the formation of other settlements, through 'reciprocal marriage exchange', and the 'inter-*aldean* circulation of spouses'. Thus missioners registered a characteristic feature of domestic agricultural community, defined by the links among similar contiguous or neighboring habitats. This pattern of "exchange of couples" appears to have assured the permanent development of productive forces in the *comarca* (sub-region). This in turn creates a network of inter-familiar relations in the *comarca* and notable inter-*aldea* cohesion. Consequent demographic growth increased the pressure over available lands, and the transition from collection to agriculture.

More locally, since late 19th century, collectors of rubber and tagua arrived to La Jella (today Ciudad Mutis), where they found few sedentary agricultural indigenous Emberas, who received them, with the consequent formation of a small commercial community, based on that the bay was a good port for some of the ships traveling to Panama (Mosquera and April-Gniset 2001): It seems that during 1918 besides the Embera, other afro descendant families were located in the area that came from the Atrato River, Macana and San Juan River; by 1920 they were already planting coconut trees and cultivating manioc, plantain, sugar cane, and cocoa; family members who slashed and cleared neighboring sites as was the case of the Bermudez, Zuñiga in El Valle, comprised a group of around 20 couples that were the original pioneering settlers of early 20th century in Bahia Solano. According to these authors, this was the demographic turn of afro-emberá colonization of the northern pacific littoral.

In 1935, the Central Government officially 'founded' Ciudad Mutis (previously Jella) as being part of previously enacted (in 1928) Agricultural Colonies. As stated above, this agricultural colony was a failure; nonetheless this national project notably affected livelihoods and future perspectives. As immigration was already fostered by the project, a modest market began to grow (Mosquera and April-Gniset 2001).

Transportation

It is believed that a fundamental drawback to economy is the lack or inexistence of good transportation, and the limited quality agricultural land found in the area. Thus, main transportation mean is by rivers and the sea using small canoes (*chingos*), and nowadays, motored canoes to a lesser extent. There is a dirt road of 18-20km long between Ciudad Mutis and the El Valle. Likewise, a small road section that aimed at connecting the Pan-American Highway was initiated in El Valle but its construction was abandoned years after. A road network connecting the El Cedro to the interior of the country is inexistent.

An airport is located in Bahia Solano for DC-3 type planes, with scheduled commercial routes to Quibdo, Medellin, and Pereira; some other charter flights cover routs to other parts of the country. The adjacent municipality to the south, Nuqui, comprises another airport with similar characteristics and commercial routes. Though, costs per ticket to the closest cities range approximately from US$ 200 to US$ 400, making it impossible for most locals to fly unless very sporadically (usually for permanent migration or grave illness). Most locals have never taken an airplane in their whole lives.

The only seaport with large ducks (first docks were built in 1921) for ocean freighters is Buenaventura, situated to the South of Choco, in the Department of El Valle. There are around five ships from Buenaventura to Ciudad Mutis and Jurado, with capacity for approximately 50 passengers that are also used for transportation of wood, and other materials, few vegetables and fruits. These ships make a round-trip once a month from Buenaventura to small seaports at Choco (that take approximately 20 hours from Buenaventura to arrive at Bahia Solano). A one way ticket is around US$40-50, making these ships the preferred transportation of locals to the Colombian inlands. Buenaventura has a transportation road to the interior of the country in fairly well conditions that connects this port to Cali, Pereira, and Armenia, among some other important national urban centers. Many inhabitants have maintained trading networks with Panama (especially in the past), due to its vicinity, for which they use also small canoes.

Road transportation and seaport development is another regional strategy of the Integrated Pacific Regional Plan, recently proposed by the Ministry of Transport, aimed at the economic and regional integration of Colombia. This integration has been unsuccessfully pursued by national governments since 1910 to the present. The proposed road network Animas-Nuqui and seaport services in Tribuga, are two examples of this initiative. One could infer that if the road construction will traverse collective land titles this would bring very important socio-economic and political changes, especially to the northern pacific region. Foreseen is the increasing mounting of territorial conflicts, including those arising from public order, narco-traffic, and migration. Being Nuqui at two hours by canoe to the El Cedro, LCC members are extremely worried as they are not prepared for these future realities, nor know how they could profit from the promised benefits of these projects (personal communication). It is expected that new infrastructural projects would be more to the benefit of international and national capitalist organizations, unless local communities have external support, and more information on the future impacts of these projects. Choco limits with some of the wealthiest departments in Colombia (Antioquia and Risaralda pertaining to the coffee axis, and Valle del Cauca neighboring to the south). A project for building a canal connecting the Caribbean and Pacific basins through Choco envisioned since last half of the 19th century (1854 and 1875) is still included in developmental agendas to the date: explorations on the part of individuals and the US government sought to study possible trans-oceanic canal routs via the Atrato, Truandó, and Nipipi rivers (West 1957).

FINAL REMARKS

We have described how the El Cedro is embedded in a larger matrix of environmental and socioeconomic dimensions of heterogeneous spatial and temporal contexts. As the consequence of African slave trade, particularly for alluvium gold mining, Afro-descendants used spaces of the Pacific region covered by dense tropical rainforest also as an emancipatory environment. Both the inherited and learned livelihoods of the incipient extended matrifocal families (troncos) affected-culture were reshaped by new ethnic identities in which indigenous and Afro-descendant populations must have shared knowledges, and negotiated places for survival purposes in the midst of the colonial Spaniard rule.

The conformation of novel subregional and global markets emerged. Both the extraction model (initially based in gold mining) and the harsh environment- imaginaries have resulted throughout time in the production of one of most marginal areas in Colombia: The Pacific region. After manumission accorded by law in 1851, Afro-descendant communities with a very few 'bundle of powers', and a low to inexistent education attainment consolidated a settlement process in the Pacific region with pertinent reconstruction of their cultural identity from 80 to 100 years ago. From almost 10,000 Afro-descendants by the time of manumission, today their populations have rose to more than one million becoming more than 90% of inhabitants in the Pacific region with respect to the total population. El Cedro currently has from 2,300 to 2,500 people.

A more detailed insight on these communities' livelihoods and land use change is included in the following chapters. Although the African culture is still present, vivid memories have sunk under centuries of social changes. And these changes have resulted in novel reconfigurations of livelihoods and places. Afro-Colombians have created the *monte*, *rastrojo*, *container gardening*, and their *respaldo*, in sum, their collective lands. These novel land use/environmental patterns were foundation for passing of Law 70 in 1993, which sanctioned the titling process of collective lands to Afro-descendant communities in the Pacific region with traditional livelihoods and long settlement histories, and the protection of cultural and ethnic identities of the current "Black communities" of Colombia. The nuances of how gender dimensions have affected the reconfiguration of livelihoods in the last few decades are the focus of the following chapters.

Chapter 4: Land Use and Land Cover Change (LULCC)

The Land Use and Land Cover Change LULCC literature is fundamentally a spatial examination that seeks to identify the aerial extent of lands (cover) that may or may not change; and it uses spatially explicit models to either statistically explain or predict such spatial outcomes (Walker, 2004). Various authors have proposed methods that seek to identify the aerial extent and trajectories of such changes in a given period of time, and the factors and causes guiding LULCC decision making. Major contributions to the LULCC theoretical frameworks emphasize quantitative explanations, often using models which include a number of explanatory variables, and types of analysis ranging from household to national or global levels; or classified as Agent-based, Systems-based, or Narrative perspectives (Brown and Sierra 1994, Kaimanovitz and Angelsen 1998, Apan and Peterson 1998, Angelsen and Kaimanovitz 1999, Nepstad et al. 2001, Lambin et al. 2001, Sierra 2001, Walsh and Crews-Meyer 2002, Brondizio et al. 2002, Moran et al. 2002, Geist and Lambin 2002, Lambin et al. 2003, Anselin 2003, Parker et al. 2003, Chomitz 2004, Mertens et al. 2004, Rudel et al. 2005, Seto 2005, Verburg 2006, Dalle et al. 2006, Messina 2006).

Land Use and Land Cover Change (LULCC) Assessment

Scholarly works on land use and land cover change LULCC include a variety of perspectives for assessing both the land use and land cover decision-making process, and the identification of causal relations of change. However, few LULCC contributions focus on the theorization of gendered patterns of environmental change. Thus, it is still challenging to develop a 'spatial theory' of gender-based land use and land cover change.

Many of the scholarly related contributions are theoretically based (not spatially explicit), whilst empirical case studies often address different approaches to resource use.

Causal explanations commonly accepted in gender-neutral/inclusive LULCC must also be identified to address its gender dimensions. A Gendered Land Use and Land Cover Change (GLULCC) concept on its own will require many specific empirically and theoretically based contributions, in recognition of the cultural, socio-economic and political diversity of geographic locations around the globe.

Nevertheless, LULCC research commonly relies on spatial explanations that allow multiple-scale applications often using geographic information science (i.e. remote sensing geographic information systems, GPS), and cartographic representation techniques. However, pertinent efforts have been less profuse in the spatial analysis of structural positions of men and women in the context of change identification, simulation or prediction. In this subfield, more theorization and empirical research could contribute to better understanding the roles of gender relations in LULCC processes (GLUCC).

On the other hand, certain geographic locations around the world have become centers of LULCC research as study sites. Examples of these are the influential contributions of scholarly works in the Amazon, Brazil, Ecuador, Bolivia, Guatemala, El Salvador, Mexico, Thailand, Philippines, China, and Cameroon, among other places. The various LULCC research efforts in turn have been analyzed altogether by key authors in the context of global environmental change, or for the purpose of generalization (Allen and Barnes 1985, Angelsen and Kaimanovitz 1999, Lambin et al. 2001, Geist and Lambin 2002, Burgi et al. 2004, Rudel et al. 2005). In sum, the interrelations between LULCC change and the decision making systems are explained by biophysical, cultural, socio-economic and political variables (Sierra, 2004), which are their ‘proximate and underlying causes’ (Geist and Lambin 2002).

LULCC literature is prolific and follows different lines of explanation and emphasis. Below, key contributions, and relevant modeling methods are reviewed.

Generalization and a Global Understanding of LULCC

Research efforts towards generalization and the global understanding of LULCC are important for framing main theoretical and methodological contributions in the last decade. Many of these contributions usually link case studies with global assessments.

The results of 140 formal economic models on tropical deforestation classified by scale (i.e. household, microeconomic, regional, national), and methodology (analytical, simulation, empirical) were synthesized by Angelsen and Kaimanovitz (1999). Their analyses raised questions on the validity of common accepted causes directly driving deforestation processes including roads, agricultural prices, and wages, as well as on the limitations posed by data availability to quantitative models that use variables such as the magnitude and location of deforestation (dependent variable), with explanatory variables including agents of deforestation, land allocation decisions, agents’ decision parameters, macroeconomic variables, and policy instruments. Whereas, main findings on the underlying causes of deforestation in the analyzed cases (population pressure, income level, economic growth, technical progress, external debt, trade, structural adjustment) evidenced that relations of population growth, poverty reduction, and other macroeconomic factors with deforestation processes were unclear and difficult to determine, gender as a causal cause of deforestation was not reported in these 140 cases.

Contribution from 26 researchers on the state of understanding of LULCC (Lambin et al. 2001) show agreement on that this understanding is based on simplifications that will in turn underlie the drafting of pertinent ‘environment-development’ policies. Main conclusion of their reflections is that population and poverty are not the major causes of LULCC around the world. Instead, they argue that land cover change is driven by the ways in which people, affected by institutional factors, react to economic opportunities and constraints. Upon their analyses on case studies on different geographic locations (i.e. Tropical deforestation, Rangeland Modifications, Agricultural Intensification, and Urbanization), the authors evidenced that infrastructural development and political decisions linked to economic opportunities are largely the main drivers of change. Another important finding of this group of scholars is that agricultural intensification seems to follow three main pathways: Land scarcity, commoditization, and intervention (from state, donors, or NGO’s). In the global context this group of authors perceived in their words (while assessing aggregated LULCC) that “better data alone are insufficient for improved models and projections of land use and land cover change… they must be matched by enhanced understanding of the causes of change” (p. 262). In sum, the authors call attention to the fact that sometimes misleading simplifications of LULCC are influencing environmental and development policies worldwide, while a better understanding of the causes of change is still critical. In my view, this clearly suggests embracing broader frames of analysis to understand the causes of LULCC, among them increased social signifiers in heterogeneous temporal and spatial contexts. However, is worth noting again that the analysis of main causes of change suggested by these authors, namely infrastructural development, political decisions, and economic opportunities do not stress gender as explanatory factor of LULCC.

Geist and Lambin's (2002) 'general understanding' of the proximate causes and underlying driving forces of tropical deforestation, show results of a frequency analysis derived from 152 local-scale case studies in Africa, Asia and Latin America. They argue that tropical deforestation's most important causal factors' (underlying causes) are contained within under economic factors (81% of the cases), institutions (76% of the cases), and national policies; whereas previous studies overemphasized population growth and shifting cultivation. On the proximate causes they give major importance to agricultural expansion, wood extraction, and infrastructure development, acknowledging regional variations. Indeed, the authors evidenced that agricultural expansion was the outstanding proximate cause of tropical deforestation (96% of the analyzed case studies). Based on these findings they concluded that tropical deforestation is the result of an arrangement of proximate causes and underlying forces which vary geographically and historically (Figure 5); therefore "no universal policy for controlling tropical deforestation can be conceived" (p. 150).

The work on forest transitions by Rudel et al. (2005) is based on the FAO's forest cover change estimates for 139 countries in the 1990s. The concept of forest transition used by the authors is the 'predictable' path of forest change as response to economic development, industrialization and urbanization. According to Rudel (1998), initially a large decline of forest will take place followed by a slow increase in forest cover. Therefore, transitions will impact environmental services differentially (i.e. biodiversity, water, soils, and climate). The authors acknowledge forest transitions as result of two main situations: first, when economic development stimulates the creation of sufficient 'non-farm jobs' thus inducing forest regeneration; and second, when forests are scarce and governments and property owners are encouraged to plant trees. They conclude that while more research should be conducted in order to confirm their findings on the two types of transitions, policy makers could in turn foster these processes acknowledging that although “transitions do little to conserve biodiversity” (p.24), they potentially impact positively on soils, water quality, and climate change.

From the scholarly work illustrated above by 29 researchers on numerous (around 300) case studies worldwide, some prominent findings are common on the general understanding of LULCC processes. First, there is a consensus that major causes driving LULCC are economic opportunities and constraints faced by people mediated by institutions, infrastructure development, and national policies (including intervention by external organizations). Second, population growth and poverty reduction are not causes of LULCC, or at least are ambiguous or difficult to establish as such. Third, improved methodologies and quality of models must be a focus of much of the scholarly efforts towards understanding LULCC. Four, more research and pertinent findings are needed to confirm some of the previous authors’ findings. And five, better data alone will not improve models and pertinent LULCC projections, but the better understanding of the causes of change. Cutting across these influential contributions is the importance given to policy making; both as cause and consequence of LULCC, and the problems posed when decision making is based on simplifications on LULCC processes whose validity is still questioned. It is also evident a gender neutral/inclusive approach to these findings.

Methods and Models in LULCC research

Spatially explicit and quantitative methods often structured as models have increasingly become the focus of LULCC research in the last decade, evidencing more complex processes of land use and land cover change, and largely enhancing the importance of remote sensing technology (Lambin et al 2003). Many models have directed efforts towards elucidating the causes of LULCC, overcoming simplifications and acknowledging more spatial and temporal scales. These scholarly efforts in turn have allowed asserting the linkages, conclusions, directions, and generalizations expressed above. From the bulk of pertinent literature, some key works help to illustrate methodological trends and modeling in LULCC research.

LULCC models

Various classifications of models are proposed by LULCC researchers. Among those economic models, integrative approaches, and multi-agent based systems models are particularly relevant both because these have been more scholarly prolific, and seem to tackle more comprehensive approaches to the understanding of LUCC.

Kaimanovitz and Angelsen's (1998) synthesis of some 150 economic models of tropical deforestation and their methodologies (90% of their available models were produced since 1990) proposed a classification scheme of these models as follows: analytical or regression models at the household level; regional models integrating spatial and non-spatial data; and national level models based on macroeconomic variables, global analysis, and comparative statistics. They evidenced that these models often lack an explicit spatial dimension, and are limited by the fact that many assumptions are needed for simplification purposes. In addition, general limitation of analyzed economic models of deforestation were identified: 1) an extensive data collection in the field is required; 2) quantitative simulations on future LULCC may be complicated; 3) the application of these models are constrained to particular areas; and 4) some tend to be static and only provide for general conclusions.

In contrast Lambin et al. (2003) acknowledges a move from LULCC simplifications towards a more complex set of causal explanations (changes in social organization and loss of entitlements to the environment are now accredited). In their words, while more innovating methodologies are being developed in LULCC modeling at local and regional scales, very few models may realistically predict future LULCC at regional to global scales. Thus they argue that the complexities in LULCC research require an integrative LULCC framework of human-environment relations. This integrative framework should be based on three levels of understanding which act at different temporalities of change -from immediate, to gradual, and longer transitions, respectively-: agent-based perspective (i.e. decision-making process by individuals as a consequence of external factors and microeconomic approaches); systems perspective (i.e. LULCC explained by the existence of organizations/ institutions, and decisions at this level); and narrative approaches (i.e. LULCC historical interpretations at specific localities). This last approach has more common analytical schemes with the ones used in cultural and political ecology research.

Another approach which follows the lines of complexity research is the multi-agent systems model of LULCC (MAS/LULCC models) described by Parker et al. (2003). MAS/LULCC integrates two models: a cellular model on the landscape where decisions are being made, and an agent-based model on the actors' decision making on the analyzed system. They provide also a review of modeling techniques as a justification on the use and development of MAS/LULCC models (i.e. equation-based models; systems models; statistical techniques; expert models; evolutionary models; cellular models; hybrid-models and agent based models). These researchers contend that none of the above mentioned techniques "can represent the impact of human decision-making on the landscape" (p.321). Conversely, they argue, MAS/LULCC models are more flexible, and may be used as a 'simulated social laboratory', which allows building in critical data to a particular system. However, the main challenge acknowledged by the authors in using MAS/LULCC models is "the need to understand (and theorize) and represent complexity". In this scholarly contribution, the problem of understanding complexity (including causes of LULCC) remains pertinent.

These reflections on the LULCC models bear out three things. First, models of LULCC have evolved from more simplistic to complex methodologies and theories on the understanding of causal relations of change. Second, problems related with different scales of time and place within modeling are finding solutions through the use of integrative LULCC frameworks, such as those from human-environment relations. And third, the combination of various models and methodologies advanced by inter-disciplinary research teams could potentially increase the understanding of LULCC processes, and lead to more valid conclusions from local to global levels.

LULCC modeling and methodologies

The wealth of modeling and methodological contributions to LULCC research is not limited to the previous reflections. Indeed, a detailed enumeration of such inputs is very extensive. These contributions vary from models that are empirically based (i.e. the use of fieldwork data) to those which are theoretically based. They also differ on how they tackle simpler to complex LULCC processes. On the other hand some models are statistically oriented (e.g. emphasis on logit or multivariate regression models), whereas others are spatially-explicit (e.g. emphasis on GIScience). For instance, Geographic Information Science by itself (i.e. remote sensing, geographic information systems, GPS) is widely used for studying the relations between LULCC, environmental and socio-economic variables (Longley et al 2001, McCoy 2005). More importantly, these methods have revealed processes of LULCC in specific locations, and allowed the handling and management of new information. Conversely, LULCC research in areas with very scarce availability of data sometimes is constrained to rely exclusively on information collected in the field (i.e. questionnaires, surveys, GPS maps). Increasing levels of understanding on the complexity of change are fostering the development of new models and methodologies of LULCC. Within these efforts is worth mentioning some key contribution by LULCC researchers.

Early works on statistical analysis (namely multivariate or logistic regressions), GIS and remote sensing utilized to understand the relations between environmental and socio-economic variables, showed that the spatial and temporal variability of LULCC was so significant that extrapolation or generalization of pertinent results could only be done with ‘caution’ (Apan and Peterson 1998). More so, the analysis of interrelations between deforestation at multiple geographic scales with road infrastructure, physical environment, land tenure, and zoning policies, based on geo-referenced data and logistical-multiple regression models allowed to conclude that “explanatory variables influence deforestation in different ways depending on the particular zone, time period, and geographic scale” (Mertens et al. 2004 p.273). On the other hand, due to that local population often have limited spatial reference (while asserting landscape changes and their causal effects) the use of remote sensing techniques could greatly improve and complement ethnographic research on ‘cultural landscapes’ (Jiang 2003).

Yet, it was also evident that multiple scales application permits different types of analysis and assessment, thus allowing the production of complementary information for environmental management based on simulation (scenarios) of land use change at different scales (nation-wide and regional) (Verburg and Veldkamp 2004).

On complementary approaches pivotal to human-environment relations, research on landscape dynamics using paneled-pattern metrics showed how the integration of landscape ecology, remote sensing (temporally discrete data), and geographic information systems complements and enhances the understanding of landscape change more than does LULCC alone (Crews-Meyer 2002). In this same line, probabilistic drivers of landscape change identified with cellular automata (CA) simulation models, household and community-level surveys have helped establishing relationships between cities, road infrastructure, and off-farm employment with agent decision-making (Walsh et al. 2002, Messina and Walsh 2001). Similarly, landscape dynamics (specifically deforestation processes) approached by using spatial analysis and livestock economic studies have explained LULCC as consequence of infrastructure development, ecological conditions, zoning policies, and marketing chains of livestock products (Mertens et al. 2002).

The above examples of LULCC and landscape models illustrate some current trends in LULCC research. Most contributions are case studies in different geographical areas with emphasis on deforestation processes. Only two of the above models are theoretically based (i.e. Anselin 2003). However all models privilege the use of quantitative data, and often are based on the use of GIScience for data extraction and analysis. At the case study level, many scholars acknowledge that findings on the explanatory variables of LULC dynamics may be specific to a particular time, location or scale. Indeed the application of LULCC with landscape models at different scales has proved to enhance understanding for environmental management purposes.

Geographic centers of LULCC research

Interest in land use and land cover change research arose several decades ago primarily linked to its potential impact to global environmental change. Recent research reflects a deeper understanding of the causes of LULCC that "involves situation-specific interactions among a large number of factors at different spatial and temporal scales" (Lambin et al. 2003; p. 207). And this latter recognition is the result of pertinent LULCC research conducted worldwide with diverse thematic interests, including the importance given to tropical deforestation. LULCC research centers comprise China, Vietnam, Philippines, Costa Rica, El Salvador, the Amazon region, Ecuador, Cameroon, Bolivia, Peru, Guatemala, Mexico, and Thailand, among other places. This section encompasses some examples of influential contributions of LULCC research around the globe.

A vast amount of land use and land cover change research in Latin America, has focused on the study of tropical deforestation in the Amazon region as a result of agricultural frontier expansion, logging, mining, distance to markets, oil extraction, transportation infrastructure, or the urban use of space (Walker 2004; Brondizio et al. 2002; Perz 1999; Brown and Sierra 1994; Angelson and Kaimowitz 1999); Nelson and Goeghegan 2002; Nepstad et al. 2001; Shanley et al. 2002, Wunder 2003). Other authors had sought to identify the decision making patterns of traditional Amazonian farmers, indigenous, and colonists' communities (Pichón 1993; Sierra 2001 and 2004; de Jong et al 2001). Brazil (Fearnside 2001, Walker et al. 2002), Ecuador, and Peru have been main centers for research on tropical deforestation processes; and to a lesser extent Colombia (Moran et al. 2002), Venezuela (Wunder 2003), and Bolivia (Mertens et al. 2004). On the other hand, significant empirical LULCC research has also taken place in other Latin

American countries such as El Salvador (Hecht et al. 2005), Mexico, Belize, Guatemala and Costa Rica, among other places.

The scholarly work by Hecht et al. 2005 in El Salvador, explains the dynamics of forest recovery (resurgence) as a consequence of globalization and local processes of civil war. In the authors' words civil war, structural policies, and agrarian reform has constrained the agricultural frontier expansion, suggesting broader environmental shifts. "The war's environmental impact -at least for forests, was quite positive-….. Civil war restrained the expanding agro-industrial, livestock, and peasant agricultural frontiers" (p.312). More importantly, the authors argue that processes of globalization enhanced forest resurgence in El Salvador in contrast to other geographical areas in Latin America. However, the scholars stress that recovery area-processes are occurring in other places of Latin America, which ecological and socio-political dynamics are not well known, thus pointing new research opportunities. This same year, Verburg et al. (2006) publish their analysis on the role of land use modeling approaches for assessing protected areas in the Philippines. The authors concluded that 'each scale of analysis requires a different modeling approach that leads to different insights in the land use change process and addresses different stakeholders" (p. 170).

Another LULCC application is that of Zhao et al. (2004). These authors report an investigation of changes in land use and ecosystem services in Chongming Island, China. They used a method for ecosystem-service value-assessment for a ten-year period, and satellite image processing. Using these methods, the authors determined that the total annual ecosystems service value declined by 62% between 1990 and 2000.

The impact of macroeconomic change on deforestation since 1970 in South Cameroon was studied by Mertens et al. (2000). Causes and processes of LULCC were identified based on 552 household surveys and remote sensing in 33 villages. The authors found that increasing deforestation rates were related to periods of economic crisis (1986-1991) in the study area. In their words, the household surveys enabled the identification of causal relationships and the processes of LULCC.

Fearnside's (2001) case study in Southern Pará, Brazil, in his words provides potentially valuable information for policy-making towards better social and environmental development. In Pará, ranching and land-tenure issues are main causes driving deforestation. "reclaiming of pasture lands for agriculture… is an essential activity if the large farmers are to be redistributed to small farmers without spurring further deforestation" (p.1370). Also in Pará, Walker et al. (2002) research the impact of land tenure security on tropical deforestation, based on data of household surveys with a time series of classified satellite images. The authors conclude that land tenure security is associated with forest and suggest that "resource conservation arises on the basis of long-run attachment to land" (p.149).

Finally, Seto's (2005) work on two similar coastal deltas in China and Vietnam, combine multiple data sources and research perspectives to understand the human causes of land use change associated to urban growth. A narrative perspective is used to inform the processes and causes of land use change.

These few case studies reflect contrasting findings, methods, and theoretical approaches by researchers sometimes working in the same geographic locations. This confirms the fact that in addition to the methods, theories, and geographical places, own beliefs and perhaps strengths are also shaping research initiatives worldwide. However, gender relations as underlying cause or causal relation of LULCC is not acknowledge at any significant extent.

THE REMOTE SENSING PROCESS

We have reviewed some major contributions to the LULCC theoretical and methodological frameworks. These frameworks emphasize quantitative explanations of the causal relations of change, often using models that include a number of explanatory variables at the household to national or global levels. We have seen how LULCC research commonly relies on spatial explanations and multiple-scale applications using geographic information science. On one hand, spatially explicit and quantitative methods often structured as models have increasingly become the focus of LULCC research in the last decade. Consequently, many models have directed efforts towards elucidating the more complex causal relations of LULCC, in response to overcoming simplifications and acknowledging potential particularities of different spatial and temporal scales. On the other hand, scale-related problems within LULCC research are finding solutions through the use of integrative LULCC frameworks, such as those of human-environment relations. Likewise, the combination of various models and methodologies advanced by interdisciplinary research teams are potentially increasing the understanding of LULCC processes, leading to more valid conclusions from local to global levels.

Out of the bulk of pertinent literature, key works help to illustrate recent methodological trends and modeling in LULCC research. While LULCC models foster potential simulations of LULCC processes, a myriad of scholarly research worldwide provide new information for continuously challenging causal relations commonly accepted by LULCC researchers. In this sense, the study of LULCC in different geographic areas with specific environmental, cultural, socio-economic and political settings will continue to contribute for a better understanding of LULCC processes.

Actual trends of LULCC research were shortly described above, but two main research lines could potentially be strengthened. First, pertinent efforts have been less profuse in the analysis of structural positions of men and women in the context of change identification, simulation or prediction, which could contribute to enhance our understanding of the roles of gender relations in LULCC processes. In other words, scholarly works on land use and land cover change reflect a variety of perspectives on the decision-making process, but there are fewer contributions on the theorization of gendered dimensions that potentially effect environmental change. And second, categorizations of LULCC are often identified with the use of GIScience, and field surveys on socio-economic variables at the household or community levels. However, an increasing participatory categorization encompassing local knowledge could potentially improve the scientific interpretations of LULCC processes for pertinent policy-making (Robbins 2001a, Kwan 2002, Viana and Freire 2002, Turner 2003).

This section analyzes the traditional Land Use and Land Cover Change (LULCC) remote sensing process, with the objective of highlighting issues considered important to gendered LULCC analyses built on the basic steps undertaken in this process: 1) definition of the study area; 2) statement of the problem; 3) collection and use of geospatial data; 4) radiometric and geometric correction; 5) classification process; and 6) change detection / modeling. Additional emphasis is given using a practical digital image processing application accompanying these explanations to illustrate opportunities and limitations of this process.

In 1858 near Paris over the Val de Bievre, the French photographer Gaspard Felix Tournachon took the first known aerial photograph from a balloon after applying for a patent on aerial survey (Jensen 2000). Almost 150 years later, in 2005, the world witnessed the conformation of the Global Earth Observation System of Systems, which envisions future decisions and actions affecting humankind informed by comprehensive Earth observation and information (GEOSS 10-year Plan p.1). Within this elapsed period, increasing refinements on suborbital and orbital platforms fostered initially by European countries and the United States, underpinned Earth Observation (EO) systems. Balloons, pigeons, aircrafts, satellites, have helped obtaining imagery on the Earth surface while technology on data collection and interpretation developed. Main motivators for improving this technology have been warfare, and national security. However, non-military applications on climate change, resource management, and disaster alleviation have also been privileged.

Restrictions on Earth observation below the “airspace” claimed as exclusive sovereignty by the states, prompted the proposition of the “Open Sky doctrine” by US representatives during the mid-1950s to establish the principle in international law on “freedom of space” at altitude; yet, this policy was effectively confirmed worldwide with launching of Sputnik I by the Soviet Union, first satellite orbiting the Earth in 1957 (Jensen 2000).

Today, besides aerial photography, other optical, multispectral, active and passive, microwave, thermal infrared, and LIDAR remote sensing systems are concurrently operational. Each of these have distinct capabilities for obtaining information on the Earth surface according to their mission’s objectives, the platform they use, their altitude and position above the ground, the periodicity of data collection over the same site on the Earth surface, and the electromagnetic spectrum used for remotely sensing data. Thorough descriptions of remote sensor systems and technical characteristics are found in Jensen (2000, 2006), and Lillesand et al 2008).

Earth observation programs have dramatically outburst worldwide in the last half century -together with continuously enlarging data repositories-; meanwhile, differential knowledge has been produced based on this information. Some of the main programs include the USA-LANDSAT (1972 to present with Landsat 8 launched on February 2013), the French SPOT, the Chinese-Brazilian CBERS, and myriad others, to mention but a few. Landsat's archive alone comprises more than two million worldwide images.

These massive repositories of analog and digital spatial data and information on Earth Observation (EO) were first assembled, (re)processed, and stored by few countries (and agencies) allowing seamless national topographic mapping, and increasing thematic research in many countries. Planning of development, decision making, and policy drafting, potentially benefited with an increasing availability of geographic data and information. Earth Observation agendas also funded scientific programs worldwide, and fostered technological progresses during all phases of the "observation data life cycle". Agreements and initiatives at selected sites with governmental and non-governmental agencies (GOs and NGOs respectively), academic and private sectors between developed and developing countries took place, thus fostering increasing data and knowledge production.

Notwithstanding the broad objectives and accomplishments of EO programs, unequal data access and use, as well as knowledge production, are still apparent. On one hand, technology, capacity building and budget may explain these differences. Yet on the other, policy on geographic information differs widely in response to cultural and national sceneries (Onsrud 1998). As a consequence, knowledge production is dramatically higher inside countries with open access information policy, which at the same time have more potential to orient geospatial data production. Other countries, both marginal to these advances, or with limited open access information policy, could experience restricted knowledge production in many complex ways, impacting as well scholarly contributions. Copyrights, data acquisitions costs, as well as publication language may also play a limiting role to knowledge construction.

After the "age of space reconnaissance begun" (Jensen 2000 p.74) one could arguably say that remote sensing data and information have been collected and (re)interpreted many times for every single inch on the Earth surface to the date. However, Earth observation programs still claim that integrated and coordinated global efforts need to be undertaken to reduce critical gaps in the observation (both spatial and temporal), to reach an optimal availability, and to act in front of an eroding observational infrastructure (GEOSS 10-year Plan 2005). But who can access these data? How can it be accessed? What purposes or applications are privileged and by whom? These are all questions that have no easy answers. Suffice to say that those countries not engaged in the 'age of space reconnaissance' have been historically disadvantaged with respect to applying these technologies and resources to their own interests, with consequent shortages in their knowledge share.

But relatively recently, novel open-access policies have prompted the release of important amounts of historic and current EO data for the public use. While most imagery repositories and digital processing technology are proprietary in nature, few but/amongst the most important initiatives are now giving free public access to their image archives. In 2008 the US implemented the Free Access Data Policy for Landsat which is amongst the most important and massive repository of images worldwide; The European Space Agency (ESA) released to the public its own Landsat repository covering Europe and Africa in 2011 with more than 450 terabytes; In 2007 the Brazilian

National Institute of Space Research (INPE) put its Spatial Program to the Service of Brazilian Society reaching by 2009 more than one million of images freely distributed. This brings new opportunities/ avenues for remote sensing applications and fields of investigation that traditionally have not used extensively nor intensively EO. This also allows to mainstreaming novel research agendas as it is Gendered Land Use Science (GLUSc). Conversely, as information society is now increasingly digital, the capability to freely use information for personal or economic gain is a form of public good that creates an information commons; still, if each individual continues to maximize their own gain the dynamics leading to a "tragedy of the information commons" could take place, for example by reducing personal information privacy (Onsrud 1998 p.141).

One subfield of inquiry relying widely on remote sensing is Land use and Land Cover Change. Consequently, Gendering Land Use Science is the research agenda that I propose mainstreaming/workstreaming based on the recent availability of EO for all, and the increasing understanding of change processes for bettering policy drafting worldwide.

Basic explanations help to understand the process involved in creating LULCC knowledge out of EO. The remote sensing process is a procedure for extracting information from EO data following few steps: definition of the nature of the problem; data collection and analysis; and information presentation using images, maps or databases (Jensen 2007). LULCC studies based on the remote sensing process are technological approaches that use a combination of remote sensing, GIS and other tools to answer human inquiries (Ji 2002).

More generally, two classes of variables may be remotely sensed: 1) Land Cover (biophysical variables) that can be detected directly by sensors without having to use other ‘surrogate’ or ‘ancillary’ data (e.g. temperature, precise location, vegetation biomass, soil moisture, ocean biochemistry, etc.); and 2) Land Use (hybrid variables) created by systematically analyzing more than one biophysical variable at one time (e.g. land cover and land use mapping derived by evaluating several of the fundamental biophysical variables including object color, location, height or temperature) (Jensen 2007). The latter suggests that ecological assessments are more akin to hybrid variables

EO including aerial photographs and other multiple sources and perspectives may be used together with ethnographic research and qualitative methods in order to understand historical patterns of land use change, and 'the power and representation in landscape and its history'. Notwithstanding, some considered these data (e.g. satellite images) are not 'impartial tools' that have been used for different purposes and interests (Fairhead and Leach 1996, Robbins 2001a, Turner 2003). Indeed interpretation leading to mapping units from experts and locals may vary greatly (Robbins 2001a). This section seeks answering the following research question: Is land use change assessment gendered?

Definition of the study area

After selecting the appropriate logic for a project other steps are often followed. However, there is not an explicit reference to selecting the project's study area. Mainstream LULCC approaches often define the targeted area based on availability of spatial information. Thus, researchers do not necessarily question the underlying reasons for the study area selection. Consequently, the extent of inquiry may have fixed boundaries defined by a particular window of an image, and its spatial size frequently determines the working scale of the project. In this sense, LULCC research is commonly surface-extent and scale dependent.

Assumed fixed / definite boundaries

LULCC research envisions a study area usually bounded, with fixed limits, where surface area could be measured together with the 'features' it comprises (i.e. land use units, land cover types including vegetation, bare soils, or water bodies). Boundaries are expected to exist from the outermost limit of the study area, to the subsequent subdivisions of familiar (household) or individual spaces. This enclosure is convenient for LULCC approaches that are strongly based on defined *a priori* sampling size (random, stratified, or else) and research methods. Alternatively, LULCC assessments are based on formal economic models including variables such as magnitude and location of land use change, agents of land use change decision parameters, and macroeconomic elements (Kaimanovitz and Angelsen 1998).

Fieldwork campaigns are more easily planned for a fixed study area, which allows researchers to control better the expected results. Land use/cover units may be delimited and measured, ordered, categorized, and characterized in the same *a priori* fashion. This approach may privilege one or more of the biophysical variables that are being 'sensed'.

Thus, bounded study areas may also encourage the assumption of a priori fixed causes of land use and cover change that are inferred from "visual/electromagnetic", quantifiable, material elements. Relations to pertinent changes in neighboring areas may or may not be assumed irrelevant, as the study area (or research object) is often analyzed in isolation from regional, national, or global contexts. On the other hand, area circumscription stimulates research approaches that rely more heavily on (material) biophysical features (e.g. temperature, precise location, vegetation biomass, soil moisture, ocean biochemistry, etc.), than those that seek to elucidate (immaterial) geosensor-blind ground features (e.g. human values, beliefs, gendered dimensions of land use, etc.). The same is true for the temporal resolution of spatial data used in many remote sensing processes: time will also be bounded by the age (date) of the spatial data in consideration; and frequently, no past, in between, or future data could be considered in the results as time is implicitly extrapolated. More recent works are seeking to overcome this time bound/restriction by including larger range historical LULCC to broaden the scope of pertinent remote sensing processes, and taking into account what has been defined as 'temporal heterogeneity'(Guyer et al. 2007, Walker and Peters 2007).

The above may be problematic when in the field the geographic contexts or 'study areas' being researched are characterized by having flexible boundaries -both of the outside and inner limits-. These contrasting settings may result from familiar, kin or other social signifiers affecting territoriality, and thus, land use dynamics. In these latter areas borders may also shift in time according to cultural, environmental, socioeconomic or political circumstances. And many types of borders, including political-administrative, consuetudinary, gendered, environmental, and symbolic, may coexist at the same time.

The above is exemplified in the case of my study area: a land area only officially delimited as collective title until 2002 upon an 'official delimitation process' sanctioned by Law 70, which allowed the titling of collective lands to traditional Afro-descendant communities with lengthy established livelihoods in those lands before this law was enforced. During the last decade this collective title has undergone multiple subdivisions established by pertinent Local Community Councils in accordance to their own consuetudinary laws. Indeed, during my fieldwork campaign the "study area" was further subdivided into two sections, one corresponding to the Nimiquia River, and the other to the rest of the original "El Cedro" area. Locals argued that this subdivision was the consequence of differences between family groups with interests on potential funding opportunities provided by an NGO. Moreover, inside the broader collective title, farms have no fences thus their limits are established by natural landmarks such as trees, creeks, and other natural or symbolic features; in turn, land property rights -and further subdivisions- are often established by verbal agreements, and less frequently by way of written accords, nor based on legal property titles. Thus these boundaries are interweaving / intermingling.

More so, boundary questions in terms of extensions and shrinkages of these inner boundaries that are impacted by gender are at least fourfold: 1) land management including property is mainly driven by kin relations; 2) differential use of marginal areas by men and women is evident with respect to the more frequently used spaces; 3) gendered activities especially those that are supplementary to agriculture (the main land use) such as container gardening, collection, hunting, fishing, and logging, may define overlapping / intermingling boundaries that may change during different seasons and throughout time; and 4) the everyday life spatial boundaries of men and women that are always contingent to changes as the consequence of knowledge systems developed over lifetime (young versus old people; relations to family/kinship, socioeconomic or politic opportunities, and empowerment more generally).

The practical exercise

For purposes of testing both the above and following remote sensing process explanations, two areas were selected for the remainder of this exercise: the study area itself that is bounded by limits specified by the Community Council of El Cedro, and a broader rectangular area which encompasses an extension of 862 km^2 (Figure 6). The latter includes Bahia Solano (or Puerto Mutis), which is the largest village (and capital) of the municipality that holds the same name, and the western part of *Serrania del Baudo* (Baudo mountain range) to the right. All of the described above steps of the remote sensing process are conducted to both areas, however, few further procedures were carried only for the study area itself under the change detection section.

Is worth noting that the study area of this dissertation was not selected based on data availability, on the contrary this area due to its high precipitation regime is covered by clouds for most of the year; more so, it was not selected based on a priori selection of certain land cover types or land use types targeted to be studied. Actually, it was selected based on the intention of studying and workstreaming gendered land use and cover changes; more so, from the various preselected areas it was during pre-dissertation fieldwork, that the community Council of El Cedro gave me authorization in opportunity to advance my research. Other Community Councils estimated to use one year in average for granting my research authorization. On the other hand, the only map depicting current boundaries of El Cedro is the one prepared by the Community Council of El Cedro, which approximate boundary, is depicted in Figure 70. Indeed an official map of the study area does not exist.

Statement of the problem

This dissertation's problem is to answer two questions: 1) Is land use and land cover gendered? and 2) If yes, how it is gendered?

The remote sensing process for assessing LULCC is a technological approach suitable for 'applied studies' (Jensen 1996 or 2007).

A central theme of the Land Use and Land Cover Change (LUCC) project is the recognition that land use properties and land cover properties (many times used interchangeably) are closely related but fundamentally different -and that there is a ‘causality’ between these two where land cover is constantly transformed by land use changes: The above gave rise to the introduction of the terms Primary land use and Secondary land use (Bakker and Veldkamp 2008 p.205): While 'primary land use', refers to the traditional concept of land use that directly affects and controls the land cover (e.g. Agriculture and forest as the dominant primary land uses), the “secondary land use does not claim a certain area, nor it has a significant impact on the land cover. (e.g. leisure/tourism, extensive grazing and hunting) and can co-exist with primary land uses and with each other and are not easily expressed in quantitative terms.” (Bakker and Veldkamp 2008 p.208)

In my study area, the gendered land uses of interest (including hunting, logging, gardening, gathering, and animal husbandry) may all be considered as secondary land use functions. However, only logging which is exclusively performed by men, as well as agriculture and cattle raising (both gender-neutral/inclusive land uses in the study area) clearly co-exist or are linked to primary land use which is closely associated with land cover and its change (i.e. Forests, agriculture, and pastures respectively). To be sure, gender-neutral/inclusive land uses more general, and some men-akin land uses (as logging), directly effect and are associated with land cover dynamics. Whereas secondary land use that are women-akin (i.e. container gardening, gathering, and animal husbandry), do not significantly affect or control land cover. In multi-functional land cover such as in the study area, at least one secondary land use is combined with a primary land use; thus, LU/LC ratios of the multi-functional nature of land may help to better understand the gender dimensions in coupled land use and land cover change modeling in future research endeavors.

Multi-functional land cover refers to a situation where the land cover at one location has more than one function. In cases of multi-functional land cover at least one secondary land use is combined with a primary land use. Secondary land uses can co-exist with primary land uses and with each other and are not easily expressed in quantitative terms (Bakker and Veldkamp 2008).

Based on the above, a certain spatial configuration of the land cover may provide insights on the requirements of the secondary land uses of interest based on the land owner decision making as a way to contribute for furthering multi-functional land cover pattern modeling that takes into account (gendered) secondary land uses. The primary land use described below is the result of a classification on satellite images and other secondary data for years 1986, 1999, and 2011.

Data Collection: Obtaining imagery

In order to achieve a better product as part of a remote sensing process, data needs to be collected *in situ* to perform (unbiased) accuracy assessment of the final results (Jensen 1996/2007) [although not everybody does] often using GPS receivers (Pontius 2011). Other 'ancillary' data such as thematic maps, and population statistics, among others, may also be obtained during fieldwork.

The remote sensing process approach uses a combination of remote sensing, GIS and other technologies to answer a human inquiry. Images and aerial photographs are captured by "geosensors" (Caglia et al. 2008).

Images of varied categories and formats have four types of resolutions: radiometric, spatial, spectral, and temporal (see glossary of terms). More detailed resolution allows phenomena to be remotely sensed more accurately (Jensen 1996, Ji

2002). Yet, the research objective also determines what she/he requires to 'see'/assess/capture. It is accepted that an object or feature does not exist if it is not physically sensed by us, the sensor, or both; under this approach the data is also framed within time and space a *priori*.

The above means that representation or under representation of features and 'phenomena' depends on the resolutions of the sensor system and on the researcher decisions on their use. Reality will be mediated by remote sensing technology (namely the sensor system) and the 'interpreter/scientist' knowledge, research interests, and skills. Thus, ground objects/features, as well as people, and other phenomena, will be detected only if: 1) "the spatial resolution of the sensor system (is) less than half the size of the feature measured in its smallest dimension" (Jensen 1996 p. 4, Ji 2002); 2) if a detector / sensor is sensitive enough to differentiate the radiance reflected or emitted from the terrain, target, people, feature of interest (Ji 2002, Jensen 1996); 3) the number and size of the spectral regions (intervals), or bands, of the electromagnetic spectrum a sensor can utilized to 'observe' the Earth's surface are optimum for obtaining information, or may improve the probability that a feature will be detected or identified and biophysical information extracted (Ji 2002, Jensen 1996); and 4) the time interval at which a remote sensor repeats data collection at the same location (i.e. remote sensing systems pass over the same spot on the Earth) provides enough or adequate information on how the 'variables' are changing through time (Ji 2002, Jensen 1996). From the latter, what was hidden by these time intervals? What was blurred or became invisible by the spatial and spectral resolutions? Although remote sensing admit this, 'things' are detected and thus may be represented, according to their size, radiance reflected or emitted, electromagnetic spectral regions a sensor can use, and how often the data was collected at the same location (data on physical featured). All these constrictions are defined and constructed *a priori* in the sensors by pertinent Earth Observation programs. Thus, the information gathered by remote sensors is controlled, and restrained to specific targets or objectives *a priori*, as much as are their uses. This in turn may resolve what, where and how objects or features will be sensed by geosensors.

A LULCC process based on image processing and interpretation obtained from different periods (multi-temporal) uses available imagery to extract information and to produce knowledge. Imagery are not produced but rather used by the researcher. Who produces and for what purposes these images? Who may ask for images on demand? A wide range of image products exists since the mid-19th century, with increasing spatial, temporal, and spectral resolutions. Main Earth Observation (EO) programs have included LANDSAT, SPOT, LIDAR, RADARSAT and GeoEye.

On the part of researchers, image selection and acquisition is often constrained by the specific study area, objectives, budget, and availability. The expected research applicability is related to pertinent cumulative knowledge both on the part of the researcher or drawn from previous scholarly work (Whose knowledge system is supposed to be extracted from images?). Yet, researcher's 'standpoint' (Harding 2006), and 'situated knowledge' (Haraway 1991) arguably is often not necessarily questioned by LULCC scholars. As mentioned above, in addition, it is less common that LULCC researchers / scholars critically question gender aspects of land use and land cover change. The same is true for the inquiry on the mechanisms of image access, use and control -including underlying policies/politics, economic, military/national security concerns, and surveillance. Said other way, the broad socioeconomic and socio-political issues underlying image access, use and control, and the roles these may play on knowledge production upon imagery (including price) is very often not acknowledged (but this is still changing). As such, the image selection process may or may not become 'political unconscious' more generally for many applications (Fredric Jameson 1981 in Harding 2006).

When using remotely sensed images, everything has been pre-established by way of all types of resolutions. These predetermine the types of information that may be identified with the sensors, the size of features/ objects on the ground that will be distinguished, the radiation or reflectance that will be captured by sensors which in turn allows recognizing features/ objects or phenomena, and the geographic distribution of what will be captured or not. Consequently and necessarily, some ground features and geographic areas will be under-remotely sensed. Are gender dimensions on land use and land cover within the geosensors' rulers' interests? While sensor systems are gender-blind, image processing on the part of the researcher do respond to germane objectives.

For this exercise images of the Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM) sensor systems covering the study area were selected, provided these had less that 10 percent of cloud cover. These sensor systems characteristics are depicted in Table 4 and the selected images are described in Table 5 (Figures 9, 10, and 11). Due to that the study area is covered by clouds almost all year long (it has amongst the highest annual rainfall regime in the world), and that Landsat 7 sensor system failed after 2003, it was not possible to obtain appropriate images matching my 2006-2007 field campaign.

It could be further suggested that visualization and the visual are relevant to knowledge claims of LULCC processes based on geospatial data. However, this knowledge is generally achieved once skills for image processing and/or interpretation are acquired, and performed. And these often include mastering specialized software. It is often assumed that images of different periods depict spatial changes on the Earth's surface throughout time following a linear function; thus, appropriate image 'processing' and 'interpretation' may produce neutral/universal/standardized knowledge on land use and land cover change, among other social applications. Notwithstanding the extensive amount of these geographic applications, scholarly interests on the study of gender dimensions of LULCC have been less abundant.

Radiometric and Geometric correction

Digital image processing, on the other hand, relies more on informatics (the use of computers and software), and fewer of the above fundamental elements that are suitable for analog interpretation. Digital image processing is expected to be more value-neutral research and thus of 'weak objectivity' (Harding 2005). Most commonly used fundamental elements include "the tone and color of a pixel in statistical pattern recognition algorithms." (Hardin and Thompson 1992 in Narumalani et al 2002 p.305). Access to information technology and specialized mathematical and statistical skills may be further needed. Digital image processing generally comprise performing of radiometric and geometric correction, image enhancement, information extraction, and change detection. Radiometric and geometric corrections are techniques used to eliminate image errors due to atmospheric and environmental conditions, the sensor system, and the orbital geometry; depending on the applied technique, the appearance of the image may slightly change, or the 'spatial integrity' of the data may be compromised (relative vs. absolute). However, depending on the project objectives, these two image processing activities may be left unperformed. "In general, most remote sensing practitioners prefer to use the original, unaltered data for thematic information extraction and for other useful analyses." (Narumalani et al 2002 p.308)

Assigning coordinates to an image is known as georeferencing. In this exercise, georeferencing of satellite images was accomplished using ERDAS Imagine 10.1. Once images were imported including all their spectral bands, these were orthorectified (orthorectification is a three-dimensional geometric transformation of an image thereby adjusting it to the actual characteristics of the land surface); ground control points GCP were established and calibrated to half quadratic error (RMS). In terms of precision this enables us to obtain a valid criterion of location measurements and of the quality with which one can identify a picture element. Finally, reference models resulting from each of the selected images are obtained. Figure 7 shows the assignment of reference control points. Georeferencing of all selected satellite images allowed eliminating inconsistency in geometric accuracy. The resulting corrected images may now be overlapped with comparable accuracy.

Classification Scheme: Standards and Knowledge Systems

Subsequently, 'Information extraction' of land use and land cover classes may be accomplished using 'pattern recognition algorithms' (i.e. supervised, unsupervised, or hybrid classification techniques; fuzzy logic; expert systems; neural networks). However, before conducting any of these algorithms, a classification system (categories of LULC) needs to be adopted. In the process of classification both crisp (based on strict binary rules) and fuzzy rules (use membership and confidence values) may be used to assign affiliation of objects to feature types (Hu and Weng 2011).

Visual interpretation of imagery in general requires knowledge on, and systematic use of visible features' characteristics named 'fundamental elements'. These elements include shape, size, pattern, height or elevation, shadows, tone or color, texture, site, and association (see glossary of terms in Appendixes). This approach requires the researcher to perform 'information extraction' based on association and generalization of previously acquired knowledge. She/he will 'see' what he/she is interested on learning or knowing based on acquired expertise. Consequently, 'information extraction' is strongly based on the researcher or analyst's standpoint. Persons with differential background, knowledge, experience, culture, gender, race, class, or age will have dissimilar interpretations on the 'visualized' features and objects. Albeit the results of image processing will have the 'imprint' of the researcher(s) and a 'weak objectivity' of supposed value-neutral research (Harding 1991).

Many commonly used classification schemes seek *a priori* standardization of land use and land cover types at the national, regional, or global levels. These are categorical classifications of spatial units of land use and/or land cover (nominal and ordinal). Many classification systems are hierarchical and *a priori* systems. Yet, there are two extremes in classification systems that are mutually exclusive: the global and the local classification systems.

The former may be defined in general as hierarchical systems, with crisp boundaries, and exhaustive in nature. Worldwide best known and widely adopted classification systems include the USA Land Use and Land Cover Classification System for Use with Remote Sensor Data (Anderson et al 1976); the UN Land Cover Classification (LCCS); the IGBP and the CORINE classification schemes, among others.

All these *a priori* classification systems may be or not edited with *a posteriori* information gathered on the field.

The UN LCCS claims to be the only land cover classification that can universally accommodate any additional category at the regional or national level. According to the UN LCCS Classification Concepts and user Manual (2000), Classification is an 'abstract representation' of the situation in the field using well-defined diagnostic criteria thus necessarily involving the definition of class boundaries that should be clear, precise, possible quantitative, and based upon objective criteria. It further states that a classification should be scale and source independent (of the means used to collect information). Who does construct this representation and for what purposes? Who know about the existence of these representations and their applicability to our particular interests? Who rules the mainstream classification systems? Are there counter hegemonic abstract representations? If all data collected is physical and measurable Why this representation is allowed to be abstract? LCCS Manual further affirms that it is in the legend where the classification system is applied to specific areas; and that in this sense, the legend is dependent on scale, data, the cartographic representation and mapping methodology used. What knowledge systems are favored by representation? This Manual acknowledges that many problems have been faced in reaching standardization of classification systems at a universal level considering that standardization can only be achieved by means of imposing rigidity, a characteristic of *a priori* classification systems. Hence, new approaches to classification seek "increasing flexibility while maintaining mapability" (UN LCCS 2000 p.5). Is it about including enough classes to represent the real world, while maintaining 'strict class boundary definitions' with classes being as 'neutral as possible'? Is flexibility and standardization reached by including larger amounts of classes to accommodate variability? While crisp boundaries are mainly geographic, classes are thematic in nature, and fuzzy boundaries can be both.

The USA Land Cover and Land Use Classification System for Use With remote Sensor Data (Anderson et al 1976) was developed for federal and State needs to overview the LULC at national scale, assuming a 'uniform categorization' at the first and second levels. First level includes nine classes, namely: Urban and Built-up Land, Agricultural Land, Rangeland, Forest land, Water, Wetland, Barren Land, Tundra, and Perennial Snow or Ice. First level classes give rise to 92 second level classes. Yet, more detailed classifications at higher levels of this scheme are left opened for local classification purposes, for example. Objectives for developing this system arose from the Nation's interest on knowing the allocation of land use patterns and changes through time related to development (i.e. urbanization, transportation, recreational areas, etc.) and environmental problems (i.e. agricultural lands, wetlands, wildlife habitat). An inventory on the national use of land resource was available before 1976, thus, supporting Land use policy and planning formulation more generally. But more importantly, this classification system allows its tailoring as to grant governmental levels the means to fostering 'coordination' and avoid or reduce 'duplication of effort'. In turn, classification levels are partially dependent on sensor types (data source) in order to obtain land use categories with at least 85% accuracy. Levels I and II are directed to national or state levels; whereas the more detailed levels III and IV are intended for local information at the regional county, and municipal levels that should be generated by user groups.

In the USA, remote sensing data and technology triggered possibilities for standardization on land use and land cover classification since mid-1940s. By 1971 a Steering Committee on Land Use Information and Classification was established to develop a national classification system that could ‘form a framework’ into which more detailed categories of land use could be aggregated (Anderson et al 1976).

Anderson’s Classification System considers the potential problem of classifying areas with multiple uses (e.g. recreational, commercial, hunting, etc.). This is especially important for traditional communities, where land uses are very diverse and dynamic throughout the year. And the same could be said for gendered uses of land that also may be differential. As it is acknowledged by the authors, some multiple land use activities may or may not be ‘detectable’ using remote sensing and thus ‘collateral data’ could aid understanding specific situations. The system also considers interpretation of problems arising due to ‘vertical arrangement of many uses’ (e.g. garage buildings, subways, electrical transmission lines, etc.). In addition, land use feature types depend partially on the sensor system resolution, and the scales of data compilation and representation (Anderson et al 1976).

Multilevel Land Use and Land Cover Classification System

Remote sensor data used in the Anderson et al. (1976) classification system Levels III and IV are intended for “those who need to generate local information” as is the case for El Cedro. Rural to urban land use trajectories may be identified using Level III typical data. However, detailed levels of land uses such as in *Monte*, *Respaldo*, *Rastrojo* (particularly the *Azoteas*) (see descriptions of these in Chapters 3 and 6), and in the Village, may require using the classification Level IV typical data described below.

Considering that according to Anderson et al. (1976) “the kind and amount of land use and land cover information that may be obtained from different sensors depend on the altitude and the resolution of each sensor" the following relations are acknowledged:

Classification Level	Typical Data Characteristics
I	LANDSAT 5 TM data
II	Less than 1: 80,000 scale
III	1:20,000 to 1:80,000 scale
IV	More than 1:20,000 scale

An exercise using three different resolution remote sensor data for purposes of concept illustration is presented in Figure 8. Images from different sensors used are 1) Classification Level I - Landsat 5 TM image (Thematic Mapper downloaded from USGS December 2010), 30 meter resolution; and 2) Classification Level IV - Mosaic of Digital Orthophoto Quarter Quadrangles (DOQQ) of the Travis county (Texas), 1 meter resolution, year 2010, from the NAIP (National Agriculture Imagery Program) downloaded from TNRIS (Texas Natural Resources Information System).

Top left image depicts lands uses in the Travis county area where water bodies, agricultural lands, and urban and built-up areas may be identified fairly well. We may note that only the largest water bodies could be identified accurately in the LANDSAT 5 TM image and the boundaries and shapes of agricultural areas are blurred. In contrast, in the DOQQ both the small water bodies and agricultural areas are still distinct. Top right image shows that with increasing zooming, the Built-up areas that could be visually interpreted in the DOQQ are not distinguished in the LANDSAT image anymore.

On the exercise with Landsat images of the research area, the chosen images were radiometrically/geometrically corrected and further classified at the first level (and few at secondary level) of the Anderson et al. (1976) classification scheme following the remote sensing process described above (Table 6). First level of the classification scheme was considered appropriate for this exercise as to identifying primary land uses (i.e. forest, agriculture, and built-up areas) that relate to the secondary (gendered) land uses found in the study area which does not claim a certain area at the resolution of Landsat images (namely, logging, hunting, gardening, gathering, fishing, cattle raising, and animal husbandry).

Classifications were undertaken both over a larger squared area of 862 km^2 covering and beyond the El Cedro study area for a sub-regional understanding of primary land use change, and a region comprising / adjusted to the study area properly (Figure 6). Unsupervised and supervised classifications were done using the software ERDAS Imagine 10.1. The software Idrisi Selva 17.0 was used for identifying primary land use change between three periods of the Landsat images whereas the software ArcGIS 10.1 was used for producing graphic outputs of images.

Supervised – unsupervised classification

Supervised classifications were accomplished by using reference secondary information including the El Cedro map drawn by the Community Council, aerial photographs, and secondary cartography (relief, geology, soils) Unsupervised classifications for each image were accomplished by using classification algorithms of ERDAS Imagine software.

Images were classified into nine classes based on the Anderson et al. (1976) scheme (Table 6). Regarding the category of Intervened/ Secondary Forest Land the related spectral signatures of these land cover does not have the same intensity of Evergreen (natural) forest, its structure and leaf texture is different and shows lower coverage; these primary land use is commonly located next to croplands, pastures and roads more general.

This land cover/use classification required the following steps: (i) Analysis of digital image distribution histograms or reluctance values; separability index comparison of each image spectral bands, and selection of the best band combination. For identifying land cover units to be sampled; (ii) Reading of spectral curves of each land cover/primary-use unit defined under the Anderson et al. (1976) classification scheme for each satellite images; (iii) Supervised method definition: sample selection (parallelepiped delimitation) of the units defined by the image classification system. Corroboration of units was accomplished using primary and secondary information, in this case aerial photographs, and Google Earth and radar images; (iv) Random Analysis and nuances of confusion between selected land cover units. Adjusting land cover units for each of the images; (v) Defining unsupervised method adopting the algorithm ISODATA (Iterative Self-Organizing Data Analysis Technique) and adjust the number of units selected (ISODATA is a method which combines satellite image reflectance using the minimum spectral distance cluster formula. This is an iterative process where each reflectance value is assigned to a specific cluster); and (vi) Comparison and integration of land cover units obtained with both supervised and unsupervised classification methods, and final definition of land cover maps.

Figures 12 to 17 show the resulting classified images for 1986, 1999 and 2011 of both the broader area and the El Cedro, which is this dissertation's study area.

The selected land cover units of the classification scheme were not further validated in the field. Thus, these may be considered preliminary. Validation on the field was not possible due to that previous to fieldwork I could not find a recent image to make it approximately coincide with the period of my field campaign that took place in 2006-2007; thus, these classifications were done a posteriori to fieldwork.

LAND CHANGE MODELING

Land Use and Land Cover Change detection is a nominal measurement scale (change is assessed using slices of time / categories). In real life time is a seamless feature. Nowadays representation of LULC into 'maps' is commonly accomplished by using pixel by pixel representations thus avoiding extreme generalization of mapping units (in contrast, older LULC mapping uses a more generalized choropleth representations). Change Detection is a four dimensional assessment (where time is pivotal) that includes both space and time. However, it is more common to find scholarly works where spatial data is thoroughly assessed/analyzed, with the time sliced and categorized into shorter or longer periods depending on both data quality and availability, and the project's objective. It may be inferred from the above that constant trajectories of change are assumed/implicit. On the other hand if seasonality is very important for both data selection and the project's objective, everyday life could or not be less an important consequence of change than abrupt type of changes (as a result of a natural hazard or road construction for example). "Remotely sensed data must be spectrally separable and spatially discernible among important ground features, frequent enough in their collection for change detection over a required time period, and of sufficiently large range of magnitude for numerical and statistical processing." (Ji 2002 p.270).

Trajectories of primary land uses of the above image classifications were identified using the IDRISI module "Ecological Land Change Modeler for Sustainability". The same two mentioned above areas were selected for this exercise: the study area itself that is bounded by limits specified by the Community Council of El Cedro, and a broader rectangular area which encompasses an extension of 862 km^2 (herein the Broad Area) (Figure 6).

For each of the classified images described above, are needed areas with exactly the same number of rows, columns and pixel size (in this case 30m). Classification legends must also be the same and sequential. Any pixel in the image with no data or data with no interest should have a zero value. Thus, areal dimension, spatial resolution, and the coordinate system must be the same for all images considered in these models. Within the IDRISI software, raster format (.rst) needs to be set for all images. Finally, the land cover/primary-use aerial extensions are analyzed by pairs, that is, 1986 to 1999, and 1999 to 2011.

Land Change Modeler allows assessing trajectories and trends of change between the established land cover/primary-use categories and the dates in which selected images were collected. It also permits identifying gains and losses of a given spatial unit and the contributor land cover to the gains of another cover. For example, the gain in Agricultural Land in crops between two periods, results from the contribution of land cover loss of both Forest Land (primary) and secondary Forest Land. Likewise, the expansion of urban areas may be possible at the expense of Agriculture or Pasture Lands, for example. Results of these models are described below.

Gains and losses of Land Cover/Primary Land-use

The model allows measuring spatially explicit gains and losses of each of the primary land uses between the considered periods (e.g. in square kilometers, hectares, meters, foot). Gains and losses of all the considered land cover units (km^2) inside the "Broad Area" (left) and the El Cedro (right) are depicted in Figure 18. To the left of each graph is shown the loss extension in km^2 per each of the considered land units. To the right of each graph are illustrated the respective gains.

In Figure 18, in the case of Forest Land, for example, the data are not easily comparable since the existence of clouds and shadows may be hedging its extension gains. Since the 1986 image has a larger percentage of clouds over Forest than that of 1999, when compared with 1999 this class shows added extension of Forest Land as if it was recovered. The same occurs when comparing the net change by category (i.e. subtraction of gains and losses) as shown in the Figures 18 and 19 (in km^2 and percentage respectively), which illustrates areas without information (clouds) with loss due to that in the 1999 image there is much less cloud cover. Net gains in km^2 are depicted in Table 7 for both the Broad Area and the El Cedro.

Therefore, another IDRISI tool named "Contributors to net change experienced by" allow a more reliable comparison of land cover/primary-use change between two dates (e.g. 1986 to 1999) as the tool calculates the contribution of each class in relation to the remainder classes. Extensions in km^2 that contributed to Net Change of Forests for both the Broad Area and the El Cedro are depicted in Table 7 and Figures 20 and 21 (in km^2 and percentage respectively).

Likewise, contributions (in km^2) to loss of Forests in the Broad Area include land covers such as Pastures, Cropland, and Secondary Forest in both areas (Figure 22).

Percentages of these same contributions show the same covers plus the Urban, this last being at least equally important than the contribution of Secondary Forest in the Broad Area (Figure 23); however, this percentages in the El Cedro show an extreme figure for the contribution of the Urban land cover (that could be a computing error). Data on the left with a negative sign indicate land cover classes that diminished (took area from) Forest Land between 1986 and 1999. To the right are depicted with a positive sign the classes that contributed area (km^2) to the expansion of Forest Land between the considered periods. As shown in Table 7 a transition occurred from Forest Land to Intervened/Secondary Forest Land of -35.42 km^2 in the Broad Area and of 9.48 km^2 in El Cedro. It is also evidenced that agricultural frontier expansion (both crops and pastures) as well as Urban/ Built-up areas reduced the extension of Forest Land between 1986-1999 by -5.27, -4.99, and -0.22 in the Broad Area respectively, and -2.05, -2.35, and -.17 in the El Cedro respectively.

For each of the considered Land cover / Primary-use classes the same procedure was developed. The analysis of Secondary Forests shows that these advanced over Forest Land (35.42 km^2), but in contrast retreated over Cropland (5.56 km^2), Pastures (3.23 km^2), and Urban/Built-up areas (0.03 km^2) (Figure 24 and Table 8). The percentages of contributions to this land cover change (Figure 25) show that in the Broad Area agricultural frontier expansion contributed the most to losses in Secondary Forest, whereas in El Cedro the Urban or Built-up Area had its highest percentage of growth (of its total growth) above the Secondary Forest land cover. However the extension of Urban growth under secondary forests is only 0.2 km^2. This means that percentages depicted in the graphs are the percentage of the land cover that add or subtract to the land cover under analysis. That is, 0.2 km^2 of Urban or Built-up area is an increase of almost 100%

of the total expansion of this land cover that is doing so above Secondary Forest. While 3.45 km^2 of Cropland, is about 80 percent of the total expansion of Croplands that expanded above Secondary Forests. And 2.1 km^2 of Pastures is less that 20% of the total expansion of pastures that is subtracting the Secondary Forest land.

Regarding net changes in Agricultural Lands / Croplands, it is evidenced that crops have significantly expanded their frontier over pastures (11.11 and 7.64 km^2 in the Broad Area and the El Cedro respectively) which was the greatest contributor to this expansion, and over areas and secondary forest throughout 13 years (Table 9 and Figures 26 and 27). It is possible that what are classified as Pastures in 1986 were lands left to fallow. Croplands slightly retreated over built-up areas and beaches in this period. Based on the above, more than 20% of the total expansion of Built-up areas took place over cropland in the Broad Area; however percentage Contribution to Net Change in Croplands in the El Cedro could not be calculated by the software appropriately.

Analysis of Agricultural Lands / Pastures shows that the extension of Pastures retreated mainly above croplands in the considered period (Table 10 and Figures 28 and 29). However, main contributors to expanding the pastures' frontier were forests both natural and secondary/intervened. This suggests a general expansion of agriculture and pastures over forests more general.

Finally, Urban or Built-Up Land between years 1986 to 1999 expanded mainly over beaches, croplands, and forests. Expansion over beaches may be explained by the construction of ecotourism facilities at the northern beach ridges of the study area (Table 11 and Figures 30 and 31). Expansion of these cover class over forests is not as intuitive. Looking at the percentages, positive expansion of Urban and Built-up areas is similar in both the Broad Area and the El Cedro, expansion

Change model for 1999 and 2011 evidence the decrease in cultivated areas and the continued growth of productive activities in natural areas; in this case as cloud cover and shadow is smaller than the previous period (1986 -2011) it is possible to compare the gains and losses of each cover as shown in Table 12. Figures 32, 33, 34, and 35 demonstrate a reduction in Forest cover and an increase of pastures and secondary forests in both the Broad area and the El Cedro. However in the El Cedro, croplands show more expansion. Notwithstanding the percentage of contributions in the Broad Area continues showing a major increase in pastures with respect to the other land covers. Net change (being the result between land cover gains and losses) evidence a decreasing agricultural and forest area. Despite the cloud cover hampered the calculation of net growth, the percentage of these calculations depict in the Broad Area an outstanding increase of pastures and decrease in croplands, whereas in the El Cedro is worth noting the highest net change in urban expansion, followed by pastures and croplands.

To better analyze the changing trend of each of the land covers under study, same as for the period of 1986-1999, the IDRISI tool "Contributors to net change experienced by" allowed change calculations for the period 1999-2011. Starting with Forest Land, Figures 36 and 37 show that pasture, croplands and secondary forest expanded their frontiers above Forest Land. When considering the percentages of these net changes, in El Cedro the percentage of the total expansion of urban area above forest land is notorious.

Regarding Secondary forest (Table 13 and Figure 38 and 39) Pastures and Croplands subtracted areas from this land cover, whilst it grew over primary forest. Around 60% of the pastures expansion was at expenses of secondary forests.

The dynamics of cropland 1999-2011 is marked by its transition to pastures and for its net gains over forests (both primary and secondary). This land cover shows a particularly differential performance between the Broad Area and the El Cedro: whereas in the former there is a mark change from agriculture to pastures and a smaller extension of agriculture above forests, in the latter agriculture markedly advanced above these same land covers. Looking at the percentages, while in the Broad Area pastures are extending its frontier over agriculture, in the El Cedro, croplands advanced over forests (Table 14 and Figures 40 y 41).

The dynamics of change of pasture (Table 15 and Figures 42 and 43) in the Broad area advanced above croplands and primary and secondary forests, and in the El Cedro, retreated with respect to croplands and advanced over forests.

Finally, urban or built-up areas (Table 16 and Figures 44 and 45) advanced during the analyzed period above all the considered land covers. However, is worth noting the important growth of built-up area on beaches. With respect to other land covers, built-up areas grew at the expense of pastures and cropland in the Broad Area and in the El Cedro was the same but also affecting Forest lands.

Tables 17 and 18, and Figures 46 and 47, summarize/depict changes of all the considered land covers in both the Broad Area and El Cedro, as of 1985, 1999, and 2011.

Gain, Persistence and Loss of Land Cover/Primary-use

The general data of each of the land cover / primary-use classifications show the decline of farming activities, decreasing Forest Land extension, and increasing pasture and urban expansion in El Cedro only. These analyses are not made for the broad Area.

Between 1986-1999 Forest lands in El Cedro show greater losses in comparison with the period 1999-2011, and these are larger in Management Zones (MZ) of Tundo, and Pozamansa. Gains are not as easily established due to differential cloud cover in the considered periods. Persistence is clearly depicted in the MZ of Tundo, Nimiquia and Southern areas of El Cedro amid 1986-1999; however, these same areas between 1999-2011 depict more forest losses particularly in Nimiquia (Figure 48).

In contrast, secondary forests appear to show generalized persistence between 1985-1999, but generalized losses in most of the MZ between 1999-2011 (Figure 49). Whereas Cropland in the El Cedro show gains between 1986-1999 particularly in Pozamansa, between 1999-2011 more generalized gains are evident for the whole area, with relatively small patchy loses everywhere (Figure 50). Pastures show loss between 1986-1999 particularly in Pozamansa and Boroboro, but between 1999-2011 gains are evident in most MZ (Figure 51). Is worth noting again, that land cover classes did not have fieldwork assessment as to prove their extension or location, thus these are considered preliminary.

Trends between Land Cover/Primary-use

The purpose of a Changing Trend Model is to provide an approach for generalizing about the pattern of change between two hedges in this case secondary forest (1999) into pasture (2011) (Figure 52). The blue color highlights areas with greatest change of forest to pasture. The surface is created by coding areas (areas with spatial clustering trends) where the value close to 1 indicates greater change and no-change areas are close to 0. This map seeks to highlight that the activity has grown on pasture over forest areas being the most important change for the period 1999-2011, particularly close to River Valle.

Likewise, the trend between Forest to Secondary Forest (Figure 53) depicts higher values (in blue) to the southern part of the study area, and to a lesser extent in the MZ of Nimiquia, and Tundo.

FINAL REMARKS

The Land Use and Land Cover Change LULCC literature is fundamentally a spatial examination that seeks to identify the aerial extent of lands (cover) that may or may not change; and it uses spatially explicit models to either statistically explain or predict such spatial outcomes (Walker, 2004).

This chapter included the critique and practice of the traditional Land Use and Land Cover Change (LULCC) remote sensing process, with the purpose of highlighting issues considered important to gendered LULCC analyses built on the basic steps undertaken in this process: 1) definition of the study area; 2) statement of the problem; 3) collection and use of geospatial data; 4) radiometric and geometric correction; 5) classification process; and 6) change detection / modeling.

We have reviewed some major contributions to the LULCC theoretical and methodological frameworks. We have also discussed how LULCC research commonly relies on spatial explanations and multiple-scale applications using geographic information science. And have included a practical exercise using Landsat images of 1986, 1999, and 2011 following the remote sensing process for assessing LULCC.

Actual trends of LULCC research were shortly described above, but pertinent efforts have been less profuse in the analysis of structural positions of men and women in the context of change identification, simulation or prediction. Due to that Land use and Land Cover Change assessment relies commonly on remote sensing, Gendering Land Use Science is the research agenda that I propose mainstreaming/workstreaming based on the recent availability of Earth Observation data for all, and the increasing understanding of change processes for bettering policy drafting worldwide.

However, a central problem of the Land Use and Land Cover Change (LULCC) project is the recognition that land use properties and land cover properties are closely related but fundamentally different -and that there is a 'causality' between these two where land cover is constantly transformed by land use changes: While 'primary land use', refers to the traditional concept of land use that directly affects and controls the land cover (e.g. Agriculture and forest as the dominant primary land uses), the secondary land-use does not claim a certain area, nor it has a significant impact on the land cover (e.g. leisure/tourism, extensive grazing and hunting) and can co-exist with primary land uses and with each other and are not easily expressed in quantitative terms." (Bakker and Veldkamp 2008 p.208)

After the "age of space reconnaissance begun" (Jensen 2000 p.74) one could arguably say that remote sensing data and information have been collected and (re)interpreted many times for every single inch on the Earth surface to the date. But who can access these data? How can it be accessed? What purposes or applications are privileged and by whom? These are all questions that have no easy answers. Suffice to say that those countries not engaged in the 'age of space reconnaissance' have been historically disadvantaged with respect to applying these technologies and resources to their own interests, with consequent shortages in their knowledge share. But relatively recently, novel open-access policies have prompted the release of important amounts of historic and current EO data for the public use. This brings new opportunities/ avenues for remote sensing applications and fields of investigation that traditionally have not used extensively nor intensively EO. And also allows to mainstreaming novel research agendas as it is Gendered Land Use Science (GLUSc).

The remote sensing process is a procedure for extracting information from EO data. More generally, two classes of variables may be remotely sensed: 1) Land Cover (biophysical variables) that can be detected directly by sensors without having to use other 'surrogate' or 'ancillary' data (e.g. temperature, precise location, vegetation biomass, soil moisture, ocean biochemistry, etc.); and 2) Land Use (hybrid variables) created by systematically analyzing more than one biophysical variable at one time (e.g. land cover and land use mapping derived by evaluating several of the fundamental biophysical variables including object color, location, height or temperature) (Jensen 2007).

LULCC research envisions a study area usually bounded, with fixed limits, where surface area could be measured together with the 'features' it comprises, which stimulates research approaches that rely more heavily on (material) biophysical features than on those that seek to elucidate (immaterial) geosensor-blind ground features (e.g. human values, gendered dimensions of land use, etc.). The same could be true for the temporal resolution of spatial data used if no past, in between, or future data could be considered in the results as time is implicitly extrapolated. More recent works are seeking to overcome this time bound/restriction by including larger range historical LULCC to broaden the scope of pertinent remote sensing processes, and taking into account what has been defined as 'temporal heterogeneity'(Guyer et al. 2007, Walker and Peters 2007).

The above may be problematic when in the field the geographic contexts or ‘study areas’ being researched are characterized by having flexible boundaries -both of the outside and inner limits-. These settings may result from familiar, kin or other social signifiers affecting territoriality, and thus, land use dynamics. The latter is exemplified in my study area where these boundaries are interweaving / intermingling.

On the other hand, representation or under representation of features and ‘phenomena’ depends on the resolutions of the sensor system and on the researcher decisions on their use. Reality will be mediated by remote sensing technology (namely the sensor system) and the ‘interpreter/scientist’ knowledge, research interests, and skills.

What was hidden by these time intervals? What was blurred or became invisible by the spatial and spectral resolutions of sensors? remote sensing admit that, ‘things’ are detected and thus may be represented, according to their size, radiance reflected or emitted, electromagnetic spectral regions a sensor can use, and how often the data was collected at the same location (data on physical featured). This in turn may resolve what, where and how objects or features will be sensed by geosensors.

Who produces and for what purposes these images? Who may ask for images on demand? A wide range of image products exist since the mid-19th century, with increasing spatial, temporal, and spectral resolutions (e.g. LANDSAT, SPOT, LIDAR, RADARSAT, GeoEye). Whose knowledge system is supposed to be extracted from these images? It is less common that LULCC researchers / scholars critically question gender aspects of land use and land cover change. As such, the image selection process may or may not become ‘political unconscious’ more generally for many applications (Fredric Jameson 1981 in Harding 2006).

Are gender dimensions on land use and land cover within the geosensors' rulers' interests? While sensor systems are gender-blind, image processing on the part of the researcher do respond to germane objectives.

Subsequently, 'Information extraction' of land use and land cover classes may be accomplished using 'pattern recognition algorithms' (i.e. supervised, unsupervised, or hybrid classification techniques; fuzzy logic; expert systems; neural networks). However, before conducting any of these algorithms, a classification system (categories of LULC) needs to be adopted. These are categorical classifications of spatial units of land use and/or land cover (nominal and ordinal). Many classification systems are hierarchical and *a priori* systems. Worldwide best known and widely adopted classification systems include the USA Land Use and Land Cover Classification System for Use with Remote Sensor Data (Anderson et al 1976).

Who does construct this representation and for what purposes? Who know about the existence of these representations and their applicability to our particular interests? Who rules the mainstream classification systems? Are there counter hegemonic abstract representations? If all data collected is physical and measurable, Why this representation is allowed to be abstract? What knowledge systems are favored by representation? New approaches to classification seek "increasing flexibility while maintaining mapability" (UN LCCS 2000 p.5).

Land Use and Land Cover Change Detection is a four dimensional assessment (where time is pivotal) that includes both space and time. However, it is more common to find scholarly works where spatial data is thoroughly assessed/analyzed, with the time sliced and categorized into shorter or longer periods depending on both data quality and availability, and the project's objective. It may be inferred from the above that constant/linear trajectories of change may be assumed/implicit.

Trajectories of primary land uses of the above image classifications were identified using the IDRISI module "Ecological Land Change Modeler for Sustainability". The provided exercise in this chapter focused both on the study area itself that is bounded by limits specified by the Community Council of El Cedro, and a broader rectangular area which encompasses an extension of 862 km^2 .The model allowed measuring spatially explicit gains and losses of each of the primary land uses between the considered periods (1896, 1999 and 2011). Another IDRISI tool named "Contributors to net change experienced by" allowed a more reliable comparison of land cover/primary-use change between two dates (e.g. 1986 to 1999) as the tool calculates the contribution of each class in relation to the remainder classes. For each of the considered Land cover / Primary-use classes the same procedure was developed.

It was evident that between 1986 and 1999 a transition occurred from Forest Land to Intervened/Secondary Forest Land and agricultural frontier expansion (both crops and pastures); Agricultural Lands / Croplands significantly expanded their frontier over pastures, and over areas of secondary forest. More than 20% of the total expansion of Built-up areas took place over cropland in the Broad Area; however percentage Contribution to Net Change in Croplands in the El Cedro could not be calculated by the software appropriately. Pastures retreated mainly with respect to croplands in the considered period. However, main contributors to expanding the pastures' frontier were forests both natural and secondary/intervened. This suggests an expansion of agriculture and pastures over forests more general. Also, Urban or Built-Up Land between years 1986 to 1999 extended mainly over beaches, croplands, and forests.

Change model for 1999 and 2011 evidenced a reduction in Forest cover and an increase of pastures and secondary forests in both the Broad area and the El Cedro. Net change (being the result between land cover gains and losses) evidenced a decreasing agricultural and forest area, and an increasing urban expansion. The dynamics of cropland 1999-2011 is marked by its transition into pastures and for its net gains over forests (both primary and secondary).

The general data of each of the land cover / primary-use classifications show the decline of farming activities, decreasing Forest Land extension, and increasing pasture and urban expansion in the El Cedro. Between 1986-1999 Forest lands in El Cedro show greater losses in comparison with the period 1999-2011, and these were larger in Management Zones (MZ) of Tundo, and Pozamansa. Gains were not as easily established due to differential cloud cover in the considered periods. Persistence was clearly depicted in the MZs of Tundo, Nimiquia and Southern areas of the El Cedro amid 1986-1999; however, these same areas between 1999-2011 showed more forest losses in Nimiquia.

In contrast, secondary forests appear to show generalized persistence between 1986-1999, but generalized losses in most of the MZs between 1999-2011. Whereas Cropland in the El Cedro show gains between 1986-1999 particularly in Pozamansa, between 1999-2011 more generalized gains are evident for the whole area, with relatively small patchy loses everywhere. Pastures show loss between 1986-1999 particularly in Pozamansa and Boroboro, but between 1999-2011 gains are evident in most MZs. Is worth noting again, that land cover classes did not have fieldwork assessment as to prove their class, extension or location, thus these are considered preliminary.

Subsequently, the purpose of a Changing Trend Model was to provide an approach for generalizing about the pattern of change between two hedges in this case secondary forest (1999) into pasture (2011). Trends of pasture over forest areas were the most important change for the period 1999-2011, particularly close to River Valle. Likewise, the trend between Forest to Secondary Forest depicted higher values to the southern part of the study area, followed by the MZ of Nimiquia, and Tundo.

On one hand, based on empirical evidence during my fieldwork campaign the gendered land uses of interest in the study area (including hunting, logging, gardening, gathering, and animal husbandry) may all be considered as secondary land use functions. In contrast, only logging which is exclusively performed by men, as well as agriculture and cattle raising (both gender-neutral/inclusive land uses) clearly co-exist or are linked to primary land use which is closely associated with land cover and its change (i.e. Forest, agriculture, and pastures respectively). On the other hand, empirical evidence also suggested the need of taking into account both 'temporal heterogeneity' and deeper history approaches to better understand land use and land cover change trajectories on one part, and to raise the necessity of translating and accounting (when possible) both primary and secondary land uses into land cover.

It was evident that based on practicing the remote sensing process for assessing GLULCC, the treating and classification of the chosen Landsat images were hiding the gendered land uses that were evident in the study area during my fieldwork campaign (at least at the spatial resolution of these images). Whilst, primary land uses (e.g. agriculture, forest, pastures) that are considered gender neutral/inclusive in the study area, were the ones that were openly revealed in the Landsat images. But at the same time, this method provided the spatial explicit configuration (patterns) of gendered uses and spaces locally. In multi-functional land cover such as in the research area, at least one secondary land use is combined with a primary land use; therefore, LU/LC ratios of the multi-functional nature of land may help to better understand the gender dimensions in coupled land use and land cover change modeling in future research endeavors.

Likewise, temporal heterogeneity of land use and land cover change was also found to be hidden by the above referred remote sensing practice due to that selected Landsat images tackle only the years 1986, 1999, and 2011. Therefore, land use and land cover trajectories both happening before, later on in between these years may not be evident (are hidden) by the practiced digital image processing.

Cutting across the above is the potential use of these results, together with quantitative (Chapter 5) and qualitative (Chapter 6) approaches, on the assessment of (gendered) land use and cover change to decision and policy making.

Chapter 5: Quantitative Gendered Land and Water Use

This section shows results on gendered land use drivers based on both primary and raw secondary datasets on socioeconomic, cadastral, and land use questions at the local study area. Primary 'data' were gathered by conducting structured interviews during my dissertation fieldwork campaign that took place in the second semester of 2006 and first semester of 2007, and is the focus of the second part of this chapter. Data models based on this primary data are also described. Gendered land tenure and land use questions are chosen as dependent variables, whilst some biophysical, cultural, and socio-economic questions are used as explanatory variables in these models.

The raw secondary data presented below is a twofold census survey (it targeted 100% of known inhabitants and farms at the research area) piloted in the study area by the NGO *Natura* in 2004: one dataset on the education attainment of locals, and one dataset on the relative location of *fincas* (farms), its land use and tenure types. This census was obtained with help of local research assistants that collected the data based on their best knowledge of people inhabiting their land during this survey (Cesar Monje, personal communication). People living both at the El Valle village (inside the El Cedro) and its rural area were surveyed. Local census comprises one dataset on the relative location of *fincas* (farms) including their land use and tenure types, and one dataset on demographic information with emphasis on the education attainment of local inhabitants. Neither of these latter datasets include location coordinates of land plots (farms) nor of the El Cedro village (*El Valle*) neighborhoods. Unfortunately these raw datasets were only available to me after my fieldwork campaign of 2006-2007.

The *Natura* datasets were further cleaned, reorganized and analyzed by me to improve reliability and potential use in relation with my own primary data. Exploratory statistics and cross-tab and pairwise correlations of the above secondary datasets are presented below in the first part of this chapter.

The resulting figures, together with findings discussed in Chapter 6 seek answering the research questions: Are LULCC drivers gendered? And if yes, how are these gendered? Do statistic models help also explain or reinforce evidence on gendered land use obtained by qualitative research methods?

EXPLORATORY STATISTICS ON GENDERED LAND TENURE (SECONDARY DATA)

Six Management Areas or Zones in the study area have been defined by the Local Community Council of El Cedro; in addition, the “El Valle” village is described herein as zone #7 although it is not a Management Zone itself (Figure 4 and Table 19). Management Zones comprised in the El Cedro are: zone #1: Nimiquia; zone #2: Pozamansa; zone #3: Boroboro; zone #4: low and mid parts of the Angia and Caimanera rivers; zone #5: Tundo and Chado; and zone #6: The Beach and *Sendero Utria* (dirt path connecting the *El Valle* village to the *Utria* National Natural Park).

According to the first *Natura* survey on land tenure and use, a total of 431 *fincas* (farms) were owned by people living in the study area in 2004. From these, 31 records were excluded of the analysis because: (1) they lack a specific geographic reference that prevents relating them to the other 400 records, and (2) some of these records are also incomplete.

Although local, more detailed, place names of farms (*fincas*) are provided in the *Natura* 2004 census, the bulk of them are not found in the available cartography. Thus, Management Zones are used here to organize the farm related data. 431 *fincas* (records) and 27 attributes (variables) are included in the first *Natura* dataset. Information on the land manager (or land tenant), main current land use types, number of years under production of *fincas*, and ownership/land tenure types are provided. Land managers are authoritative persons within an extended family whose responsibilities include distributing land among its family members (a more detailed explanation on this is found in Chapter 6).

The El Cedro has an approximate extension of 14,602 Hectares (or 146 km^2). Nimiquia, and Tundo and Chado have both the largest total surface extensions (including the *Respaldo*) and the largest average size of lots (135 and 66 hectares respectively); whilst the zone of Beach and Sendero Utria has the smallest total area and the second smallest average size of lots (14 hectares) after Boroboro (11 hectares) (Table 19).

On the other hand, considering a mean family size of five persons in El Cedro (based on the education attainment census described below), the estimated average number of persons potentially using these 400 farms (land lots) per km^2 is 14 (the number of persons per hectare is zero) for the whole study area (excluding the village area). The Beach and Sendero Utria as well as Boroboro have the highest estimated number of persons potentially using the land per km^2 (44 and 34 persons per km^2 respectively), whilst Nimiquia and Pozamansa have the lowest estimated average numbers of land users (4 and 8 persons per km^2 respectively). Angia and Caimanera with 17 persons per km^2 and Tundo and Chado with 13 persons per km^2 potentially using the land, are both closer to the referred estimated potential land users average for the whole study area. Mean number of land lots per km^2 including the Respaldo (land lot density) is 3 farms (lots) per km^2. Thus, highest lot density is approximately 9 lots per km^2 in the Beach and Sendero Utria, followed by 7 lots per km^2 in Boroboro, and by equal or less than 3 lots per km^2 in the remainder zones. A general description of each zone is provided in Table 20.

Management zones with less number of farms or parcels are Nimiquia (#1) and Pozamansa (#2), whereas zone #5 (Tundo and Chado) has the highest number of individual plots, followed by zones #6 (the Beach and Sendero Utria)*, and #3* (Boroboro) with 23%, 21% and 20% of the total farms respectively. Land tenants of the zones with highest number of individual parcels (22%, 23% and 18% respectively) show slightly similar proportions than their total number of farms (Table 21 and Figure 4).

Is worth noting, that although the *Tundo and Chado* zone (#5) has the highest total number of farms, land managers are relatively fewer than in the other two zones considered above. The highest percentage of women land managers is found in the Beach and *Sendero Utria* zone (27% of this area's land managers).

In contrast, the highest proportion of men land managers in a given area is found both in the Boroboro and Pozamansa zones (85% and 83% of these areas' land managers respectively). Zones #3 (*Boroboro*), #4 (*Angia and Caimanera* lower and mid areas) and #5 (*Tundo and Chado*) depict a higher number of persons who manage more than one land plot, whilst zone #1 (*Nimiquia*) has the fewer authoritative land managers with more than one lot and all of them are men. Currently, the largest proportion of land managers is male. However, the oldest areas under production in El Cedro (zones #4, #5 and #6 respectively) display a larger proportion of women land managers in comparison to the rest of the considered zones). A higher share of men than women land managers is evident in areas with lands of relatively fewer years under-production.

Land use, resources, livelihoods (productive activities)

The *Natura* 2004 data set has mixed classes of land use, resources, and productive activities properly. The considered variables are agriculture, cattle breeding, fishing, hunting, timber, handcrafts, logging for boat construction, and other (the latter is not specified clearly but seems to include gathering, and the built-up-area land-use category). The percentage of parcels on the previous categories is depicted in Figures 56 and 57. Evidently, this data set is using neither a land use hierarchical classification system nor any mainstream or local land use classification scheme. It includes a listing of main activities or resources that may be currently or potentially (as in the case of timber) in place in a given land plot. Yet, it is possible to identify some trends from these figures.

The highest percentage of usage is agriculture in all zones (82% to 95% of the total plots in each zone) with the zones of *Angia and Caimanera* (#4), followed by *Boroboro* (#3), ranking first and second highest in percentage (96% and 95% respectively). Lower reliefs in alluvial floodplains found in these two zones most probably have led to relatively better soils, which are best suited for agricultural purposes than in the other considered zones. However, more research (including soil sampling) is needed to support the above proposition.

In contrast, cattle raising is present in 42% of the total land plots in *Nimiquia* (highest rank), with *Pozamanza* having the second highest percentage of this usage (28% of the total plots in this zone). Considering that the *Nimiquia* and *Pozamansa* zones are relatively farther than the other zones from the El Valle village, distance between these two areas may be playing a significant role to these usage types. Although this activity seems to be increasing, it is still not as widely extent in the El Cedro. With respect to fishing, the ranking is just the opposite. The *Nimiquia* and *Pozamansa* zones have the lowest percentage of this use, as does the area of *Tundo and Chado* (with only 0%, 6% and 2% of the total land plots under this use in each area respectively). In contrast, the

Boroboro and *Beach/Sendero Utria* zones are ranking first in the fishing activities (16% and 12% of each zone's plots respectively).

Hunting, timber, and the construction of boats have all high percentages, ranking first in *Boroboro* and second in *Pozamansa*, with respect to the remainder zones. *Boroboro* holds the first position (with 27%, 20% and 23% of the total land plots in each land use respectively) and Pozamansa ranks second (with 16%, 28% and 13% of the total land plots respectively in the timber, hunting and boat construction categories). The above suggests that timber and animals to hunt are more abundant resources in these two zones. More so, timber in *Pozamansa*, and hunting in *Boroboro*, may be the most valued and salient usages or available resources to their land plots. Fishing is important in *Boroboro* as well.

It is assumed that the years under usage of the total (or active) land plots in the original raw data set are defined by the particular number of years in production or use per plot. However, for purposes of identifying trends, and of relating these to the data of structured interviews conducted in the field, I further aggregated those values into ranges, namely, less than 30 years; between 30 and 49 years; and more or equal to 50 years. Based on information gathered with unstructured interviews and participatory observation during my fieldwork campaign (described in Chapter 6) I chose intuitively these classes: I was informed that women left the rural areas to cluster inside the *El Valle* village around 30 years ago, thus, it seemed interesting to identify statistics of a 20 year period between 30 and 50 years before my fieldwork campaign. Considering these classes are only intuitive, using GIS software I also calculated natural breaks of 3, 4, and 5 classes for this variable (Table 22 and Figure 58).

Information on the total land plots' age is more difficult to interpret by itself. On one hand, all zones have land plots in almost all age ranges. And on the other, there are higher proportions of land plots in use/production under 30 years old in fairly all zones (particularly in the Playa/Sendero and Tundo-Chado zones, and with the exception of the Nimiquia). These highest rankings may be explained by redistribution processes of land property taking place during the last 30 years. If this is true, who took over and for what purposes those land plots in the last few decades? Results on pairwise correlation run between this and other variables of this dataset (described below) provide insights for a feasible answer. While the *Pozamansa* and *Tundo-Chado* areas have the relative highest proportion of plots with ages of more than 50 years; *Nimiquia* has its higher rankings of plots in the 30-49 years range; and both the *Boroboro and Angia-Caimanera* zone have significant percentages of land plots under this age range too (31% and 29% of the total lots per zone respectively).

Customary tenure-type variables in the *Natura* datasets included what locals may describe as mechanisms of access to land property. The following classes are considered: (1) purchased/bought; (2) inherited; (3) possession; (4) work or labor; and (5) donation. Limitations to the analysis of these variables are that the meaning of those categories may be understood in different ways by locals than by outsiders. Notwithstanding perhaps controversial semantics, most properties in the six considered zones were inherited or bought. While land inheritance may be explained by kinship relations that are pivotal to the afro-Colombian's cultural identity described earlier, access to land by possession, own work, and donation is much less common in the El Cedro (Figure 59).

Finally, a map showing the location of the *Respaldo* (an ownership category of land) is included (Figure 60). Three variables describe who uses the *Respaldo*: 1) the family, 2) neighbors, and 3) nobody. Three additional classes define the land use of *Respaldo*: 1) hunting, 2) logging, and 3) Gathering materials for handcrafts. All zones with exception of Pozamansa have nearly from 40 to 50% of the *fincas*' *Respaldo* used by family members.

Percentages of *Respaldo* used by nobody oscillate between 20 to 38% of the total plots in most management zones, with the exception of *Pozamansa* where 56% of its total farms' *Respaldo* is used by no one. The highest figures of *Respaldo* used by the categories 'family' and 'nobody', allow asserting that the *Respaldo* is primarily a marginal family land, which use is reserved for future/incidental purposes or by family members. With respect to the *Respaldo*'s land use, only hunting depicts relatively higher percentages in comparison to logging or handcrafts that are almost zero in all zones. Hunting's highest percentage of usage in *Respaldo* is in the *Tundo/Chado* and *Nimiquia* zones (18% and 12% respectively).

Is worth noting now that Management Zones with highest percentages of men land managers such as Nimiquia, Pozamansa and Boroboro, show also amongst the highest percentages of plots used for hunting, timber, and the construction of boats, whereas in those with relative higher proportions of women land managers such as the Beach and Sendero Utria, and Tundo and Chado, land usage in agriculture and fishing is outstanding; but also these areas show the highest proportions of land plots in use/production under 30 years old probably due to redistribution processes of land property.

Education Attainment and Age Classes

The second *Natura* dataset considers the educational attainment of local population. Data are organized by the names of different neighborhoods inside the *El Valle* village, plus the category "Rural" corresponding to persons living in rural areas. Most people in 2004 and in 2006-2007 were currently living in the village. Sixteen neighborhoods in total are encompassed inside *El Valle* village. These data include 2,308 records and 18 questions.

Population in the El Cedro is young to a greater extent. Around 75% of both men and women in year 2004 were younger than 34 years, and 91% were younger than 55 (see table 23). According to the *Natura* survey, however, only nine persons were reported older than 85. In this respect, is worth noting that during this dissertation's fieldwork the age of research subjects was routinely inquired; many subjects (at least most of the aged people) did not know precisely the year on which they were born and thus reported an approximate age. Notwithstanding this potential data inconsistency, to the best of my knowledge the *Natura* population and education attainment census is the most complete and detailed (not alone the only) available for the El Cedro. Women are less than men in most age classes with the exception of the 30 to 34, 50 to 59, 70 to 74 and more than 85 years old categories in which women outnumbers men (Figures 61, 62 and 63). Nuances of this population distribution may be the topic of future research.

According to this dataset on Education Attainment by gender and age, there were 2,308 persons (1,088 women and 1,220 men) in 460 families in 2004, which gives an average of five persons per family. Of this total population, 100 women and 372 men were household heads respectively. Note that the number of *fincas* and families do not match by 60 (single persons are also included as families). Thus, it is possible that these

60 families or persons did not own *fincas*, in other words, they were landless in year 2004 (their livelihoods might have included other activities such as commerce, tourism, and handcrafts that do not rely heavily on land ownership/tenure). Aside, it may be possible that these two separate surveys have omitted counting persons and/or farms inside the study area.

Although in the *Natura* survey the total number of men to women is not critically dissimilar in El Valle/El Cedro (1088 to 1220), there are a much higher proportion of men than of women household-heads. Indeed, from a total of 472 households only 21% women claimed to be household heads, while the remaining 79% heads were claimed by men (remarkably, the analysis of the *Natura* land use and tenure survey described above reported equal figures of 21% and 79% of land tenant women and men respectively).

The *Natura* education attainment survey was conducted in the El Valle village. Considering that the El Cedro population is now primarily settled in the village itself with few inhabitants permanently living in the rural areas, their *fincas* (land lots) are visited/maintained/cropped/used regularly (but differentially) by their owners.

The population in each of the El Valle village neighborhoods ranges from a minimum of 13 to a maximum of 847 persons. From these, the neighborhoods of Miraflores, Maria Auxiliadora, and Buenos Aires hold the higher numbers of persons (847 or 37%, 235 or 10%, and 216 or 9% of the total population respectively).

With respect to education attainment properly, for statistical purposes in Colombia an illiterate is a person older than 15 years who does not read or write. Still, in the El Cedro when considering all age classes, a higher proportion of men than women do not read and write (300 or 28% illiterate of total women in comparison to 386 or 32% illiterate of total men). However, the percentage of illiterate women and men over the total population per gender is slightly the opposite (19% and 18% respectively). Yet, if compared all the illiterates with the total population per gender, illiteracy of women cohorts is relatively lower than of men (114/1088=0.105 women; 117/1220=0.316 men). (Table 24 and Figure 64)

Likewise, in Colombia mainstream statistics often use five age classes corresponding to the educational levels considered relevant to this dissertation, namely, Kindergarten (KG: from 3 to 5 years old); Primary School (PS: from 6 to 11); Secondary School or High school (SS: from 12 to 15); Vocational Education (MV: from 16 to 17); and Higher Education (HE: from 18 years and above). Raw data was reclassified by me into these categories. Outstandingly, the only age class in which the proportion of education attainment of men exceeds that of women (in year 2004) is between 6 to 11 years old corresponding to Primary School (see Table 25). In all the remainder age classes women attainment percentage is higher than that of men. In the El Cedro, one of two existing schools offers vocational education with credit hours that may count towards pursuing a Bachelor's degree under an agreement with the *Universidad Tecnologica del Choco* (Technological University of Choco, in Quibdo). Therefore, based on this *Natura* survey, a higher percentage of women in comparison to men, pursue educational attainment at all levels including the Vocational and Higher Education levels, (with the exception of primary school which percentage is lower than that of men). Note that Vocational Education and the further advancement into Higher Education should be commonly pursued after 16 years of age. Education attainment per gender and age range is depicted in Figure 64.

CORRELATIONS ON LAND USE AND TENURE QUESTIONS (SECONDARY DATA)

Pairwise correlations on land use and tenure were conducted both to aggregate (into six Management Zones) and individual observations of the *Natura* data set on Land Use and Tenure (2004 secondary data). No further analyses were made to the respective Education Attainment data because it doesn't allow further integration with the respective dataset on land tenure (management) and land use.

Results of pairwise correlations of both aggregate and individual records are described below. Detail on the codes used for each variable is provided in the respective segment.

The Number of Land lots (aggregate records)

Description and codes of variables used in this section are found in Table 26. Terms used for describing farms include: fincas, land parcels, land plots and land lots.

Nearly perfect direct correlations are found between the total number of land plots (N_PLOTS) per Management Zone (MZ) and the number of men land tenants, both owning one and more than one land lot (Table 26). Likewise, meaningful correlations exist between the total number of lots and different land uses (in 2004) per MZ for the whole *El Cedro* area: a nearly perfect and direct correlation with agriculture; an inverse strong correlation with livestock breeding; and an inverse and nearly perfect correlation with hog breeding. Due to the very few land lots devoted to hog breeding, correlations between this and other variables are considered preliminary. Other land uses have from moderate to slight relationships with the total number of land plots. This may be explained by the fact that most plots in the El Cedro are devoted to multiple uses at the same time.

Some figures of the correlation between the total number of land plots, and land plots' age (under production), seem relevant. A nearly perfect direct correlation between these two variables is found for the range of land lots of less than 30 years (98%) and for 39 to 90 years (98%) as depicted in Table 26. In contrast, the weakest (although still strong) correlation between these two questions is found for the plots' age classes of more than 50 years and of 46 to 90 years. Is also worth noting, an inverse and strong relationship found for the percentage of the age class of 23 to 35 years and the total number of plots.

These results are suggesting a distribution of land parcels throughout time with two positive spikes (land lots' ages of <30 and 39-90 years) and an inverse/negative spike for lots under production inside the period of 23 to 35 years, when the percentage of total lots decreases per Management Zone. This distribution may be giving statistical evidence on the resettlement of women from the fields (rural areas) to the village some thirty years ago. A probable consequence of this resettlement is the reduction on the percentage of farms under production during the period of 23 to 35 years back (as of 2004).

In addition, relationships between the total number of farms per Management Zone and the land tenure-type variables show strong direct correlations with land farms bought/purchased, and acquired by work or labor. Moderate to weak relationships are found between other land tenure types and the total number of plots. Besides, the variable '*Respaldo* used by family' have a direct and nearly perfect relationship with the number of plots, while '*Respaldo* that is not being used' has only a moderate direct relationship. Other classes of the variable *Respaldo* show weak correlations with this question.

The above relationships indicate that a higher proportion of land lots are owned/managed by men in comparison to women, and that the most common land use is agriculture, particularly at zones with higher number of land plots (e.g. zones #5, #6 and #3). Considering that these data are aggregated into six Management Zones (MZ), cattle raising is more common in zones with fewer land lots (e.g. zone #1 and #2); as is hog breeding. Other land uses do not depict strong relationships with the total number of land lots. Similarly, it seems that an important proportion of land lots have been acquired by purchases and labor, perhaps more so than by inheritance at zones with higher number of land plots. As the referred land tenure types challenges what the literature suggests on traditional Afro-descendant communities' kinship relations to land -which is mainly accessed by inheritance-, intuitively we may infer changes on customary laws throughout certain periods and in particular Management Zones in *El Cedro*. Specific correlations between land tenure, lot's age, and Management Zones are further described below.

Land Uses

The considered land use variables include agriculture (AGR), cattle breeding (CATTLE), fishing (FISH), hunting (HUNT), timber (WOOD), handcrafts (CRAFTS), logging for boat construction (BOAT), and other (the latter is not specified clearly but seems to include gathering, and the built-up-area land-use category). As mentioned above, most common land use in *El Cedro* is agriculture although land lots commonly have simultaneous land uses making it difficult to characterize them by a predominant use. Still, correlation numbers give some indications on the relationships between agriculture and other land use variables (Table 27).

Therefore, using the raw secondary data set every land use of a given land plot was reclassified as an independent variable. Correlation figures between aggregate records of land use and other associated variables are shown in Table 27. Aggregate observation on the "Agriculture" land use has an inverse and very strong relationship with the percentage of livestock breeding and with hog husbandry. In contrast, direct correlations are found with all the considered remainder land uses but these relationships are only slight to moderate in all cases, with the exception of the direct correlation with handcrafts which is very strong. Farms of all ages are from strongly to nearly perfectly correlated with agricultural land use.

However, best correlations are found for the age classes of less than 30 years and of 39 to 90 years of use. In general, is worth noting the slight to moderate inverse interrelation between agriculture and the percentage of land lots of 23 to 35 years of use (even though its statistical significance is low). Conversely, direct, strong to nearly perfect relationships are found between agriculture and both farms that were obtained by working them, and farms which *Respaldo* is used by family members. All other mechanisms of access to land property (such as bought, inheritance, possession and donation) have direct and slight to moderate relationships with agriculture. Correlations of the percentages of those mechanisms in the case of bough and donation, however, show a slight to moderate inverse relationship with agriculture.

Besides the above relationships, the percentage of livestock breeding has an inverse, nearly perfect relationship with lots that are from 14 to 28 years of use (and of less than 30 years of use more general), and a direct strong relationship with the percentage of lots of 23 to 35 years of use. Moreover, the percentage of farms with Livestock breeding has an inverse moderate correlation with farms that have been inherited or which *respaldo* is used by family members or by nobody; while conversely, it has a very strong direct relationship with parcels which *respaldo* is used for gathering handcraft materials. These relationships with Cattle Breeding may suggest an increased percentage of land lots devoted to cattle breeding coinciding with the reference period of 30 years ago in which women -followed later by men- abandoned the fields to resettle in the village. Likewise, there is also an indication on that these *respaldos* are more often used for gathering handcrafts' plant provisions, suggesting they are not well suited for other uses.

The activity of fishing as a land/water use is nearly perfectly correlated with land lots which *respaldo* is used by neighbors. All other correlations with land uses, land ages, and mechanisms of access to land property are slight to moderate.

Hunting is very strongly interrelated with land lots of 11 years or less, and nearly-strongly correlated with land lots that are acquired by possession. All other considered variables have slight to moderate correlations with hunting.

On the other hand, correlations using aggregate records indicate that the variable defined as "Timber" (potentially logging) is from moderately to strongly correlated with land lots acquired by possession or donation. Strong to very strong direct correlations are found between the percentages of farms of less than 13 years and "timber" (particularly less than 11 years), with a moderate correlation with percentages of land parcels less than 17 years. All other considered variables, including the uses of *respaldo* have slight to moderate correlations with logging.

"Timber" is moderately correlated with logging for boat construction, from moderately to strongly correlate with lots less than 17 years of use, and from moderately to strongly correlated with land parcels acquired by possession or donation. Weak inverse correlations are found between "Timber" and the percentages of lots of 18 to 38 years, 30 to 50 years and more than 50 years of use. Indeed, strong to very strong direct correlations are found between the percentages of lots of less than 13 years of use and

“Timber” (particularly less than 11 years), with a moderate correlation with percentages of lots less than 17 years. All other considered variables, including the uses of *respaldo* have slight to moderate relationships with “Timber”. It calls the attention that inverse moderate correlations are found between “Timber” and the percentage of land lots bought or inherited.

The above relationships with “Timber” lead us to conjecturing that the awareness of Timber (and perhaps of logging) in the study area has been considerably increased during the last 17 years (as of 2004). Notwithstanding that timber is almost depleted in older land lots under use. For instance the two main sawmills were established inside or near the study area in the 1960s (Leal and Restrepo 2003). Yet, these resources are still abundant in places labeled by locals as “collective lands”, at land lots with longer fallow periods, or at lands inside, or closer to, marginal lands. Consequently, common mechanisms of access to timber lands (possibly logging) are possession and work. On the other hand, the strong direct relationship between timber and the percentage of lots of 11 years or less could be related to the establishment of the collective title in 2001, an assertion that needs further insight.

Finally, using aggregate records there are other two variables considered under this title: Gathering of plant products for handcrafts (Handcraft), and timber for boat construction (Boats) (Table 27). Gathering of plant products for handcrafts is a land use type that is strongly to perfectly correlated with farms of less than 30 years in use with the best correlation found with those less than 11 years old. All other classes of “years under use” show moderate to slight correlations with “handcrafts”. A moderate correlation is found between gathering for handcrafts and “timber for boat construction”, but slight correlations are found with other land uses. It is odd the inverse almost strong correlation between “Handcrafts” and land parcels which *respaldo* is used for handcrafts. Boat construction is a particular kind of handcraft. Pairwise correlations on aggregate records depict that “Boats” is strongly correlated with farms acquired by possession, but slightly to moderately correlated to all other considered variables.

Unfortunately Pigs do not have enough number of observations for valid results.

The above findings indicate that the agricultural use in farms, which is the most common, has direct relationships with land lots that *Respaldo* is used by family members. This is also the case with the rest of the considered uses with exception of livestock breeding that depicts an inverse relationship, suggesting these are incompatible land uses. Farms of age classes of less than 30 years and of 39 to 90 years old both have direct and very strong correlations with agricultural land use. But it is meaningful to note the inverse correlation between agriculture and the percentage of farms of 23 to 35 years old, while the percentage of land lots for livestock breeding show a direct strong relationship with the percentage of lots of 23 to 35 years old. The latter may be marking a land use change during this period, and on the other hand may support evidence for the reference date on which women claimed to have abandoned the rural areas to settle in the *El Valle* village. In any case the preferred mechanism of access of agricultural farms seems to be by working them (partly the same as farms used for logging), yet, the percentage of farms that were purchased depicts an inverse relationship with this use (similar to the case of logging). The stronger direct correlations of logging, hunting and handcrafts with farms of 11 or fewer years under use, and of the first two with land lots acquired by possession may be evidencing land use change, land tenure change, or new lands accessed for these uses since the previous one to two decades of the *Natura* survey.

Gendered Land Tenure (Aggregated records)

The relationships between the gender of land tenants/managers and the remainder considered questions are of particular relevance to this dissertation. Variables that are considered relevant in this segment are: Land tenants/managers of all genders (LTENANT), Women Land Tenants/Managers (LTWOM), Men Land Tenants/Managers (LTMEN), Women owning/managing more than one farm (W>1FARM), and Men owning/managing more than one farm (M>1FARM). Correlations may lead us to infer both network and empowerment relations per gender (Table 28 and 29).

Land tenants/managers (LTENANT) of all genders is a variable that shows a direct, nearly perfect, correlation with land tenants that are men. It is noteworthy that between land tenants/managers and farms that have been inherited it exists a direct and strong relationship. Inheritance is more relevant to land tenure than to the number of plots per se. In contrast, land obtained by way of working it, is very weakly correlated to land tenure. Tenure of more than one plot/farm (LTENANT>1) is from strongly to nearly perfectly correlated with plots that have 11 years or less, and the percentage of those being obtained by possession or by working the land. Thus, these two latter mechanisms of access to land property (possession and working the land) seem to be more significant particularly during the last decade.

By further isolating the farms owned by women (LTWOM) from those owned by men (LTMEN), is feasible to identify which relationships are more relevant between these two and the other questions (Table 29). I further separated the farms owned/managed by women (LTWOM) from those owned/managed by men (LTMEN), as to identify which relationships were similar or not between these two variables (Table 29). Only the farms owned/managed by men (LTMEN) depict a direct nearly perfect correlation with farms used in agriculture, yet these figures could result from the fact that there are much more men land tenants than women, and that most of the total farms are used in agriculture (notwithstanding the percentage of farms in agriculture in relation to LTMEN and LTWOM resulted in very weak relationships).

Individually LTWOM and LTMEN have inverse relationships with the percentage of farms used for cattle breeding, however this correlation is weaker (and does not have an appropriate significance level) for LTWOM than for LTMEN (this relation may be explained by the fact that there are relatively few farms used for livestock breeding). Instead, both the percentages of farms used for hunting (%HUNT) and for logging (%WOOD) have nearly perfect but inverse correlations with the percentage of farms managed by women (%LTWOM); while in contrast, the correlation between %HUNT and the percentage of farms managed by men (%LTMEN) is direct and very strong, and the applicable relation with the percentage of farms used for logging (%WOOD) is also direct but weaker. In these latter cases, correlations using percentages seem to be more meaningful. More so, farms used for handcraft materials (CRAFTS) depict a strong direct relationship with LTMEN and an irrelevant correlation with LTWOM, however, same as with the relations with agricultural use, the figure may be talking about a tenure relationship rather than of a gendered use considering the higher proportion of land parcels owned by men (figures between same variables with percentages show very weak correlations).

The percentage of farms used for logging for boat construction (%BOATS) have a very strong correlation with both the percentage of farms managed by women (LTWOM) and by men (LTMEN), however this relation is inverse with respect to LTWOM whilst it is direct concerning LTMEN. Finally, the correlations between farms used in hog breeding (PIGS and %PIGS) depict negative relations with both of the gendered land tenure variables considered, yet, as stated above, due to the very few farms under this usage these figures may not be reliable.

With respect to the variables on the oldness of farms under usage (Table 30), it is remarkable that farms of more than 46/50 years of use have a direct and very strong correlation with women who manage more than one farm, whereas the farms of less than 30 years in usage have a direct and nearly perfect correlation with the farms that are owned/managed by men. More so, farms of 11 or less years under usage has also a direct and nearly perfect relation with those of men who own/manage more than one (LTMEN>1), and this correlation is fairly similar when the former variable is depicted as a percentage.

Other relations that deserve attention are those on the farms that are from 23 to 35 years under usage: the percentage of these farms has a negative although weak relation with women who have more than one farm (LTWOM>1), whilst it has also an inverse but very strong relation with men who own/manage at least one farm (LTMEN). It seems that the period of farm-usage from 23 to 35 years back has a stronger correlation with farms owned/managed by men than by women, and may be evidencing a period of change in gendered land tenure from a larger proportion of farms owned/managed by women (before that period) to a smaller proportion of farms owned/managed by women after that period, an assertion that may be reinforced by the direct and very strong correlation between farms older than 46/50 years and women managers of more than one farm.

But what mechanisms of access to land property may be inferred from correlations between LTWOM (farms owned/managed by women) and LTMEN (farms owned/managed by men) with other variables? Farms that were purchased (BOUGHT) are directly and from strongly to nearly perfectly correlated to (LTMEN) and (LTWOM) respectively. However, land buying is particularly relevant during the last one to two decades as described above. In contrast, land inherited (INHERIT) is strongly and directly correlated only to LTWOM.

Whereas farms obtained by means of possession (POSSES) is directly and very strongly correlated with men that own/manage more than one farm (LOTMEN>1) (the percentage of farms acquired by possession has an inverse and moderate to weak correlation with the percentage of farms managed by women). The same is shown for farms owned by way of working them (WORK), which relation is only significant and direct with respect to LTMEN and particularly so in relation to men who manage more than one farm. The above is showing that favored mechanisms of access to land by women are traditionally inheritance and more recently by way of purchases. Although for men, these mechanisms are more varied favoring purchasing of land, and could include accessing farms by way of working their land or by means of possessions.

On the other hand, "Women with more than one land lot" (LTWOM>1) has direct and very strong relationships with farms older than 46 years, and direct to moderate relationships with lots of 12 to 22 years old (Table 29 and 30).

The variable "men with more than one land lot" (More_PLM) have more relationships with different questions than More_PLW does. Perhaps due to that there are much more land lots owned by men than by women statistical relationships are easier to establish between the considered questions.

The use of *Respaldo* on the part of family members is nearly perfectly correlated both to LTMEN and to LTMEN>1. The use of Respaldo on hunting and logging is only directly related with LTWOM>1, from weak-to-moderately to nearly-perfectly respectively. Other uses of *Respaldo* with exception of RNONE (which is very strongly correlated to LTWOM and moderately to strongly correlated to LTMEN) are not so meaningful. Based on the above it seems that *Respaldo* has a gendered-differential use: women land-managers apparently prefer to save *Respaldo* without use -and when they manage more than one farm they allow its use for logging and/or hunting-, while men managers more commonly consent their use by family members.

The above results suggest that women access to land is mainly by inheritance, and less commonly by purchasing or working (the latter particularly relevant during the last one to two decades). In contrast, men may practice other mechanisms of access to land property including purchases, working the land, possession or custody of land. This suggest a much more restricted mechanisms of access to land by women than by men, where traditional customary laws of land inheritance may benefit women access to land more general.

With respect to land uses and considering that agriculture is the predominant use of the total number of farms, the direct and nearly perfect correlation between farms used in agriculture (AGR) and the farms owned by men is certainly resulting from the fact that this cohort currently owns the majority of properties. Likewise, and considering the relative few farms used for cattle raising (CATTLE), the inverse correlations between gendered land tenure/management (both LTWOM and LTMEN) and the farms under this usage may be displaying not gender but land property relationships. On the other hand, there are nearly perfect but inverse correlations with the percentage of farms managed by women (%LTWOM) and the percentages of farms used for hunting (%HUNT) and for logging (%WOOD); whilst there are contrasting direct correlations between these same variables and the percentage of farms managed by men (%LTMEN). Similar relations are depicted between the variable on the farms used for logging for boat construction (%BOATS) and both LTWOM and LTMEN. The above resulting figures are at this moment showing that these three land uses (hunting, logging and boat construction) are particularly preferred by men than by women. The correlations between farms used in hog breeding (PIGS and %PIGS) with both of the gendered land tenure variables considered may not be reliable due to the very few records on this land use. Other correlation figures such as the resulting between gendered land tenure/management and the farms used for handcraft materials (CRAFTS) may also be showing not a gender but a land property proportion-relationship as these are resulting from accounting the number (not percentage) of farms under this usage.

About correlations between the oldness of farms under usage and other variables, it is noteworthy that farms of more than 46/50 years of use have a direct and very strong correlation with women who manage more than one farm (LTWOM>1) whereas those farms of 11 or less years under use are also directly and very strongly correlated to men that own/manage more than one farm (LTMEN>1). This is suggesting a change on land management throughout time: saliently with more women land managers in older periods and much more significant men land managers in the recent one to two decades. In the midst of these two periods the relations with farms that are from 23 to 35 years under usage merit attention: the percentage of these farms has a negative although weak relation with women who have more than one farm (LTWOM>1), whilst it has also an inverse but very strong relation with men who own/manage at least one farm (LTMEN). The above highlighted correlations may be showing a turning point period between 23 to 35 years ago when these gendered land management were in full swing of being reversed/inverted.

Regarding the use of *Respaldo*, correlation figures suggest that commonly the land owned by women may not include *Respaldo* and when it does they prefer to leave it with no use, alternatively allowing its use for logging and hunting when they own/manage more than one farm. Yet, the existence of *Respaldo* and its use by family members is a common characteristic of farms owed by men.

Property access types, land lots age, and use of the Respaldo

Besides the relationships described above, many of which consider variables related to the farms' oldness under use, below are described additional correlations between the types of access to land property, and the variables associated to the farms' age, and use of the *Respaldo* (Table 31).

These figures suggest changes occurring throughout time in the mechanisms of access to land. While the most common mechanism of access to land property corresponding to older lots under use is inheritance, other mechanisms such as land purchase and donation are more common in relation to the acquisition of younger land lots under use.

Buying land (BOUGHT) as a way of accessing to property is strongly correlated with almost all land age classes considered. However, it is nearly perfectly correlated with those land lots that are of 46 years or older, and of 12 to 22 years old. It could be inferred that older land lots are being sold mainly during the last few decades by their original or previous owners. It seems that older land lots that have hunting and logging potential are the preferred lands being bought. The settlement history of the study area described in a previous chapter (Mosquera and April Gniset 2001) indicates that afro-Colombian settlers first arrived and settled state lands that were vacant around 90 years ago. Thus, older lands were not purchased but freely settled and further worked used under strong kin relations. Consequent social and demographic changes throughout time have resulted in more diverse types of land acquisitions (besides inheritance) among them land sellings, which are more apparent during the last decade. For instance, is worth noting that the percentage age class of 23 to 35 years under use is the only one with an inverse and strong relationship with the variable BOUGHT. Notwithstanding, certain farm age-classes acquired by purchase, for example land lots of 12 to 22 years of use and from 1 to 13 years, may allow us to suggest a surge of a land market system in the study area in which all or part of traditional land lots are being sold for a profit (particularly older and/or larger ones) both to community members or external colonists. More evidence for the latter assertion may require further research. Figures show that relationships between land tenure and the age of lots per se are not as strong as if considering a gendered tenure when these relationships are more meaningful.

In Table 30, "inheritance" (INHERI) is the second considered mechanism of access to land. Figures show that merely the land's age class of 36 to 55 years in use is positively interrelated with INHERIT.

Regarding the use of *respaldo* (Table 31), only its use by family members is nearly strongly correlated to INHERIT. This results are consistent with the fact that land tenure of afro-descendant communities in the Colombian Pacific region are mainly obtained by inheritance as a result of kin relationships (Friedemann 1995, Arocha 1999) and that currently there are more men land managers than women in the El Cedro.

On the other hand, correlation figures depict that lands acquired by possession (POSES) are nearly perfectly correlated with lots of less than 17 years older, and moderately correlated with those older than 50 years. Are those lands acquired by possession marginal or abandoned lands? Are some of the older lands being abandoned or left for others to possess them in the last two decades? Although answers to these questions also require future pertinent research, it seems that possession is a mechanism of access to land largely happening during the last 17 years; more so, its moderate correlation with lots older than 50 years may suggest a novel land access type by possession of older lands under production (with or without mediating authorization by their original owners).

Lands acquired by work (WORK) have a very strong to nearly perfect relationship with lots younger than 22 years, with best correlations with lots of 1 to 17 years old. There is also a strong relationship between WORK and lots of 18 to 38 years old, whereas those older than 46 to 50 years have a moderate (almost strong) correlation with WORK (it seems that elder and or women pay laborers to work their farms). A moderate to strong relationship is found between WORK, BOUGHT, and POSES. There is a strong to very strong correlation between WORK and lots that *Respaldo* is used by family and for hunting activities. The above is again suggesting relationships between the WORK, BOUGHT, and POSES land access types with land lots of less than 17 years of use, and thus, a preference of these land access types during the last two decades. It also leads us to infer relationships between these land access types and *Respaldo* used on hunting and logging.

Relationships between land acquired by donation (DONATION) and land age classes are less strong. But similarly to the above two access-to-property variables, DONATION is almost strongly correlated to land lots of 17 years or less. DONATION, however, has a strong inverse correlation with lots of 39 to 90 years old.

Likewise, relationships are also found between variables related to the *Respaldo*, land tenure types, and the age of use (Table 31). The *Respaldo* used by family members (RFAMILY) is positively and nearly perfectly correlated with all land lots' age classes, but particularly from 18 to 38 years of use. Indeed, *respaldo* used by family members is the most common use in the study area. However, land lots older than 46 years old seem to have only a slight to moderate correlation with RFAMILY.

The above suggests positive relationships between *Respaldo* used by family members and land access by inheritance. It seems as well that RFAMILY is incompatible with other uses of the *Respaldo*. It may also be inferred that older farms under use have converted most of their *respaldo* into regular farms, which now most probably belong to family members. Alternately, these *Respaldos* have been bought/sold.

Using aggregate records the *Respaldo* used for hunting (RHUNT) is from slightly to moderately correlated with all of the farms' age-class variables considered, although best correlations are found with lots of less than 22 and of more than 50 years. In contrast, a slight inverse correlation is found between RHUNT and the percentage of lots of 23 to 35 years (although without statistical significance). There is a nearly perfect direct correlation with *Respaldo* used for logging. Hence, logging and hunting are activities that seem to be strongly interrelated and all of them are only performed by men.

Respaldo used for collection of materials for handcrafts (RCRAFT) has an inverse moderate correlation with lots older than 46 years, and with lots with less than 11 years, though. While handcrafts' materials and the handcrafts' types themselves have changed throughout time, these correlations may tell something about those changes, notwithstanding the need of further research. During fieldwork it was evident the existence of two types of handcrafts: handcrafts made by elders for livelihood activities such as fishing nets, and handcrafts for tourism / selling purposes in practice during the last one and half decade.

On the other hand, "logging at the *respaldo"* (RLOG) has a direct strong relationship with lots of more than 50 years, and a moderate relationship with lots of 12 to 22 years. All other year classes have slight to moderate correlations with RLOG (and an inverse moderate correlation with the percentage of lots of 23 to 35 years). BOUGHT has a strong direct correlation with RLOG (which is consistent with findings described above), while the percentage of INHERIT has an inverse, nearly strong relationship with this same variable. Relationships with the remainder *Respaldo*-use questions are: nearly perfect and directly interrelated with RHUNT, and moderately related with the percentage of RHUNT. The other *Respaldo* uses are slightly to moderately correlated to RLOG. Based on the above, it may be hypothesized that the *Respaldo* used for logging is a particular characteristic of older lots under use; and that more recently, land lots which *Respaldo* has hunting and/or logging potential -and that besides have not been inherited to other family members- are being purchased.

A moderate inverse correlation is found between RNEIGH (*Respaldo* used by neighbors) and the percentage of RHUNT (*Respaldo* used for hunting). All other relationships between RNEIGH and the reminder *Respaldo*-use variables are mainly slight and inverse. These figures suggest that both land lots with relatively less years under use (probably inherited, bought, or accessed by possession or work) or land lots relatively older, either have no *Respaldo*, or if they have it, the *Respaldo*'s resources are either short not as valuable as to allow its use by neighbors. *Respaldo* of farms of more than 30 years are commonly used by someone, either family members or neighbors.

Pairwise correlation on Land Use/Tenure (Individual Records)

Besides the above statistics on aggregated records, pairwise results of 400 individual records of secondary data (including binary, categorical, and continuous variables) on land use and tenure show some additional and consistent results to the ones described above on the aggregated records' correlations. Notwithstanding very weak pairwise-correlation figures were obtained. Results of correlations between variables on gendered land tenure/management, and on gendered land use with appropriate significant levels are highlighted below. New continuous variables in this individual-record data set include: the total number of simultaneous land uses or productive practices of each farm record (TOTALUSE); and the years under production of farms (FARM_AGE). New binary (1, 0) variables included correspond to the six management zones where 1 indicates the zone in which the farm is located. The remainder variables of the individual-records dataset are the same that were considered in the aggregated data set described above. Percentages of these continuous variables are excluded due to that these are not relevant for individual records.

Correlations on Gendered Land Tenure (individual records)

Pertinent weak but remarkable correlations with appropriate significant levels were found between gendered land tenure/management and the remainder variables considered. Figures include the direct or inverse relationships found using the individual-record dataset.

Inverse relationships are found between farms owned/managed by women and land uses such as cattle breeding, hunting, and logging for boat construction. Likewise, it is worth noting the direct and very significant relationship of this tenure variable and the years under production of farms (Farm Oldness), which corroborates findings obtained with the aggregated data: This implies that the older is the farm under usage the more direct relationship may be found with women owners/managers. Conversely, no statistically-significant relationship was found between women land tenants/managers that own more than one farm, and the remainder variables.

The correlations obtained between men land tenants/managers and the other questions were not meaningful. A single inverse relationship was found between this and the land-property variable of farms acquired by work, which is not consistent with previous findings. This relationship is conflicting with results obtained with the aggregated data. However, the relationships between Men owner/managers of more than one farm and the remainder variables are significant. These show direct correlations with land uses such as fishing, hunting, gathering materials for handcrafts, and logging for boat construction. Indeed, a direct and very significant relationship is found with the total number of land uses (the more land uses are found in a given farm the more direct relationship with this variable may be found). Likewise, this variable depicts an inverse correlation with the variable of Farms Acquired by Inheritance, whilst a direct relation with Farms Acquired by Donation is found (which is consistent with previous findings although both with relatively lower statistical significance).

Correlations on MZs, Land use/Tenure (individual records)

Relationships between six binary variables corresponding to the management zones (MZ) comprised in the study area show self-explanatory findings that aid to further characterize these areas (Table 33).

Correlations with land use types that were evidenced in these sites during fieldwork include: Direct relations between Nimiquia and cattle raising; between Pozamansa and logging and hog breeding; between Boroboro and logging, agriculture and fishing; and between Angia & Caimanera and agriculture; as well as the inverse correlations between Beach & Sendero Utria and hunting and logging. However, it is problematic the inverse relationships found between Tundo & Tado with agriculture and fishing when these land uses were also verified during fieldwork. It is worth noting the direct and very significant relationship between the total number of land uses and the zone of Boroboro, and conversely, the inverse relations with this variable and the zones of Tundo & Chado and the Beach & Sendero Utria.

Finally, the direct relations between the zone of Tundo & Chado and farm-access by way of possession and work, together with the direct and very significant relations with the use of *Respaldo* for logging and hunting, reinforce the above assertion on that this zone may be undergoing amongst the most important land use and tenure changes in the area. In the same line, the direct and significant correlation between the zone of the Beach & Sendero Utria and Farms-access by way of inheritance may also be analyzed in conjunction with the above findings on direct relations between these land tenure access type and the ownership/management by women (also in relation with the farms' age under production).

GENDERED LAND USE DRIVERS (PRIMARY DATA)

Primary-survey data was obtained in the collective land of El Cedro (titled to Afro-Colombian communities) during a fieldwork campaign held on second semester of 2006 and first semester of 2007. The above analyzed secondary data was only available to me for use in this dissertation after my campaign was finished. Thus, the results of my fieldwork campaign helped guiding the analyses of secondary data. In turn, secondary data assisted the assertions and conclusions relating to gendered land use change in this subsection.

A systematic random stratified sampling strategy over 19 neighborhoods comprising the *El Valle* village (the only urban center inside El Cedro) was practiced. As described in Chapter 1, the *El Valle* village received more population since 30 to 35 years ago when its first school was opened (nowadays there are two schools running in this village). Inside the referred 19 neighborhoods, structured interviews were conducted independently to women and men -at their houses- to identify access mechanisms affecting gendered land use decisions in the last few decades. A total of 151 houses were visited. The survey questions covered a) demographics; b) livelihoods; c) land use (extent, location, perception of change); d) land products (costs and needs); e) land and house tenure (number, travelling time from the village to the property, tenure type, years under land use); f) individual earning abilities and budget; g) key household assets (including TV and refrigerator); h) gendered knowledge transfer; and i) number of years the person has been living in El Cedro. The resulting survey included 17 landless people and 134 landholders. It is not clear how information of these 17 landless persons may contribute or not to better understand gendered land use decisions. Therefore, the data analysis described below considers two data sets: one set of 151 records including both land owners and landless subjects; and a subset of 134 records including landholders only. Structure of the survey sample is detailed in Tables 34 and 35.

Participant subjects to this survey are mainly Afro-descendant persons with the exception of one man and one woman who are mestizos. All of them are older than 18 years and were screened by a face-to-face interview. A systematic random sampling strategy was originally intended both at *fincas* (farms) in each of the El Cedro's management zones (MZ), and inside the *El Valle* village's neighborhoods. However, due to the concentration of population inside the village, the difficult determination of each MZ in the field (as there are no physical boundaries between management zones nor farms), and to the reluctance (or impracticality) of local subjects to commute to their fincas while participating in the survey, it was not possible to collect georeferenced data on the aerial extent of *fincas* and their different types of land uses *in situ*. Instead, a local guide helped me to explore the rural area when trespassing to land properties was only accomplished through trails that the guide considered proper. Thus, exploratory walks over most of the study area were conducted but no measurements on the fincas' extension or delimitation were possible. Indeed, from 151 interviewees, very few agreed to visit their *fincas* for the purposes of this survey. Of those, none agreed to disclose their fincas precise-boundaries. Reasons to their hesitancy could include the persistent rainy weather that prevented extensive walkthroughs, illiteracy of many of them with respect to areas measurements (although measuring in hectares are a common convention) , difficulties proper to transportation by boat as a common means for commuting from the village to farms (the bulk of boats are not motorized), distrust towards foreigners to their community, ethnic discrimination towards whites or mestizos, and food crops often being stolen by thieves. Furthermore, on one hand, locals who are now settled in the *El Valle* village commute with differential intermittency to their properties; but on the other, authorization is required to trespass properties although no physical boundaries are limiting these (the few parcels used for livestock are the only ones that may be fenced).

Survey data are intended to a) propose statistical models with the cultural, ecological, and socio-economic variables/signifiers obtained during the fieldwork campaign; b) conducting access maps/analyses; and c) accomplishing a narrative perspective of gendered land use change of the research sites. Items b and c are included in Chapter 6. Dependent variables of the proposed regression models (logit and multinomial logit) described below are the gendered land tenure and farm-land uses, while particular land uses, relative location of farms, cultural, and socio-economic factors (or mechanisms of access) are used as explanatory variables.

In addition, Approximately 25 semi structured interviews were conducted to identify access mechanisms focused on the traditional land use practices in the research area, with duration of approximately two hours each. Questions were posed mainly during participatory observation or informal talks. Participant subjects included afro-Colombian men and women, and mestizos of different ages of more than 18 years old. Interviews included a set of questions on a) limitations on accessing to resources such as land, farms, seeds, tools, agrochemicals, among others; b) financial support and labor; c) gendered customary laws and de facto laws related to subsistence / productive activities; d) education and knowledge transfer; e) local gendered spaces; f) traditional land use practices and change; and g) gendered resource dependence. Based on these semi structured interviews, I further conducted a phenomenological research to five women and four men of 65 to 85 years old on the question: “Why is almost nobody living in the fields anymore?” Likewise, seven semi structured interviews were directed to local organizations in the study area. Interviews lasted approximately 1.5 hours each. Questions included a) organizational issues on the gendered number of members and activities; b) gendered roles and spaces within organizational activities; c) customary laws and other laws pertinent to the organization; d) tools used and support received by the organization; and e) environmental knowledge applied on the organization's activities.

Integration of both theoretical frameworks of gendered resource access and LULCC plus qualitative research results with the statistical analyses herein (including regression models), are sought to provide broader insights for understanding gendered land use more general. These results in turn, may add to scholarly works that allow comparative analysis of geographic areas with similar traits in the Americas and worldwide.

On the other hand, mainstream LULCC surveys in which the household head is pivotal were not considered appropriate to this research (see chapter 2: Gender, the Household and the Community). "Households are not bounded units and their internal structures and workings produce and are produced by larger scale cultural, economic and political processes" (Moore 1992, p.131). In addition Wolf (1997) noted that concentration on the household as a unit, and the individual as an actor, may blur broader relations of inequality. The Intrahousehold Disadvantages Framework claims that by collecting sub-household level data it may be provided more insight to understanding the household as a non-homogeneous 'complex unit of analysis' with different levels of intra-household resource allocation and decision-making affected by individual agency, power/ information asymmetries, supra-household social relations, and non-household institutions (Bolt and Bird 2003 p.1-2). Furthermore, Bermant (2008 p.11-12) asserts that kinship structures also influence the allocation of authority in the household in which under patrilocal and patrilineal systems men often control property, resources and income, whereas under matrilineal systems women have more autonomy, placing as well greater authority on the women's relatives. On the other hand, it has been affirmed that evolutionary models for the analysis of landholding denote a 'masculine orientation of development' based on the household, in which women's actions are considered secondary or unimportant to changes of landholding systems with the consequence of women heads of households not being the focus of an analytically distinct category (Yngstrom 2002). Indeed, for traditional Afro-Colombian communities with complex consuetudinary rules of mixed patrilineal and matrilineal systems, landholding inheritance is a right of both men and women, whereas house-buildings (as the locus/place of a family) are commonly inherited by women -together with its utensils - more general (Camacho 1999). Notwithstanding this dissertation is not focused on intra-household relations this is certainly a field of study that needs further insight as to better understanding gendered land use change.

Consequently, the sampling unit chosen in this research is "the house" in recognition to the above assertions on the household concept. I further assumed that at least one family and/or woman lives at one house. Surveys were conducted to either a man or woman of any age (equal to or above 18 years old) who were willing to participate, even if the interviewee claimed or not to be the household head. Privacy of participants is protected by avoiding personal information that could lead to their identification. Thus all names are faked, and participant responses are anonymous. Statistical analyses on this survey are described below. This phase is conducted in order to answer questions number one and two of this dissertation: 1) is land use gendered? and 2) if yes, how is it gendered? Statistical analyses on these interviews are described below.

Pairwise Correlation and Frequency Procedures (Primary Data)

Using the sample surveys of 151 records (134 excluding non-landholders), first, a pairwise frequency procedure was run between both the dependent variables: "Woman owner/user of at least one Farm" (W_FARM) and "Man owner/user of a least one Farm" (M_FARM), and the remainder independent considered questions in order to investigate their association. For each dependent variable, the independence variables that demonstrate a high to moderate degree of association (p<= 07) were selected to guide the proposed logit models. Second, pairwise Pearson's correlations were calculated for all variables of the referred above data set (*n*=151 and *n*=134). Variables approaching or reaching conventional significance levels guided the proposed binary logit models shown below. Notwithstanding, correlation figures of the considered data sets show in general slight to moderate relationships with few exceptions.

When computed in a sample the "Pearson's correlation reveals the degree of linear relationship between two variables ranging from +1 (when there is a perfect positive linear relationship between variables) to -1 (when there is a perfect negative or inverse linear relationship between variables). A chi-square test is used to identify if there is a relationship between two categorical variables (binary variables may be categorical variables of only two values, 1 and 0). This procedure is used to obtain the test statistic and its associated p-value. Considering that the chi-square test assumes that the expected value for each cell is five or higher, if this assumption is not met in the data set, the Fisher's exact test is better fitted to indicate if there is a statistically significant relationship between two variables.

Significance Level Tests

Significance levels of the survey questions (for *n*=151 and *n*=134) were calculated by running both Chi Square (CHISQ) and Fisher's exact tests using the Frequency and Correlation procedures (Tables 36 and 37). Significance levels resulting of CHISQ and Fisher's tests are very similar. Descriptions of the survey's questions with labels that identify the measurement scales/ type of each of them (i.e. binary, interval, categorical, or continuous) are also provided in these tables. Results obtained of the Frequency Procedure CHISQ and Fishers' tests demonstrate that between W_FARM or M_FARM and the rest of variables relevant associations with conventional significance levels are mainly found with the variables on Land Use Types (agriculture, cattle raising, others) and livelihoods (school teaching and Cooking), Animal Husbandry (mainly chicken, ducks and pigs), Environmental Knowledge Transfer (by way of the mother, father, others or by themselves), and Monthly Income and Expenses. Although relationships between other question such as the Total Number of Farms owned by a single person (# Farms Owned) may also depict significant levels at one degree of freedom=0.05 or less, in contrast, the variables on Education Attainment and Land Tenure Type, which are considered important, have inappropriate confidence levels with the exception of the variable "Farm Owned by the Woman's husband". I avoided excluding important variables that may be weakly associated with the dependent variables on their own, but that could become influential in the presence of other independent factors (King and Peralvo 2010).

With respect to correlation results, on the other hand, the bulk of figures have from weak to moderate relationships with W_FARM and M_FARM (with few cases depicting strong to very strong associations). What is worth noting, however, is that the statistical significance levels between W_FARM and M_FARM with the remainder considered questions are identical only when using the survey sample excluding non-landholders (*n*=134). Yet, the signs of these relationships, either positive or negative, are exactly the opposite.

It is unexpected the very weak association between dependent variables and the age of respondents. It was patent during fieldwork that older people were more reliant on their land than young ones. Indeed, a 19 year old woman stated: "*monte* is for animals, my grandparents worked their farms all their lives, and look what they have now, they don't have any money; I would like to be a secretary…I haven't visit my family farm like in one year". Whereas a 72 year old woman declared: "crops are like my own children, I take care of them and suffer when they are stolen". Although, it is widely accepted that most valued asset among Afro-Colombians is the land (Camacho 1999) considering communities in homogeneous terms may blur the impacts of land use change in local populations (King and Peralvo 2010).

Gender dimensions

Statistical Pearson Correlations and Frequency procedures were calculated for the survey sample (*n*=151 and *n*=134). A binary/dichotomous variable named GENDER that describes the gender of each of the interviewees (woman=1; man=0) was included. As specified above, correlation results showed in general very weak figures, but at the same time confidence/significance levels at 0.05 or less were common. Table 38 depicts significance levels and respective correlation coefficients of pairwise statistical relationships between the variable GENDER and the remainder questions, obtained with the Frequency and Pearson's Correlation procedures. Of these results is worth noting the inverse/negative (-) and direct/positive (+) of these numbers' relationships between the above variables. Indeed, these correlation figures and signs are highlighting gender dimensions to specific land uses, which were also evident during fieldwork.

Using only 134 records corresponding to landholders, exactly the same statistical relationships were obtained (but with opposite sings) between both GENDER variables and the remainder questions. The latter was not the case when including records on landless people (*n*=151). Certainly, gendered issues of particular land uses are better illustrated using *n*=134 which includes only landholders (Table 38 illustrates the case for the variable GENDER1).

Correlation results showed in general very weak figures, but at the same time confidence/significance levels above 0.05 were common. Table 39 illustrates significance levels, signs, and respective correlation coefficients of pairwise statistical relationships between the GENDER variables and the remainder questions, using the Frequency and Pearson's Correlation procedures.

Direct (+) correlations (with appropriate statistical significance levels) correspond to land uses practiced almost exclusively by women. In contrast, inverse (-) correlations match land uses commonly practiced only by men. Certainly, during the fieldwork campaign it was evident that women were experienced in container gardening or *Azoteas* (AZO), collection of fuel fodder or materials used for handcrafts such as seeds and plant tissues (COLLE), and on animal husbandry (ANIM). Women were not involved on hunting (HUNT), or logging (LOGG), nor did they practice fishing in the ocean (FSHOCE). In contrast, men were akin to these three latter activities. On the other hand, Land and water uses that were indistinctly performed both by men and women include fishing in rivers (FSHRIV), cattle raising (CATT), and agriculture (AGR). But relationships between GENDER and these latter variables are statistically insignificant, and correlation coefficients are very slight. From these data it is evident, more general, that statistical significant direct/positive (+) relationships with GENDER are linked to women livelihoods and issues, whereas statistical significant inverse/negative (-) relationships are linked to men's. These gendered relationships including their statistical significance calculated by the Fisher's Exact Test are depicted in Table 39.

As shown above, land and water uses that are equally practiced by men or women, do not show statistically significant relationships with any of the GENDER variables and thus, these seem to have a neutral-to-gender tendency (or gendered inclusive). In contrast, relationships between the GENDER variables and the remainder considered questions with relevant significance levels are showing a gendered dimension or preference. From the latter, we may now try and specify certain gendered Land and water use preferences. In other words, and based on the above, it may be inferred that women and men land and water use preferences are mirrored in the above statistical figures' signs and confidence levels. Hence, it may also be assumed that relationships between the GENDER variables and those of Land (and water) Use Types with irrelevant significance levels are showing Land (and water) Use Types that are gender neutral or inclusive.

The same may apply to statistically significant correlations between GENDER and other variables such as LIVRUR (persons living in the rural area) that shows an inverse relationship with respect to GENDER1 (women=1); and KMOTH (knowledge transfer by the mother) that indicates a positive correlation with respect to GENDER1 (women=1). Certainly, almost only men are now living in rural areas, and knowledge transfer via the mother is typical for the bulk of women. Another interesting finding is that, in general, women perform more productive activities than men, which are totaled in the variable TACTI (Total Land Uses/Productive Activities Performed). Indeed, the TACTI variable has a direct relationship and an appropriate significance level with respect to GENDER1. Similar situations may be inferred from relationships of the remainder variables considered based on the correlation coefficient's sings and confidence levels calculated with statistical procedures.

Individual-level Statistical Models: Gendered Land use/Tenure

Based on the above significance level tests and finding on gender issues individual-level statistical models are proposed for the variables on gendered land (and water) use and tenure.

A binary logit model (BLM), which is estimated by maximum likelihood, is a regression model to fit a categorical (in this case a dichotomous/binary) dependent variable with independent variables being either categorical or quantitative; due to problems identified when using ordinary least squares-linear regression for a dichotomous dependent variable, logit regression are now being used by most researchers (Allison 1999). "…a dichotomous dependent variable in a linear regression model necessarily violates assumptions of homoscedasticity… and normality… of the error term." (Allison 1999 p.10) This means that the coefficient estimates are no longer efficient, the estimated standard errors could also be biased to unknown degrees, the test statistics could also be biased and probabilities may be greater than 1 or less than 0 which is impossible for the true values (Allison 1999 p.10).

The logit model uses odds to represent the chances that an event may occur, and as a measure of the relationship between two dichotomous variables. "…the odds of an event is the ratio of the expected number of times that an event will occur to the expected number of times it will not occur… like probabilities, odds have a lower bound of 0. But unlike probabilities (which have an upper bound of 1), there is no upper bound for odds." (Allison 1999 p.11-12) Odds ratios are "frequently regarded as fundamental descriptions of the relationship between the variables of interest... (and) … are directly related to the parameters in the logit model." (Allison 1999 p.11-13).

If p is the probability of an event, and O is the odds of the event, then,

$$O = \frac{P}{1-p} = \frac{\textit{Probability of event}}{\textit{Probability of no event}} \tag{5.1}$$

In the logit model, transforming the probabilities to an odds removes the upper bound, and taking the logarithm of the odds removes the lower bound: "Setting the result equal to a linear function of the explanatory variables, we get the logit model. For k explanatory variables, and i=1, …., n individuals, the model is" (Allison 1999 p.13)

$$\text{Log}\left[\frac{P_i}{1-p_i}\right] = \alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} \tag{5.2}$$

where, p_i is the probability that y_i=1, α is the intercept, the x's may be either interval-level variables or dummy (indicator) variables, the i subscript distinguishes different members of the sample, and the β are the values of the maximum likelihood estimation (the coefficients for the independent variables). The expression on the left-hand side is usually referred to as the logit or log-odds. Solving the logit equation for p_i it is obtained, (Allison 1999 p.13)

$$P_i = \frac{1}{1 + \exp(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik})} \quad (5.3)$$

With this equation, no matters what values are substituted for the βs and the *x*s, the p_i will always be a number between 0 and 1 (Allison 1999 p.14). “The (logit) model can be easily generalized to allow for multiple, unordered categories for the dependent variable.” (Allison 1999 p.15).

A dummy/ binary or dichotomous variable is a numerical variable used in regression analysis to represent subgroups of the sample in a study often used to distinguish different treatment groups. In the simplest case, a dummy/binary or dichotomous variable has two values (0, 1). Another advantage of a 0,1 dummy-coded variable is that it may be treated statistically both as a nominal-level variable and an interval-level variable. For a binary response variable *y* denote its two categories by 1 and 0 and the regression model describe the population proportions, where success represents the probability of P(*y*=1) (Agresti and Finlay 2009). Many questions of this dissertation’s survey are represented (and few others, such as the variable GENDER, were included) as dummy variables. Description of each of these variables is found in the above Tables.

Statistical analyses were accomplished first by specifying logit models for the variables F_WOM (farm owned and/or used by women) and F_MEN (farm owned and/or used by men). Maximum likelihood is the only method for estimating the logit model in general use for individual-level data (Allison 1999 p.16). For estimating the coefficients I used both individual-level data of 151 interviews (including 17 records of people who didn’t have land), and 134 records out of *n*=151 (which exclude landless persons). I run the BLMs using the SAS software 9.2 on statistically significant variables calculated on the correlations described above. Explanatory variables such as land tenure type, people’s age, and particular land uses (e.g. agriculture) were recoded as binary/dichotomous variables in order to include them in the models.

The specified binary logit models on gendered land tenure/use predict that the dependent variable is equal to 1 (or the probability of the highest value being 1). Land lots owned and used by women (F_WOM) was recoded to a dichotomous variable that indicates that a farm is owned and used by a woman (1) or not owned and used by a woman (0). Likewise, land lots owned and used by men (F_MEN) was recoded to a binary variable that specifies that a land lot is owned and used by a man (1) or not owned and used by a man (0). These gendered land use/tenure variables were regressed on four to eight individual-level variables in binary logit models (BLM). These models seek to estimate the probability of a land lot (farm) being owned and used by a woman or a man in relation to select individual-level variables. The BLM adopts the general form described in equations (5.2) and (5.3) where $P_i = Y_i = 1$ is the dependent variable of gendered land ownership and use, the x's are independent variables (dichotomous or interval), and the β's are the coefficients for the independent variables.

Descriptive statistics for the interval independent variables included in the BLMs are listed in Table 40 and the other explanatory variables are described in Tables 36 and 37. The SAS (version 9.2) code used to estimate the logit models (LOGISTIC procedure) is as follows:

```
PROC LOGISTIC DATA=interviews DESCENDING;
CLASS variable1 variable2 variable3…..;
MODEL dependent variable = variable1 variable2 variable3…..;
RUN;
```

The DESCENDING option specified in the PROC statement reverses the default of LOGISTIC to estimate the lowest value of the dependent variable (0). The CLASS option specifies the categorical variables included in the model.

BLMs of land use and tenure by women

The F_WOM (farm owned and/or used by women) variable was regressed on four to six individual-level variables in binary logit models (BLM) using the individual-level data of 151-records. Independent variables included education attainment (EDU), farm used in logging (LOGG), container gardening (AZO), animal husbandry (ANIM), income per month (INCOME), knowledge transferred by the subject's mother (KMOTH), and knowledge acquired by the subjects itself (KTHEM) (descriptive statistics for INCOME are found in Table 36. Description and statistical significance of the remainder variables are found in Table 38. Best results were obtained with the explanatory variables EDU, AZO, LOGG, ANIM, KMOTH, and KTHEM regressed in the BLM (Output 6.1 (*n*=151) and 6.2 (*n*=134) in Appendix D).

$$P_{(151)} = \frac{1}{1 + \exp(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik})} \qquad (5.4)$$

$$P_{(134)} = \frac{1}{1 + \exp(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik})} \qquad (5.5)$$

Education attainment (EDU 0 to 4) is expected to be associated negatively with land use/tenure by women thanks to that higher education attainment levels lead to more women's expectations on engaging in other livelihoods away from working the land. Variables positively related to women's land use/tenure including container gardening

(AZO) and animal husbandry (ANIM) are hypothesized to also relate positively to women's land use/tenure. In contrast, men-akin land uses, for example, logging (LOGG) is expected to relate negatively with women's land (and water) use. Individual-level income (INCOME) is the estimated monthly income obtained from resource extraction, agriculture, and other academic (school teaching), commercial (small businesses inside the village), and tourism activities (jobs at hotels or as tourism guides, among others). INCOME is expected to relate positively with land use/tenure of both women and men, considering that agriculture and resource extraction is still the main income sources (notwithstanding subsistence means) in the study area. Environmental knowledge transfer-variables include knowledge transfer by the mother (KMOTH), the father (KFATH), by other persons including family members or friends (KOTHE), and knowledge acquired by them (KTHEM). It is hypothesized that more often it is the mother who transfer environmental knowledge to their daughters, while fathers do the same to their sons; other family members and friends transfer knowledge both to men and women, and also both men and women may acquire their environmental knowledge themselves. The latter BLM run using n=151 threw appropriate fit statistics and coefficients. However when it was also run using the sample data with n=134 (a shorter dataset) the validity of the model fit was questionable in all cases.

Consequently, by using n=134 new combinations of five to six individual-level variables were regressed again in BLMs. These variables included the same as above plus the variable INFIX. Fixed Income (INFIX) is the estimated monthly income obtained from commercial, academic, or tourism activities. INFIX is hypothesized to relate inversely to land use/tenure by women considering that other livelihoods are at present more valuable to them than resource extraction and agriculture. New best BLM results were obtained with the variables AZO, LOGG, ANIM, INFIX, KMOTH, and KTHEM regressed in a BLM (Output 6.3 (n=134) and Output 6.4 (n=151) in Appendix D). All the newly specified models using n=134 were also run again into the n=151. This time, BLM results fitted in all cases in both datasets. Notwithstanding, the model fit statistics were better in the 134-record sample data, and the coefficient estimates varied between both datasets (Equations 5.6 and 5.7).

$$P_{(151)} = \frac{1}{1 + \exp(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik})} \quad (5.6)$$

$$P_{(134)} = \frac{1}{1 + \exp(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik})} \quad (5.7)$$

"… ML (Maximun Likelihood) estimators are known to have good properties in large samples. Under fairly general conditions, ML estimators are consistent, asymptotically efficient, and asymptotically normal. Consistency means that, as the sample size gets larger, the probability that the estimate is within some small distance of the true value also gets larger. No matter how small the distance or how high the specified probability, there is always a sample size that yields an even higher probability that the estimator is within that distance of the true value. One implication of consistency is that the ML estimator is approximately unbiased in large samples. Asymptotic efficiency means that, in large samples, the estimates will have standard errors that are, approximately, at least as small as those for any other estimation method. And finally, the sampling distribution of the estimates will be approximately normal in large samples, which means that you can use the normal and chi square distributions to compute confidence intervals and p-values." (Allison 1999 p.16).

Finally, I tested the latter BLM changing the dependent variable to F_MEN (land lots owned and used by men) and using both *n*=134 and *n*=151. The F_MEN variable (farms owned and used by men) was regressed on the same dependent variables as above (i.e. AZO, LOGG, ANIM, INFIX, KMOTH, and KTHEM) in BLMs (Output 6.5 (*n*=151) and 6.6 (*n*=134) in Appendix D). This procedure was performed in order to verify the difference between the model fit and coefficients between the F_WOM and F_MEN dependent variables while using the same sample data. When the BLM was run using *n*=134 the model fit statistics, intercept and coefficient estimates were identical; however the intercept and coefficient showed opposite signs. In contrast, these statistics were different between having F_WOM and F_MEN as dependent variables when the BLM run on *n*=151-record dataset (Table 41).

Results depicted on Table 41 suggest that sample data with no missing data in the dependent variable gives better results when running BLMs. The 151-record dataset (which includes 17 records corresponding to persons who are non-land tenants/users), necessarily includes no data in those 17 records of the dichotomous variables F_WOM and F_MEN. Consequently, results of the specified BLMs will always have different model fit statistics and coefficients in this situation. In contrast, running the model using *n*=134 in which the dichotomous variables' records are complete will throw exact results for both of the considered dichotomous variables although the intercept and coefficient signs are reversed. This means that no matter what explanatory variables are used to model the probability of Y_i=1, the gendered dependent dichotomous variable, the BLM statistical results will have the same figures with inverse signs for Y_i=0. Therefore, hypotheses behind the BLMs are what make them more sounding.

The first hypothesis implicit in these BLMs is that women will own and use the land when they practice specific gendered land use/livelihoods which were evident both during fieldwork and based on statistical analyses of the survey's data. These women's land use/livelihoods include container gardening (AZO); collection of fuel fodder, seeds and plant products (CRAF); and animal husbandry (ANIM). In contrast, there will be and inverse/negative relationship between women's land use and tenure with land uses such as hunting (HUNT), logging (LOGG), and fishing in the ocean (FSHOCE), which are men-akin. Other gendered-neutral/inclusive land use-variables such as agriculture (AGR), cattle raising (CATT), and river fishing (FSHRIV), which are equally practiced by men or women, will not be statistically significant in these BLM models. In addition, women's pursue for higher levels of education attainment throughout time have led to their engagement in other livelihoods dissimilar to resource extraction and agriculture. As a consequence of the latter, it is assumed that fewer women are owning and using the land throughout the last few decades as their education attainment becomes higher. More so, it is hypothesized that the environmental knowledge that is transferred from mother to daughter or acquired by women themselves will increase the probability that a woman uses/owns land plots. All other BLM individual-level variables included are linked to these hypotheses. Although additional and more complex hypotheses may be drawn from both the feminist political ecology and the LULCC literature in relation to gendered land use and tenure, due to results on the statistical significance of the sample data's explanatory variables, the above BLMs specification necessarily leads to hypotheses reduction and simplification. In effect, sample survey's potential explanatory variables such as those listed in Tables 36 and 37 (e.g. Income/Expenses variables, land area, location in one of six management zones, age, number of children, tenure type variables, number of houses owned, and civil status, among others) proved not to be statistically significant to be included in the specified BLMs that have F_WOM as the dependent variable.

BMLs of land use and tenure by men

Following the same procedures as above, using the individual-level (sample data) data of 151-records the F_MEN variable was regressed on five to eight individual-level variables in binary logit models (BLM). Independent variables included AGE, CHILDT, ANIM, FSHOCE, TACTI, INCOMCO1, KFATH, and KTHEM (descriptive statistics for the variables "the subject's age in years" (AGE), number of children (CHILDT), and the total number of land uses/productive activities performed (TACTI), are found in Table 37). Description and statistical significance of the remainder variables are found in Table 38. Best results were obtained with the variables AGE, LOGG, TACTI, FSHOCE, INCOMCO1, and KTHEM regressed in the BLM (Output 6.7 (*n*=151) and 6.8 (*n*=134) in Appendix D).

$$P_{(151)} = \frac{1}{1 + \exp(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik})} \quad (5.8)$$

$$P_{(134)} = \frac{1}{1 + \exp(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik})} \quad (5.9)$$

Age (AGE) is expected to be associated positively with land tenure and use by men thanks to the expected additional requirements of land tenure to accommodate an anticipated increasing number of family members. Due to kin relations, every child is expected to inherit land both from the father and the mother. Likewise, a higher number of children is hypothesized to relate positively with men's land tenure/use for the same latter reason. Variables related to land (water) use/tenure including ocean fishing (FSHOCE) are assumed to relate positively to men's land use and tenure as was evident during the fieldwork campaign: only men were involved in sea-fishing whereas women were involved only on river-fishing undertakings. In contrast animal husbandry (ANIM), as well as other women-akin land uses, is expected to relate negatively with men's land use. The variable TACTI is hypothesized to relate inversely with land use and tenure by men considering that women subjects contend to perform a higher number of land uses/livelihoods in comparison to men (respective assertions from women were heard during fieldwork). Individual-level categorized income (INCOMCO1) is the estimated monthly income obtained from resource extraction, agriculture, and other academic (school teaching), commercial (small businesses inside the village) and tourism activities (work at hotels or as tourism guides) categorized in three classes by the researcher (class two refers to the Colombian minimum official wage in US$ in 2007); classes one and three are income below and above this reference respectively). INCOMCO1 is expected to relate positively with land use and tenure by men (LOTM), considering that agriculture and especially resource extraction is still the main income source (notwithstanding subsistence) in the study area. Finally, with respect to the environmental knowledge transfer-variables described above it is hypothesized that more often it is the father who transfer environmental knowledge to their sons (KFATH). Likewise, it is also men who more commonly gain environmental knowledge by themselves (KTHEM) in comparison to women. The specified above BLMs were also run using the sample data of 134-

records; this time, using this shorter dataset the validity of the model fit was appropriate in all cases.

Likewise, using the 134-record dataset (*n*=134), new combinations of four and five individual-level variables were regressed again in BLMs. These variables included the same as above. Best BLM results were obtained with the variables AGE, LOGG, FSHOCE, TACTI, and KTHEM regressed in a BLM (Output 6.9 (n=134) and Output 6.10 (n=151) in Appendix D). The specified models of *n*=134 were also run into *n*=151) This time also the BLM results fitted in all cases. Notwithstanding the model fit statistics and the coefficient estimates varied slightly between results of this model in both datasets.

$$P_{(151)} = \frac{1}{1 + \exp(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik})} \quad (5.10)$$

$$P_{(134)} = \frac{1}{1 + \exp(-\alpha - \beta_1 x_{i1} - \beta_2 x_{i2} - \ldots - \beta_k x_{ik})} \quad (5.11)$$

The first hypothesis implicit in these F_MEN- BLMs is that it is more likely that men own and use farms with specific gendered land use preferences which were evident both during fieldwork and that are corroborated using statistical procedures on the survey's data. These men-akin activities include hunting (HUNT), logging (LOGG) and fishing in the ocean (FSHOCE). In contrast, there will be inverse/negative relationships with land uses such as container gardening (AZO); collection of fuel fodder, seeds and plant products; and animal husbandry that are female-akin. Other gendered-neutral/inclusive land use-variables such as agriculture, cattle raising or river fishing will not be relevant to these models as these variables are not statistically significant in the sample data. In addition, it is hypothesized that the environmental knowledge that is transferred from father to son or acquired by themselves will increase the probability that a man uses /owns a given farm. All other BLM individual-level variables included are linked to these hypotheses.

Finally, I tested this latter BLM changing the dependent variable to F_WOM (land lots owned and used by women) and using both the 134 and 151-record dataset. The F_WOM variable (land lots owned and used by women) was regressed on the same dependent variables as above (i.e. AGE, LOGG, FSHOCE, TACTI, and KTHEM) in BLMs (Output 6.11 (*n*=134) and 6.12 (*n*=151) in Appendix D). This procedure was performed in order to verify the difference between the model fit and coefficients between the F_WOM and F_MEN dependent variables while using the same sample data. When the BLM was run using the 134-record dataset the model fit statistics, intercept and coefficient estimates were identical; however the intercepts and estimates showed opposite signs. Conversely, these statistics were different for F_MEN and F_WOM as dependent variables with the BLM for *n*=151 (Table 42).

Individual-level Statistical Models: Specific Land Uses

Local people perform various land (and water) use types simultaneously. These uses may now be characterized in three groups: men-akin, women-akin, and gender-neutral/inclusive land use types (Figures 65 and 66). The number of persons who practice land use types within the three referred groups is depicted in Figure 65, notwithstanding the same person may perform land uses of the different groups simultaneously. The highest cumulative number of persons per group corresponds to gender- neutral/inclusive land use types (which include agriculture, river-fishing and cattle raising), followed by women-akin land use types (i.e. container gardening, gathering, animal husbandry), and by the men-akin land use type group (comprising hunting, logging and sea-fishing), which are practiced by the smallest cumulative number of persons. The percentage of persons performing each of the land use types considered (which may not be cumulative) out of 134 records of persons owning/using the land are depicted in Figure 66. Agriculture is performed by the highest cumulative number of persons, followed by animal husbandry, gathering, and by fishing in rivers.

Same as for the variables on farms own/used by men or women, binary logit models (BLM) on particular land use-types were also run (e.g. BLM for hunting, BLM for container gardening). These land-use/livelihood BLMs predict that the dependent variable is equal to 1 (or the probability of the highest value being 1). All land use-type variables were recoded to dichotomous variables that indicate that a farm is being used in a particular land use-type (1) or not used in that particular land use-type (0). These land use-type variables were regressed on two to seven individual-level variables in binary logit models (BLM). Likewise, two dichotomous variables were also included in the sample data, namely GENDER1 (1=women; 0=men) and GENDER0 (1=men; 0=women) that describe the gender of the subject who uses/owns a given land lot. The GENDER variables were used for testing the relative "significance" of gender on each of the individual land use-type BLMs that are described below (e.g. logging, hunting, gathering). These models seek to estimate the probability of a land lot being used or not in a particular land use-type in relation to select individual-level variables. The BLM adopts the general form described in equations (5.2) and (5.3), where $P_i = Y_i = 1$ is the particular land use-type dependent variable, the x's are independent variables (dichotomous or interval), and the β's are the coefficients for the independent variables.

BLMs of particular land use types were specified using variables with statistical significance levels identified on the pairwise correlation procedures described above. These models were run only for *n*=134 considering that just the landholders' records comprise the data of interest.

Binary Logit Models for particular land (and water) uses, namely Hunting (HUNT), Logging (LOGG), Fishing in the Ocean/ in the river/ in general (FSHOCE / FSRIV / FISH), Container Gardening (AZO), Collection of fuel fodder/seeds/plant products (COLLE), Animal husbandry (ANIM), Agriculture (AGR), and Cattle raising (CATT), were regressed on varying number of independent variables in BLMs. Subsequently, the independent GENDER variables were included and regressed together with the previous explanatory variables in all best specified BLMs, with the aim of testing if the models improved or worsen with the inclusion of the gender variables. This is done as one suggested method for identifying/ acknowledging gender dimensions in land use and land cover assessments.

Descriptive statistics for the interval independent variables included in the BLMs are listed in Table 40 and the other explanatory variables are described in Tables 36, 37, and 38. The SAS code used to estimate the land-use logit models (LOGISTIC procedure) is as follows:

```
PROC LOGISTIC DATA=interviews DESCENDING;
CLASS variable1 variable2 variable3…..;
MODEL dependent variable = variable1 variable2 variable3…..;
RUN;
```

The DESCENDING option specified in the PROC statement reverses the default of LOGISTIC to estimate the lowest value of the dependent variable (0). The CLASS option specifies the categorical/dichotomous variables included in the model. Correlation coefficients and statistical significance between the three men-akin land (water) use types, the four women-akin land (water) use types, the three gender- The highest cumulative number of persons per group corresponds to gender- neutral/inclusive land use types (which include agriculture, river-fishing and cattle raising), followed by women-akin land use types (i.e. container gardening, gathering, animal husbandry), and by the men-akin land use type group (comprising hunting, logging and sea-fishing), which are practiced by the smallest cumulative number of persons. The percentage of persons performing each of the land use types considered (which may land (water) use types, and the independent variables used in the BLMs are found in Tables 43, 44, and 45 respectively. Based on these results, BLMs were specified for each of these land use-types. The three groups of BLM outcomes are explained below and summarized in Tables 46, 47, and 48.

Hypotheses supporting land use BLMs are both based on data and information obtained from the fieldwork campaign, on the surveys described above, and on a map of the study area's Management Zones (MZ) (Figure 70) produced by local inhabitants including members of the Community Council. This map will be referred below as the MZ map.

BLMs of men-akin land (water) use types

Land (and water) uses that are men-akin comprise hunting (HUNT), logging (LOGG), and ocean fishing (FHSOCE). This assertion is based on gendered-land use dimensions verified during the fieldwork campaign and confirmed by statistical outcomes of correlation procedures summarized on Tables 37 and 43. Based on the sample data of 134 records, the proportion of persons engaged in these land use types in comparison to other uses is showed in Figure 67. Please note that although a cumulative percentage of 49% is showed for this group of land uses, this number result of same persons possible practicing from one to three of the considered land use types concurrently.

The HUNT dependent variable was regressed on four to six independent variables in binary logit models (BLM) using the individual-level dataset of 134-records. Independent variables include either river or sea fishing (FISH), agriculture (AGR), logging (LOGG), commuting distance to landholding in hours (LDISTHR), income per month (INCOME), knowledge transfer by different persons excluding mother and father (KOTHE), and knowledge acquired by the subject itself (KTHEM) (descriptive statistics for INCOME and LDISTHR are found in Table 38). The probability modeled is HUNT=1. Description and statistical significance of the remainder variables are found in Table 37. Best results were obtained with the explanatory variables: FISH, LOGG, LDISTHR, INCOME, and KOTHE regressed in the BLM. Detailed BLM statistical results are found in Output 6.13, 6.14 and 6.15 (including the GENDER variables) in Appendix E.

Location variables include the traveling distance between the household and the closest point of the land lot own/used by each participant subject in hours (LDISTHR). Distance is measured as travel time (1 to 3 hours) connected by rivers or walking paths. Traveling time is the approximate number of hours spent in a regular wooden boat named *chingo* in the area, which needs rowing (motor less) plus the time invested while walking. Commuting to a given land property commonly needs mixed rowing and walking; however, data on this two traveling-mode times are added in the sample data. Commuting time is expected to relate directly to hunting as pertinent animals are located in areas farther to the *El Valle* village, mainly in the Management Zones of Nimiquia (#1), Boroboro (#3), and Tundo and Chado (#5) (please refer to the MZ map). Although MZ #5 is closer to the village than the other two referred zones, access to hunting places needs walking which could make it longer the traveling to these properties than to land plots that are not suited for this use.

Hunting is expected to be associated positively with logging considering that (in terms of travelling time) access to hunting and timber resources is similar. Indeed, in most cases, timber and hunting resources are located together in areas farther to the village (as shown in the MZ map). Exceptions include smaller forest extents mapped inside the MZ #2, #4, #5 and #6 where timber resources are shown including non-hunting-type animals. Likewise, hunting is anticipated to be associated positively with fishing both in rivers and oceans (FISH) thanks to that these two activities are perceived to be corresponding and are also conducted by men. Although the latter hypothesis was not evident during the field campaign, direct statistical interrelations between these two variables supported this assertion.

In addition, hunting is expected to relate positively with INCOME (as described above) considering it adds to locals' income sources as was evident during the fieldwork survey. Similarly, it is hypothesized that environmental knowledge related to hunting is more often transferred to men through other family members and friends (KOTHE), or alternatively, that it is acquire by men themselves (KTHEM). Indeed mothers (women) do not hunt in the study area; besides, not all fathers (men) do hunt. Thus the activity is conducted by a specialized group of persons. Indeed there's a Hunters Committee for the *El Cedro*.

The specified BLM for hunting (the probability modeled is HUNT=1) threw appropriate fit statistics and coefficients (Table 46). Subsequently, the GENDER variables were added to the above referred individual-level variables, and all were regressed again in this BLM. Calculation of the above specified BLM including the gender variable of man=1 (GENDER0) is hypothesized to improve the model fit statistics considering that this livelihood is men-akin. In contrast, adding GENDER1 (women=1) to the BLM is expected to result in worsening statistics. In effect, the new model fit statistics obtained using the variables GENDER0 regressed in the hunting BLM improved the model, which is consistent with the former expectation (although the model fit is questionable). However, as shown in table 36, the only difference between the specified BLM including GENDER0 and the same BLM including GENDER1 is that the resulting coefficient of the gender variable is reversed (the signs of this coefficient is opposite); yet all other statistical figures are the same (See Output 6.14 and Output 6.15 in Appendix E)

The logging (LOGG) land use type was regressed on two to seven independent variables in binary logit models (BLM) using the individual-level dataset of 134-records. The probability modeled is LOGG=1. Best results were obtained with the explanatory variables: total lots owned/used by a subject (TLOTS), hunting (HUNT), and income per month as categorical variable (INCOMCO1) regressed in the BLM. Descriptive statistics for TLOTS is found in Table 38. Description and statistical significance of the remainder variables are found in Table 37. Detailed BLM statistical results are found in Output 6.16, 6.17 and 6.18 (including the GENDER variables) in Appendix E.

As stated above, logging is expected to be associated positively with hunting mainly because timber and hunting resources are located together in areas farther to the village (as shown in the MZ map). Likewise, logging is predicted to be associated positively with the total number of land lots owned and used by a person (TLOTS):

persons with more than one land lot commonly use the second, third or more lots for timber extraction. Direct statistical interrelations between the latter two variables support this assertion.

Logging is also expected to relate positively with INCOME, since timber nowadays is the main income source for locals involved in this activity. This was evident during the fieldwork campaign and has also been studied by other scholars (Leal and Restrepo 2003). The specified BLM for logging threw appropriate fit statistics and coefficients (Table 46). Consequently, similar to the hunting variable, the previously selected independent variables plus the GENDER variables were regressed again in this BLM. Calculation with the GENDER questions inside the above specified BLM is hypothesized to improve the model fit statistics considering that logging is a gendered land use type (men-akin type). The new model's fit statistics obtained using the variables GENDER1 and GENDER0 regressed in the logging-BLM are consistent with the hypothesis for the HUNTING model referred above (Outputs 6.16, 6.17 and 6.18 in Appendix E). Is worth nothing that BLMs including the variables GENDER1 and GENDER0 resulted in the same model fit statistics and coefficients. Notwithstanding, the coefficient of the gender variable depicts the same number but with reversed signs when comparing both outputs.

Finally, last water use under the men-akin group is the "Fishing in the Ocean" (FSHOCE) dependent variable. This dependent variable was regressed on three to eight independent variables in binary logit models (BLM) using the individual-level dataset of 134-records. Best results were obtained with the explanatory variables: total number of farms own by a subject (TLOTS), river-fishing (FSHRIV), expenses per month (EXPENSE), and livelihood knowledge acquired by the subject itself (KTHEM) regressed in the BLM. The probability modeled is FSHOCE=1. Detailed BLM statistical results are found in Output 6.19, 6.20 and 6.21 (including the GENDER variables) in Appendix E. Descriptive statistics for TLOTS and EXPENSE are found in Table 38). Description and statistical significance of the remainder variables are found in Table 37. Economic variables include the total expenses per month (EXPENSE) of each individual (although she/he may or not be the household head and /or may not report the total household cash expenditures).

Ocean fishing (FSHOCE) is predicted to be associated positively with the total number of lots owned and used by a person (TLOTS): fishing fosters the acquisition of more than one lot by way of purchases. Direct relationships between ocean fishing and the BOGHT tenure type variables support this expectation. On the other hand, this resource extraction type allows increasing income, but also (as well as fishing in rivers) is essential part of this population's subsistence economy as evident during fieldwork. Although income increases with this activity, it is the variable EXPENSE which best correlates and fits inside the BLM. Indeed, ocean fishing is hypothesized to increase the purchasing capacity of locals, particularly of other provisions or assets different than food, which could even include land parcels.

Ocean fishing is expected to be associated positively with river fishing considering pertinent assets and knowledge may be used in both water body types. Likewise, ocean fishing is anticipated to be associated positively with the number of key goods (TV and refrigerator) considered in the survey, particularly refrigerators. However, the inclusion of this question in the BLM did not lead to better statistical results. The same is true with the expected positive interrelation between ocean fishing and the variable of "land acquired by purchasing" (BOUGHT) that is hypothesized to explain in part ocean fishing. Yet, acknowledgement of the latter variable in the BLM did not improve pertinent results. Although the latter hypothesis was not evident during the field campaign, direct statistical interrelations between these two variables support this assertion.

In addition, ocean fishing is expected to relate positively with INCOME (as described above) considering its resource extraction adds to locals' income sources as evident by the fieldwork survey. Similarly, it is hypothesized that environmental knowledge related to ocean fishing is more often transferred to men through other family members and friends (KOTHE), or alternatively, that it is acquire by themselves (KTHEM). Women do not practice ocean fishing locally (they do in other areas particularly in tranquil sea bays); besides, not all fathers (men) do fish in the ocean. Thus the activity is also conducted by a specialized group of persons. Ocean fishing with aid of motored boats is a relatively recent activity in the study area (10 to 15 years ago), thus, most fishermen are men fairly younger than 45 years old.

The specified BLM for ocean fishing (the probability modeled is FSHOCE=1) threw appropriate fit statistics and coefficients (Table 46). Same as with previous models, the GENDER variables were added to the above referred individual-level variables, and regressed again in this BLM. Calculation of the above specified BLM including the GENDER questions is hypothesized to improve the model fit statistics considering that this livelihood is men-akin. In effect, the new model fit statistics obtained using the GENDER variables regressed in the ocean fishing in the BLM are consistent with this hypothesis (Output 6.19, 6.20 and 6.21 in Appendix E). As shown in table 46, the only difference between the BLM including GENDER1 and the specified BLM including

GENDER0 is that the resulting coefficient of the gender variables are reversed (the signs of this coefficient is opposite); yet all other statistical figures are the same.

In conclusion, the first hypothesis implicit in the men-akin BLMs is that men will own and use the land when they practice specific gendered land use activities which were evident both during fieldwork and using statistical procedures on the survey's data. These include hunting (HUNT), logging (LOGG), and fishing in the ocean (FSHOCE). All other individual-level variables included in the BLM are linked to this hypothesis. On the other hand, it is expected that men-akin livelihoods -in comparison to all livelihoods considered in the study area- are the ones more responsible for increasing income, as compared to the female-akin or gendered neutral/inclusive ones. More so, men-akin land use types (in this case particularly hunting) are assumed to take place at land lots with direct relationships to travelling time (the chosen access measure), that is, with longer commuting times and very often in *Monte* (forest).

BLMs of women-akin land (water) use types

Land (and water) uses that are women-akin in the study area comprise: Container Gardening/*Azoteas* (AZO), Gathering of Fuel Fodder/ Seeds/ Plants Products (COLLE), and Animal Husbandry (ANIM). This claim is both based on gendered-land use dimensions verified during the fieldwork campaign and confirmed by statistical outcomes of correlation procedures summarized on Tables 36 and 44. Based on the sample data of 134 records, the proportion of persons engaged in these land use type in comparison to other uses is showed in Figure 68. Please note that although a cumulative percentage of 113% is showed for this group of land uses, this is a number which may result of same persons possible practicing from one to three of the considered land use types concurrently.

The dependent variable of Container Gardening, locally named *Azoteas* (AZO), was regressed on eight to three independent variables in binary logit models (BLM) using the individual-level dataset of 134-records. The probability modeled is AZO=1. Best results were obtained with the explanatory variables: total number of children (CHILDT), total number of land uses/livelihoods undertaken by the subject (TACTI), and livelihood knowledge transferred by the subject's mother (KMOTH) regressed in the BLM. Descriptive statistics for the independent variables CHILDT and TACTI are found in Table 38). Description and statistical significance of KMOTH is found in Table 36. Detailed BLM statistical results are found in Output 6.22, and 6.23 and 6.24 (including the GENDER variables) in Appendix F.

Demographic variables include the total number of children (CHILDT) of each participant subject. In the sample population, the total number of children ranges from zero (0) to eleven (11) per subject. CHILDT is expected to relate positively to container gardening or *azoteas* (AZO) considering *azoteas* represent among many other functions, a corresponding food source, and a vessel for knowledge conservation and transfer within the families inside the study area (Camacho 2001, Mena et al 2001, Leyton et al 2001, Hovorka 2005). Thus, women with children are hypothesized to practice more container gardening.

AZO is also expected to be associated positively with the total number of land uses/productive activities/livelihoods practiced by women. The latter thanks to that in one hand AZO is a women exclusive activity; and on the other, a greater proportion of women perform higher number of land use types/productive activities/livelihoods than men. During the fieldwork campaign, this assertion was only intuitive based on comments shared by the population: “we (women) work more than men; or “women work shoulder to shoulder with men, they even work more than they do”; or “afro-Colombian women are very strong, they work on everything, even more than men”. But then again, the statistic correlation (described above) between land lots used by women (LOTW) and the total number of land use types/productive activities/livelihoods conducted (TACTI) per record is direct and positive.

In addition, it is hypothesized that environmental knowledge on constructing and maintaining *azoteas* (AZO) is almost always (if not always) transferred to women through mothers (KMOTH), or alternatively, through other family members including grandmothers (KOTHE). Indeed, *Azoteas* are maintained exclusively by women in the study area.

The specified BLM for AZO (the probability modeled is AZO=1) shows appropriate fit statistics and coefficients (Table 47). Consequently, the GENDER variables were added to the above individual-level variables, to be regressed again in this BLM. Calculation of the above specified BLM including the GENDER questions, but particularly the GENDER1 variable (women=1), is hypothesized to improve the model fit statistics considering that this livelihood is not only women-akin, but women-exclusive. In effect, the new model fit statistics obtained using the variables GENDER1 and GENDER0 regressed in the AZO- BLM are consistent with this hypothesis (Output 6.23 and Output 6.24 in Appendix F). Again, as shown in Table 47, the only difference between the *azoteas'* BLM including GENDER1 and the specified BLM including GENDER0 is that the resulting coefficient of the gender variable is reversed (the sign of this coefficient is opposite); yet, all other statistical figures are the same but improved.

The land use type of gathering Fuel Fodder/ Seeds/ Plants (COLLE) as dependent variable, was regressed on four to six independent variables in binary logit models (BLM) using the individual-level dataset of 134-records. The probability modeled is COLLE=1. Best results were obtained with the explanatory variables: education attainment (EDU), total subject's number of children (CHILDT), total number of landuses or livelihood activities performed by the subject (TACTI), and tenure type "collective" (TTYPE1) regressed in the BLM. (Descriptive statistics for CHILDT and TACTI are found in Table 38). Description and statistical significance of the remainder variables are found in Table 36. Detailed BLM statistical results are found in Output 6.25, 6.26 and 6.27 (including the GENDER variables) in Appendix F.

Demographic independent variables include the education attainment level (EDU), which is classified using the standard category system used in Colombia. It is hypothesized that gathering is associated with lower education attainment levels, such as those corresponding to none education attainment (EDU1) and elementary school (EDU2). Likewise, gathering is expected to be associated positively with the total number of children considering that is a common practice that women (more than men) perform this activity with aid of their children. Same as above, as gathering is a women-akin land use, it is expected to add to the total activities performed commonly by women (TACTI) and thus it is hypothesized to be associated to this question. In addition, it is expected that gathering is accomplished commonly in areas that are openly accessed, or where access is allowed. These areas may be located in *Respaldo* areas, or be areas with no property rights such as beaches, and marginal lands not yet claimed by locals, which are referred commonly as "collective" (TTYPE1). In the MZ map, these areas may overlay *Respaldo* or are not mapped because of their small size such as beaches. The latter hypothesis was evident during the field campaign, and also direct statistical interrelations between these two variables support this assertion. In addition, it is hypothesized that environmental knowledge transfer on gathering (COLLE) is not critically significant to this land use type considering this knowledge may be transferred by all members of the community including parents, other family affiliates, friends, and more generally by themselves.

In contrast to most of the above models, the specified BLM for COLLE (the probability modeled is COLLE=1) depict lower quality fit statistics and coefficients (Table 47). Still, the inclusion of the GENDER variables slightly improved the model fit statistics. This result may lead us to infer that the gender dimension of the gathering land use type may not be as clearly identified as in the above land use type cases. (Output 6.25, 6.26, and, 6.27 in Appendix F). Once more, as shown in table 47, the only difference between the COLLE-BLM including GENDER1 and the specified BLM including GENDER0 is that the resulting coefficient of the gender variable is reversed (the sign of this coefficient is opposite); yet, all other statistical figures are the same.

Finally, the animal husbandry (ANIM) dependent variable was regressed on eight to three independent variables in binary logit models (BLM) using the individual-level dataset of 134-records. The probability modeled is ANIM=1. Best results were obtained with the explanatory variables: the subject's age (AGE), TACTI, and KMOTH regressed in the BLM. Descriptive statistics for the independent variables AGE and TACTI are found in Table 38). Description and statistical significance of KMOTH is found in Table 36). Detailed BLM statistical results are found in Output 6.28, 6.29 and 6.30 (including the GENDER variables) in Appendix F.

Demographic variables include the age of each independent level participant subject in years (AGE). In the sample population, age ranges from 18 to 90 years old.

Age is expected to relate positively to animal husbandry (ANIM) based on correlation results between these two variables. During the fieldwork campaign it was only evident that older women performed in general more productive activities than younger ones, however, it was not clearly apparent the relationship between age and animal husbandry. Consequently, animal husbandry (ANIM) is also expected to be associated positively with the total number of land uses/productive activities/livelihoods (TACTI) practiced by women. The latter thanks to that in one hand ANIM is a (nonexclusive) women-akin activity; and on the other, a greater proportion of women perform higher number of land use types/productive activities/livelihoods than men as asserted above.

In addition, it is hypothesized that environmental knowledge on animal husbandry (ANIM) is commonly transferred to women through mothers (KMOTH), or alternatively, through other family members including grandmothers (KOTHE). This assertion comes from political ecology scholarly works that identifies a closer relation between women and animal husbandry in many cultures (Valdivia 2001, Sharp et al 2003).

Same as with the gathering land use type, the specified BLM for ANIM the probability modeled is ANIM=1 depicts non-conventional fit statistics and coefficients (Table 47), than the previously modeled land use types. Notwithstanding, the GENDER variables slightly improved the model fit statistics as well. This, yet again, may lead us to infer that the gender dimension of the animal husbandry land use type may not be as clearly defined using the current sample data as has been the case with above land use type BLMs. (Output 6.28, 6.29, and, 6.30 in Appendix F). Similarly, as shown in Table 47, the only difference between the Animal Husbandry BLM including GENDER1 and the specified BLM including GENDER0 is that the resulting coefficient of the gender variable is reversed (the sign of this coefficient is opposite); yet, all other statistical figures are the same.

BLMs of gender-neutral land (and water) use types

Land (and water) uses that are gender-neutral/inclusive comprise Agriculture (AGR), fishing in rivers (FSHRIV), and Cattle raising (CATT). This claim is based on gendered-land use dimensions verified during the fieldwork campaign and confirmed by statistical outcomes of correlation procedures summarized on Tables 36, 37, and 48. Based on the sample data of 134 records, the proportion of persons engaged in these land use types in comparison to other uses is showed in Figure 69. Please note that although a cumulative percentage of 134% is showed for this group of land uses, this number result of summing up persons who are concurrently practicing from one to three of the considered land use types.

Locally, agriculture is still by large the most commonly practiced land use type. As shown above, 84% of persons out of the 134-record sample population are engaged in agriculture (Figure 69), followed by river fishing and cattle raising (36% and 14% respectively in this group). The agriculture land use type (AGR) as a dependent variable, was regressed on fourteen to three independent variables in binary logit models (BLM) using the individual-level dataset of 134-records. The probability modeled was AGR=1. Best results were obtained with the explanatory variables: age of the subject (AGE), number of land uses/ livelihood activities performed by the subject (TACTI), and livelihood knowledge transferred by the subject's father (KFATH) regressed in the BLM. Descriptive statistics for AGE and TACTI are found in Table 38. Description and statistical significance of KFATH is found in Table 45. Detailed BLM statistical results are found in Output 6.31, 6.32 and 6.33 (including GENDER variables) in Appendix G.

Demographic variables include the age in years (AGE) of each participant subject/record. In the sample population, age ranges from 18 to 90 years old. Age is hypothesized to relate positively with agriculture (AGR) considering that after resettlement of locals from the rural to the village area younger population -and especially women- are increasingly more reluctant to continue cultivating. Indeed, many of the youngest research subjects shared comments such as: "the field is only for animals"; or "our grandparents spent all their lives doing agriculture, and now look, they have nothing." Elders, on the other side, are almost all engaged in agriculture and commonly retire from this practice only for health problems: "my husband and I have practiced agriculture all our lives… now, only me does, as my husband retired due to health problems… we are too old now." Hence, middle-age persons are somehow in between these two positions. On the other hand, correlation results between these two variables support this expectation. Similar to animal husbandry, agriculture (AGR) is also expected to be associated positively with the total number of land uses/productive activities/livelihoods (TACTI) practiced by locals. Finally, contrary to my expectations, data suggest that agricultural knowledge is transferred more often by fathers (KFATH) than by mothers (KMOTH) or other persons (KOTHE); thus, the question KFATH is expected to fit better into the agriculture BLM. In addition, educational level (EDU) is anticipated to have an inverse (negative) relationship with agriculture; however EDU's estimate/coefficient is not statistically significant when included in this BLM.

The specified BLM for agriculture (probability modeled being AGR=1) threw appropriate fit statistics and coefficients (Table 48). However, calculation of the above specified BLM including the GENDER questions (which was firsts hypothesized to improve the model fit statistics) worsen slightly the BLM statistics. Hitherto, this worsening effect when including the gender variables made me hypothesize that gender-neutral/inclusive land use models will not improve when including gender independent variables in their calculations. In effect, the new model fit statistics obtained using the variables GENDER1 and GENDER0 regressed in the agriculture BLM are consistent with this latter hypothesis (Output 6.32 and Output 6.33 in Appendix G). Yet, as shown in table 48, the only difference between BLM including GENDER1 and the specified BLM including GENDER0 is that the resulting coefficient of the gender variable are reversed (the signs of this coefficient are opposite); while all other statistical figures resemble.

The Fishing in rivers (FSHRIV) dependent variable was regressed on eleven to three independent variables in binary logit models (BLM) using the individual-level dataset of 134-records. The probability modeled is FSHRIV =1. Best results were obtained with the explanatory variables: hunting (HUNT), container gardening or *Azoteas* (AZO), collective lands (TTYPE1), and livelihood knowledge constructed by the subject itself (KTHEM) regressed in the BLM. Description and statistical significance of independent variables are found in Table 45. Detailed BLM statistical results are found in Output 6.34, 6.35 and 6.36 (including the GENDER variables) in Appendix G.

Pertinent land use (and water use) independent variables include hunting (HUNT) and container gardening (AZO). Fishing in rivers is at the base of the local subsistence economy. Indeed, settlement processes in the Pacific region have followed river courses as the preferred sites for establishing families and communities (West 1957, Oslender 2001, April-Gniset 2004). Thus, "fishing in rivers" (FSHRIV) is expected to take place almost in all rivers, and is hypothesized to relate positively both to women-akin and men-akin land uses. Within land use groups, hunting and gardening are the variables that best fitted the respective BLM. Land tenure variables include the collective-land tenure type (TTYPE1). Similar to the "gathering" BLM described above, it is expected that "fishing in rivers" be practiced both in own properties and in areas that are openly accessed, or where access is allowed. These latter areas may be located in the *respaldo,* or at sites with no 'private' property rights claims such as water bodies, and marginal land lots, which are referred commonly by locals as "collective lands" (TTYPE1).

In addition, it is hypothesized that environmental knowledge related to "river fishing" is transferred/acquired by all means possible (parents, family members, friends, by themselves). Yet, best BLM results were obtained with the KTHEM variable (KTHEM: knowledge acquired by themselves). During the fieldwork campaign I was able to test that this activity is learned in the early years by locals (both girls and boys). Children are often by themselves, and have to care for their own food in many occasions. For example, the day after a festivity (e.g. La virgin del Carmen) in the local area, all grown-ups were slept during the day: I found myself alone well until night among all the village's children, there were no place to buy any food, all commercial locals were closed, and children were actually climbing trees for coconuts and fishing in rivers, among many other subsistence strategies.

The specified BLM for fishing in rivers (the probability modeled being FSHRIV=1) threw appropriate fit statistics and coefficients (Table 48). However, once the GENDER variables were added to the above referred individual-level variables, the model fit statistics worsen. More so, coefficients of the respective gender variable showed no statistical significance within the BLM. For gender-neutral/inclusive land (water) use types, it is hypothesized that adding gender variables (i.e. GENDER1 and GENDER0) have no effect or worsen the specified BLM results. In effect, the new model fit statistics obtained using the variables GENDER1 and GENDER0 regressed in the river fishing BLM are consistent with this anticipation (Output 6.34, 6.35 and 6.36 in Appendix G).

Finally, only 19 persons or 14% of the sample population practice Cattle raising (CATT). The Cattle raising (CATT) dependent variable was regressed on nine to two independent variables in binary logit models (BLM) using the individual-level dataset of 134-records. However, best results were obtained with only two explanatory variables: AGE, and TTYPE6 (land acquired by the subject by means of purchase). The demographic variable AGE is described above. Description and statistical significance of pertinent variables are found in Table 48. Detailed BLM statistical results are found in Outputs 6.37, 6.38 and 6.39 (including the GENDER variables) in Appendix G, and in table 48).

Perhaps due to the fewer number of persons practicing cattle raising in the sample population, and that this activity is also relatively novel and not yet widely practiced in the study area, only the above two variables have statistically significant relationships with CATT among the remainder questions considered. Based on participatory observation and unstructured interviews with open ended questions conducted during fieldwork, cattle raising is a process with very particular drivers. With the exception of one case (a local man introducing cattle heads some 30 years ago), cattle raising was led by one external man who purchased land lots from locals to that end. Once this land use type was established, the foreigner disappeared almost 20 years ago. Locals waited, but the man never returned to the study area. Thus, only since around one decade ago, locals have possessed some of this man's lands for cattle raising purposes too. Recently as well, more afro-descendants have changed their land use from agriculture to cattle raising, particularly at management zone #1 (Nimiqui), also evident with the aid of exploratory statistics of secondary data described in earlier parts of this chapter. Cattle raising, is thus, expected to be associated positively with age (but information on the land lots' age is not available in the sample data) and the 'land purchase' mechanism of access. The latter hypothesis was raised during the field campaign, but direct statistical interrelations between these two variables and CATT support as well the above assertions. Consequently, the specified BLM for cattle raising must be considered preliminary (the probability modeled is CATT=1). Its fit statistics and coefficients are shown in Table 36. Yet, same as with the previous gender-neutral/inclusive land use models, adding gender variables to its specification (i.e. GENDER1 and GENDER0) not only worsen the BLM results, but coefficients of the respective gender variables depict no statistical significance within this BLM.

Multinomial Logit Models

Once the marginal significance of each independent variable was established on its own as described in the previous subsections, multinomial logistic regression (MLR) models were fitted to each dependent variable to determine which independent variables influence the characterization of gendered land-use/tenure after controlling for, or conditional on, the influence of other independent variables. MLR is an appropriate method for dependent variables having multiple unordered categories (King and Peralvo 2010). For a dependent variable y with various alternatives and the utility associated with the jth alternative is $Uj = uj + \varepsilon j = 0, 1, 2, \ldots j$, where uj is a nonstochastic function of the explanatory variables and unknown parameters and εj is an unobservable random variable then the probability of y choosing the first alternative Pr ($y = 1|X=x$), is e^{uj} divided by $e^{u1} + e^{u2} + e^{3} \ldots + e^{uj}$ (Horowitz and Savin 2001). For a dependent variable y with J categories, $Pi1$, $Pi2$, …, PiJ represent the probability that the ith respondent falls into particular categories of y, given a vector of measured characteristics of the respondent (xi); In general, the response probability Pij can be modeled as (Powers and Xie 2000 in King and Peralvo 2010):

$$Pij = \Pr(yi = j|xi) = \frac{\exp(x'i\,\beta j)}{1+\sum_{j=2}^{j}\exp(x'i\,\beta j)}, \text{ for } j>1 \qquad (5.12)$$

with the normalization that β1=0 and the requirement that

$$1+\sum_{J=2}^{j}\exp(x'i\,\beta j) = 1 \quad \text{for any } I \qquad (5.13)$$

For the normalized model, the odds ratio between categories j and 1 for a given i are:

$$\frac{Pij}{Pi1} = \Pr(yi = j|xi) = \exp(x'i\,\beta j) \quad j=2,\ldots, J \qquad (5.14)$$

In the multinomial version of the logit model (MLM) the probabilities have simple closed-form expressions, however, one danger of using this model is that it can produce misleading inferences when some of the alternatives are close substitutes because the model specification imposes the restriction that the odds or ratios of the probabilities of choosing the jth alternative over the ith depend only on the characteristics of those two alternatives (Horowitz and Savin 2001).

In order to add more demanding quantitative assessment this multinomial logit model (MLM) focused on evaluating the relationships between different land-use/livelihoods and assets to characterize a gendered land-use/ownership in *EL Cedro*. Two dependent variables were chosen to understand the types of land uses and assets that characterize a farm owned and used by women and a farm own and used by men. These variables result from the same sample survey used for the above logit models (n=151 including landless persons), and particularly from the questions that asked respondents "which types of uses they provide to their lands", and "what financial, physical, human, and social assets they have". As there are various independent variables to choose, 28 were selected and distributed into four groups: "land-use/livelihoods", "demographic factors", "financial and physical assets", and "human assets". Table 49 outlines the independent and dependent variables analyzed in the MLMs. Statistical tests of the association and significance between the independent variables and each of the dependent variables were discussed in length in the previous subsections. Binary logistic regressions described in the latter subsection allowed selecting alternatives that are not close substitutes to avoid misleading inferences; these also allows to conduct a more informed assessment on the validity of MLMs.

Based on these previous steps, multinomial logistic regression (MLR) models were fitted to each dependent variable to determine which independent variables influenced the characterization of gendered land-use/ownership after controlling for, or conditional on, the influence of other independent variables. For each dependent variable, the independent variables with a high to moderate degree of association (p-value $\leq$0.075) were selected for the MLR models (pertinent previous tables). This level of significance was used to avoid excluding variables that may be weakly associated with the dependent variables on their own, but that could become influential in the presence of other independent factors. These terms were added to the models and a likelihood ratio test was used to evaluate if they make a significant contribution to the explanation of the dependent variables. All the analyses were run using SAS version 9.2. The SAS code used to estimate the MLMs is as follows:

```
PROC CATMOD DATA = mlogit;
DIRECT variable1 variable2 variable3…..;
RESPONSE LOGITS;
MODEL dependent variable = variable1 variable2 variable3…..;
RUN;
```

Table 49 shows the independent “land-use/ livelihood” variables associated with the first dependent variable, which assessed if a farm is owned and used by women. In this case the response “3” was the baseline and the “landless” or response “2” was included in the table to reinforce the data analysis. The same procedure and independent variables were used to model if a farm is owned and used by men (statistical results are equal but with reversed signs). Table 49 also shows the independent “demographic and assets” variables associated with the first dependent variable, which assessed if a farm is owned and used by women. Same as with the previous models, the response “3” was the baseline and the “landless” or response “2” was included in the table to reinforce the data analysis. The same process and independent variables were used to model if a farm is owned and used by men (figures fairly similar but with reversed signs). Figures from these two MLMs in evaluating perceptions of land use are summarized in tables 50 and 51.

Resulting figures of the above MLMs on Gendered Land use/Livelihood independent variables (Table 50) reassert some but not all of the statistical findings described above. Is worth noting, that only two (not three as with Pearson’s correlation coefficients) women-akin land uses as are gardening (AZO) and animal husbandry

(ANIM) are statistically significant and thus explaining whether a farm is owned/used by women (collection/gathering COLLE is not statistically significant). Likewise, only two of the men-akin land uses are statistically significant (i.e. Logging LOGG and Ocean fishing FSHOCE) and therefore explaining if a farm is owned/used by men (the parameters for hunting HUNT were regarded to be infinite). Conversely, all three of the gender-neutral/inclusive land uses (i.e. cattle raising CATT, agriculture AGR, and river-fishing FSHRIV) are not statistically significant, thus do not allow explaining the gender of the landholder of a given farm in the El Cedro, which is consistent with previous findings.

On the other hand, results related to other independent variables considered in these MLMs grouped as Demographic Factors, Financial and Physical Assets, and Human Assets (listed in Table 49) are depicted in Table 51. From these is worth noting that of the Demographic factors of age (AGECO2), and the total number of children (CHILDT) are statistically significant as to explaining the gender of the landholder/uses. Indeed, both of these independent variables have direct (positive) relationships with women landholders/users, whilst they are inversely (negatively) correlate with men land tenants/users, suggesting these may explain the gender of the owner/user of a farm.

Regarding the independent variables on the Financial and Physical Assets, only the variables related to tenure type (inheritance/donation TTYP3), land area (LAREACO), fixed income (INFIX), and expenses (EXPENCO2), are statistically significant and thus explaining the gender of the landholder/user. While TTYP3, and INFIX are directly (positively) correlated and thus explaining women landholders/users, the farm area or extension (LAREACO) and the amount of monthly expenses

(EXPENCO2) have a direct (positive) relationship for explaining whether a farm is owned/used by men. These results are consistent with previous findings.

Finally, independent variables grouped under Human Assets, that are statistically significant and thus explaining the gender of the Land tenant/user include: the place where de subject were born (BORN), and the livelihood-knowledge transfer by mothers (KMOTH), or acquired by the subjects themselves (KTHEM). The place where the subjects were born is directly (positively) correlated and thus explaining if a farmlandholder/user are men. Whilst, the livelihood-knowledge transfer by mothers(KMOTH) is directly related and thus explaining whether a farm may be owned/used by women; in contrast, the variable of knowledge acquired by the subject itself (KTHEM) is positively related and thus explaining that a farm may be owned/used by men.

The above results of MLMs reassert statistical significance of explanatory variables that may characterize a farm according to the gender of the landholder/user/manager. But in addition, these allowed to bring to light other independent/explanatory variables such as the farm area or extension (LAREACO), the place where de subject were born (BORN), that were not clearly related with appropriate statistical significance in the above exercises, as to clearly explaining gender dimensions of land use and cover. Consequently we may suggest that different statistical approaches as those of the Pearson's correlation coefficients, Binary Logit Models (BLMs), and Multinomial Logit Models (MLMs), may be incorporated as to obtain more sound and complementary explanations of the gendered dimensions of land use and land cover change (GLULC) assessments.

FINAL REMARKS

Integration of both theoretical frameworks of gendered resource access and LULCC plus qualitative research results with the statistical analyses herein (including regression models), are sought to provide broader insights for understanding and assessing gendered land use and cover more general. These results in turn, may add to scholarly works that allow comparative analysis of geographic areas with similar traits in the Americas and worldwide.

Statistical results on gendered land use/cover drivers were based on both primary and raw secondary datasets on socioeconomic, demographic, environmental and particularly, livelihoods and land use/cover questions at the local study area. Primary 'data' were gathered by conducting structured interviews during my dissertation fieldwork campaign. Data models based on this primary data were also described. Gendered land tenure and land use questions were chosen as dependent variables, whilst some biophysical, cultural, and socio-economic questions were used as explanatory variables in these models' design.

Excerpts of the above results suggest that women access to land is mainly by inheritance, and less commonly by purchasing or working (the latter particularly relevant during the last one to two decades). In contrast, men may practice more often other mechanisms of access to land property including purchases, working the land, possession or custody of land. This propose a much more restricted mechanisms of access to land by women than by men, where traditional customary laws of land inheritance may benefit women access to land more general.

Since agriculture is the predominant use of the total number of farms, the direct and nearly perfect correlation between farms used in agriculture and the farms owned by men is certainly resulting from the fact that this cohort currently owns the majority of properties.

Respaldo has a gendered-differential use: women land-managers apparently prefer to save Respaldo without use -and when they manage more than one farm they allow its use for logging and/or hunting-, while men managers more commonly consent their use by family members;

Correlations between the oldness of farms under usage and other variables, evidenced that farms of more than 46/50 years of use have a direct and very strong correlation with women who manage more than one farm whereas those farms of 11 or less years under use are directly and very strongly correlated to men that own/manage more than one farm. This is signifying a change on land management throughout time: saliently with more women land managers in older periods and much more men land managers in the recent one to two decades. In the midst of these two periods the relations with farms that are from 23 to 35 years under usage merit attention: the percentage of these farms has a negative although weak relation with women who have more than one farm, whilst it has also an inverse but very strong relationship with men who own/manage at least one farm. An interesting finding is the positive or negative spike found in many of the statistical analyses for the period between 23 to 35 years ago when these gendered land management were in full swing of being reversed/inverted due to the women's relocation movement of 30 to 40 years ago described in chapters 1 and 6.

Quantitative analyses confirmed, reassert or highlighted (new) gender dimensions of land use and land cover change in the El Cedro.

Particularly, appropriate significance levels and respective correlation coefficients of pairwise statistical relationships between the variables on GENDER and the remainder questions, were obtained with the Frequency and Pearson's Correlation procedures. Of these results is worth noting the inverse/negative (-) and direct/positive (+) signs of these numbers' relationships between the above variables. Indeed, these correlation figures and signs highlighted gender dimensions to specific land uses, which were also evident during fieldwork: Women-akin land uses (gardening, gathering, and animal husbandry); Men-making land uses (logging, hunting, Ocean-fishing), and Gender-neutral/inclusive land uses (agriculture, cattle raising, and river-fishing).

As shown above, land and water uses that are equally practiced by men or women, do not show statistically significant relationships with any of the GENDER variables and thus, these seem to be neutral-to-gender (gendered inclusive). In contrast, relationships between the GENDER variables and the remainder considered questions with relevant significance levels are showing a gendered dimension or preference. Based on the latter, it was inferred that women and men land and water use preferences are mirrored in the above statistical figures' signs and confidence levels. Hence, it may also be assumed that relationships between the GENDER variables and those of land (and water) use types with irrelevant significance levels are showing land (and water) use types that are gender-neutral or inclusive.

On the other hand, Binary Logit Models (BLM) for particular land (and water) uses, namely Hunting, Logging, Fishing, Container Gardening, Collection of fuel fodder/seeds/plant products, Animal husbandry, Agriculture, and Cattle raising, were regressed on varying number of independent variables. Subsequently, the independent GENDER variables were included and regressed together with the previous explanatory variables in all best specified BLMs, with the aim of testing if the models improved or worsen with the inclusion of the gender variables. This was done as one suggested method for identifying/ acknowledging gender dimensions in land use and land cover assessments. In effect all gendered land-use models improved when including the variable GENDER, whilst those gender-neutral/inclusive land use models worsen by the inclusion of a GENDER variable within.

In addition, once the marginal significance of each independent variable was established on its own, multinomial logistic regression (MLR) models were fitted to each dependent variable to determine which independent variables influence the characterization of gendered land-use/tenure after controlling for, or conditional on, the influence of other independent variables. The above results of MLMs reassert statistical significance of explanatory variables that may characterize a farm according to the gender of the landholder/user/manager. But in addition, these allowed to bring to light other independent/explanatory variables such as the farm area or extension (LAREACO), and the place where de subject were born (BORN), that were not clearly related with appropriate statistical significance in the above exercises, as to clearly explaining gender dimensions of land use and cover. Consequently, we may suggest that different statistical approaches as those of Pearson's correlation coefficients, Binary Logit Models (BLMs), and Multinomial Logit Models (MLMs), may be jointly conducted for more sound and complementary explanations of the gendered dimensions of land use and land cover change (GLULC).

Running the above BLM models using n=134 in which the dichotomous variables' records are complete gave exact results for both of the considered gendered dichotomous dependent variables although the intercept and coefficient signs were reversed. This means that no matter what explanatory variables are used to model the probability of Y_i=1, the gendered dependent dichotomous variable, the BLM statistical results will have the same figures with inverse signs for Y_i=0. Therefore, hypotheses behind the BLMs are what make them more sounding.

Therefore, it may be inferred that women and men land and water use preferences are mirrored in the above statistical figures' signs and confidence levels. Hence, it may also be assumed that relationships between the GENDER variables and those of Land (and water) Use Types with irrelevant significance levels are showing Land (and water) Use Types that are gender neutral/inclusive.

Notwithstanding, the above proposed Binary and Multinomial Logit models assessing GLULCC could not yet be considered structural. Due to that coefficients and significance levels depend on the sample, the explanatory variables chosen, situated knowledge, and the researcher stand point, among other considerations, more research including different geographic locations and communities, besides larger survey samples are needed to reassert and contribute to the above findings. More so, innovative questions pertinent to myriad other research interest may allow the better understanding of GLULCC in countries with similar traits and worldwide as to empowering women based on better informed land use planning, policy and decision making.

Chapter 6: Re-placing gendered Colombian spaces

"Narrative succeeds to the extent that it hides the discontinuities, ellipses, and contradictory experiences that would undermine the intended meaning of its story." (Cronon, 1992: 1349-50)

This chapter brings a narrative perspective of gendered land use and land cover change GLULCC as a contribution to work streaming/ mainstreaming what I consider could be a scholarly-fertile research line. It is supported by the map of the El Cedro produced by locals (Figure 70) as well as on findings of my research campaign that took place on 2006-2007 more general. It hopes to bond, with another perspective, previous theoretical, spatial and quantitative outcomes, under the lenses of the practical experience of fieldwork that also by way of participatory observation and semi-unstructured interviews brought to the researcher (me) valuable insights and information besides the previous outcomes. A preliminary access map (conceptually constructed) based on these narratives and on elements that endorse mainstreaming the gender dimensions of land use science (GLUSc) is also provided. This section may serve both as reflection and as a concluding contribution to furthering research in gendered land use and land cover change globally.

GENDERED SPACES AND USES

Today the territory of El Cedro (El Valle) (Figure 70) may be broadly subdivided into four main or primary land use (and land cover) types openly differentiated and recognized by the community, namely, *Monte* (*bravo* and *viche*), *Respaldo, Rastrojo* and the El Valle village. *Monte* is often part, or all, of the *respaldo.* The portion of *fincas* (farms) that are marginal (Doolittle 1988) because of the difficulty to access them, their lower quality of soils, or their higher costs of production more general are named *respaldo*; alternatively, these lands are reserved for both logging and hunting activities and for inheritance purposes more general. Thus, *Respaldo* may overlap or correspond completely with those lands that are identified as *Monte* bravo or *Monte viche*. Hitherto, *Respaldo* are considered integral part of *fincas* and therefore hold customary (or legal) property rights. Yet, the ways in which the *Respaldo* is used, are normally the result of verbal agreements on who could use these lands and for which purposes (e.g. family, neighbors, community; for logging, hunting, or gathering). The above renders the classification process problematic considering that added uses (significances) diverging from land use and land cover properly (including those related to tenure and nuances of use conditions, or that are symbolic) may be also important for thorough local classification schemes (Table 52).

Main land use categories in the El Cedro are described below, and further compared with the Anderson et al. (1976) hierarchical "resource oriented" Land Use and Land Cover Classification System for Use with Remote Sensor Data, in land use planning and management activities. Notwithstanding that this classification was developed to meet the needs of Federal and State agencies in the US.

Monte

Monte is the name given by locals to the 'rural', 'natural' or 'semi-natural' land use and land cover where they develop productive practices such as logging, hunting, gathering, and to a lesser extent, agriculture. Yet, there is a distinct subdivision of this land type according both to the intensity and age under use, and to the state of conservation of the *Monte* itself. This allows locals to further subdividing the *Monte* into

Monte bravo, and *Monte Viche* (Figure 71). Widely, *Monte bravo* resembles a primary forest (in this case tropical rain forest), which uses range from not intensive logging and hunting to gathering and the more symbolic uses. In contrast, *Monte Viche* (Figure 72) may correspond to secondary forest or intervened forest, which uses commonly include those of *Monte bravo* plus agriculture, and animal breading (to a lesser extent). The *Monte Viche* is used more intensively and often for longer periods that *Monte bravo*. Although these classifications are widely used in the Colombian Pacific region, nuances of the *Monte* are encroached inside local perceptions and believes. It is unclear how perceptions of younger generations towards land and its uses will contunue endosing current classifications. Shifting values towards land may result into fluctuating customary laws throughout time.

Monte bravo

Monte bravo is approximately corresponding to primary forest (Forest Land) with different levels of fragmentation, and relatively less fertile soils. It currently comprises areas used for logging, hunting, and for collection of fodder woods, seeds, and medicinal plants or handcraft materials. Besides the above descriptions on the main classification levels of the *Monte*, there are also gender dimension to those spaces. *Monte bravo* are relatively used by men in a much greater proportion than by women. This may be in part due to the larger distances to this type of Monte from the local settlements and individual houses, that in Afro-Colombian communities it is believed that "monte is not for women" (Friedemann in Camacho 1999), the higher difficulty of bringing children safely to those spaces, and the specific types of land uses described above, especially logging and hunting, that are more akin to men than to women more general. It is extremely rare to find women involved in hunting or logging unless it is on the commercial side of these activities as intermediaries. Locally (during my fieldwork research) there was only one women intermediary of timber in El Cedro. *Monte bravo* is commonly located on denudational hills at relatively higher elevations.

In the last 40 years logging has increased in the local region (Leal and Restrepo 2003) making timber a preferred income source of men, and indirectly, of the Local Community Council (LCC). Indeed, logging has been ultimately encouraged by the LCC El Cedro that currently charges 3% out of the commercial price of the sawmill timber making this one of the few income sources of this institution. However, timber accounting is inexistent, imprecise at the most, as loggers often do not disclose the complete information of their activities.

If we were to use the Anderson et al. (1976) hierarchical "resource oriented" classification system, this land use type (and *Monte* more specifically) would be among the easier to classify. In this classification system *Monte Bravo* will be simply a Forest Land at the first level of the system (see maps in Chapter 4). Tree-crown areal density of *Monte bravo* is at least 10 percent that also allows categorizing it as Forest Land by the Anderson et al. (1976) classification system. However, at the system's second level category Tropical Rain Forest is not included. In Anderson's, this category is divided instead into Deciduous, Evergreen and Mixed Forest Land. From the latter, the Evergreen Forest Land is the more similar category to *Monte Bravo* considering that tropical hardwoods are included. Still, since those species that are associated with Wetland are not included within this category, straightforward categorization under Anderson's scheme could be problematic for this Colombian region. The *Monte Bravo* on Wetland (particularly areas that are at lower altitudes) might belong into other category such as Forested Wetland.

Monte viche

This land use type may correspond to a secondary or more intervened forest (see maps in Chapter 4), which land uses commonly include those of *Monte Bravo* plus agriculture, and animal breading (to a lesser extent). Some of these areas may have been used as part of slash and mulch shifting cultivation practices. Hunting and logging are main uses of these lands. Pig hordes that roam largely in *Rastrojo* may also use these lands for feeding. These *montes* are commonly located on hill slopes and are used both by men and women. Collection of fuel wood and gathering of seeds, medicinal plants and other plant products for handcrafts are mainly women activities inside these lands. *Monte Viche* is also the resort for new family members who may clear this forests and bushes to establish agricultural uses. The *Monte Viche* may have grown in fallow areas, thus, some could be considered as frontier agricultural areas. It is common to find trees which canopy range from 3 to 20 meters, assorted with bushes and low understory plants. Palms and fruit trees are as well common in these lands (see Figure 71 and 72).

Under the Anderson et al. (1976) classification system *Monte Viche* could be categorized into Forest Land and Evergreen Forest land (in Chapter 4 is classified as Secondary Forest Land) at Levels I and II respectively. Considering that these are forests "on which there are rotation cycles of clear cutting… the dominant cover is forest and the dominant activities are forest related". Similar to *Monte bravo, Monte Viche* tree-crown areal density is at least 10 percent that allow categorizing it as Forest Land by the Anderson et al. (1976) classification system. Yet, same as with *Monte bravo* some areas of these lands may fit better into the Forested Wetland category. More so, considering that "shallow water areas where aquatic vegetation is submerged are classed as open water and are not included in the Wetland category", their identification in the study area might need more detailed/ large scale/ resolution of sensor data.

Respaldo

The term *Respaldo* is often understood by the community as a 'collective land' but with a meaning different to that coined by law 70 referring to the collective lands that may be legally titled to afro-Colombian communities. Thus, *Respaldo* may often localize at denudational landforms and hill slopes. To be sure, this category refers to lands inside the family property that should only be used following predefined-by-the-owner rules that include at least who may use them and for what purpose in a given time period (see Figure 73).

As described above, this land use and land cover category may be considered as *Monte viche* and *Monte bravo*. Within the El Cedro collective title boundaries, however, not all *Monte Bravo* and *Monte Viche* are inside the *Respaldo* and may be located outside of what locals call their 'private property'. Likewise, not all *Monte Viche* is found inside the *Respaldo,* it may be found close to *Rastrojo* or *Potrero* (description below).

Based on the above, *Respaldo* is used by men in a greater proportion. Women uses of those spaces may include the collection and gathering of fodder and fuel wood, medicinal plants, seeds and plant products for handcrafts. Frequency of use of these women spaces may be directly correlated, however, to the distance from their houses to those spaces. Shorter distance from houses to *Respaldo* will increase its frequency of use, whereas spaces located at longer distances will have a lesser regularity of use.

Under the Anderson et al. (1976) classification scheme *Respaldo,* which belong to an ownership classification, could consequently be placed in a category at the more detailed level, namely Level III. Although for local afro-descendants *Respaldo* seem to belong to a Level I category, inside this classification scheme it will be degraded to lower Levels. Considering that "ownership classification (is) not detectable using remote sensor data… (this will be treated as an)…auxiliary concept associated with Forest Land… when supplemental information is available" (p.27).

Rastrojo

The agricultural land is called *Rastrojo,* which may comprise other land uses such as *Potrero* (pasture) and *Azoteas* (container gardening). *Rastrojo* are the most valued and best situated lands of the community. *Rastrojo* are used by women and men as cropland but each *finca* (farm) is further subdivided into a varying number of small plots allocated to different family members. These distributions are responsibility of the eldest family member be that a woman or a men. *Rastrojo* are found at alluvial plains of the El Valle (main river) and its tributaries (i.e. Angia, Tundo, Boroboro, Boroborito, Nimiquia); on two beach ridges to the north and south of the El Valle River; and on the Ciudad Mutis (also named Bahía Solano)-El Valle road corridor (on denudational hills and alluvial plains). Patterns of usage change on a seasonal basis. Subsistence farming is still the most important livelihood of the population, as was also endorsed in Chapter 5.

Rastrojo on alluvial plains (see Figure 74) are the oldest on agricultural production (perhaps with the exception of those located at the Nimiquia Zone). *Fincas* are often cultivated for about six years and then abandoned to fallow; but alternatively they are cultivated every other year if planted in maize or sweet manioc. Most common agricultural practice is the slash and mulch shifting cultivation, with use of precarious tools (digging stick, machete, axe), and very few to inexistent fertilizers or agrochemicals (prays for eradicating or preventing plagues are still very common). Unless natural levees are being cut by rivers (see Figure 75), food crops are often hidden by other vegetation including weeds and tress of less value located to the outermost part of the levee (to the river). The same is true for most appreciated fruits inside *Rastrojo,* such as pineapple, which are frequently hidden on purpose by a careful arrangement of weeds that may prevent their easy sight. These vegetation arrangements make remind the forest islands around villages that were found in Africa by Fairhead and Leach (1996). I suggest the practice of these settings may be an African costume that has remained throughout historical periods.

A variety of food crops both permanent and transitory are found in *Rastrojo*. While natural levees hold more diverse food crops, poor drainage back swamps are often grown only with rice, and plantains. *Fincas* (farms) in *Rastrojo* depict an apparent disorganized setting of perennial and transitory crops, palm and fruit trees, timber trees, and medicinal plants. These are arranged in small surface extensions that may vary from few to dozens of square meters. *Rastrojo* are also a place for other symbolic practices (such as the burial of family newborn belly buttons). Besides, is worth noting that physical boundaries of *fincas* (within *Rastrojo*) are only distinguished by their owners who use natural and symbolic landmarks for bounding their family properties.

Boom and bust cycles of rubber, rice, maize, sugar cane, ivory nut, coconut, and plantain, have played key roles in the community's economy throughout decades. Other main crops are achin, manioc, and fruit trees. Representative fruits include borojo, pineapple, avocado, guayaba, papaya, anon, cocoa, and guanabana. Relevant palm and fruit trees such as chontaduro, coconut, jicara, achiote, totumo, and ivory nut that are often found in *Rastrojo* may also be found at *Monte Viche*. Production decrease or fading of many food crops (such as maize, rice, sugar cane, and cacao) throughout the last few decades may be broadly explained by the decreasing number or inexistence of seeds, and by changes in perceptions and believes, gender relations and sub-regional markets.

On the other hand, animal husbandry has been conducted historically inside *Rastrojo*. One of old world animals domesticated more quickly by Indigenous communities was the pig which used to roam in *rastrojo* near inter harvest periods hence playing key ecological functions (West 1957). Traditional pig horde practices have almost disappeared in the El Cedro while few animals are now maintained in corrals within houses in the El Valle village (see Figure 78). Other corral animals in *Rastrojo* include chicken and ducks.

Rastrojo in beach ridges (see Figures 76 and 77) are similar to those located in alluvial plains, but are less varied. For instance, manioc and coconut palms are the most abundant products, while the above fruit trees are scarcer. Cultivated beach ridges located to the South of the El Valle River are mostly used and owed by local people (with the exception of a walking path that connects the El Valle village with the Utria National Natural Park named *Sendero Utria* where lands of few persons from the interior of the country are found. In contrast, beach ridges located to the north are now typically owned by people from the interior of the country that use these for recreational and tourism purposes; here, cultivation is now critically decreased to inexistent, a process which have taken place particularly during the last few decades.

Using the Anderson et al. (1976) classification system, *Rastrojo* may be compared to its First Level Agricultural Land category; and further to its second Levels of 1)

Cropland and Pasture, and 2) Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas. The above Pastures broadly correspond to *Potrero* lands in the El Cedro, and the Orchards and other Areas roughly parallel the *Azoteas* (gardening). Still, the fact that *Rastrojo* may often contain tree-canopy of more than ten percent, an uninformed classification may situate some of these lands into the Forest Land category (i.e. using remote sensor data and the Anderson's scheme). Hence, a more accurate categorization would require 'supplemental information' and 'auxiliary concepts'. To be sure, the agricultural activity described in Anderson et al. (1976) as 'distinctive geometric field and road patterns' are not as clearly evident in the El Cedro.

On the other hand, transition zones with *Monte Viche* and Wetlands are most common to these lands. However, considering the definition of Anderson's Wetlands as "areas where the water table is at, near, or above the land surface for a significant part of most years", precipitation regimes in the El Cedro (amongst highest in the world) could render problematic using mainstream classification schemes of Land Use and Land Cover. Although no detailed maps of the groundwater and water table were found for the study area, handmade canals for drainage purposes commonly found in El Cedro allow to infer that water table is at least near (if not over) the land surface for most of the year. More so, same as with the *Monte* lands, minor shallow water areas that need more detailed/ large scale/ resolution of sensor data to be identified might not fit properly into the Wetland but to the Open Water category instead.

Currently, many of the *Rastrojo* areas (see its description below) are facing natural conversion processes towards secondary forests, as a consequence of both agricultural frontier and livestock breeding contractions.

Azoteas

These land use is a women only activity that is found throughout the entire Pacific region (see Figures 78 and 79). There may be slightly different characteristics at the local level, but commonly, *Azoteas* have the same social and ecological functions regionally. These are container gardening that are elevated 1 to 1.5 meters above the ground due to the high rainfall regimes found in the region that prevent soils to be dry and fertile enough to hold perennial or transitory vegetation. Containers or vessels vary widely, from a bucket to a wood mat, or a small wooden boat. The latter, in my view, is the most interesting container shape that could translate into ecological, historical-cultural meanings yet to be uncovered. *Azoteas* are grown normally using a special soil that contains *tierra de hormigas* (a kind of soil produced by ants at their breeding sites), and *hojarasca* (leaves and wood sticks brought mainly from beaches).

Azoteas hold many historical and cultural signifiers for the black communities, particularly for women (Leyton et al 2001, Mena et al 2001, Camacho 2001). They are the places where basic food crops are grown; a handy source of cash money; vessels of both edible and medicinal plants, and timber trees seedlings; a place where the family newborn belly buttons may be safely kept before finding a definite place for these remains; a bond to the land and the community's identity.

However, the *Azoteas* extension and function may differ according to their location (e.g. rural areas *versus* the El Valle village), and the age of its grower or steward. *Azoteas* in rural areas generally are more extensive and hold additional diverse functions than those inside houses at the El Valle village. Likewise, those pertaining to women of around 45 years old and above may be more elaborate and diverse than those of younger women. There is evidence that *Azoteas* (at least in the Pacific region), are not only central to women in urban areas. Instead, *Azoteas* are encroached inside the communities' cultural identity, and thus are found both in rural and urban areas (see Figures 78 and 79). Nowadays with aid of the NGOs and international and national cooperation, the community is also keeping greenhouses and seedlings aimed at reforesting many of the timber species that are becoming increasingly scarce.

In the Anderson's classification system *Azoteas* may resemble the category of Agricultural Lands / Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural areas, at the system's first and second Levels respectively. Yet, inside this broad Level II category, *Azoteas* are often more analogous to Nurseries, and Ornamental Horticultural areas, notwithstanding they hold the other functions and symbolic practices described above. *Azoteas* may differ substantially from similar categories in the Anderson et al. (1976) classification system in that they 1) are above the ground, 2) are contained in vessels, 3) are found both in Agricultural Lands and Urban and Built-up areas; and 4) may encompass more varied material and symbolic functions.

Potreros

Although located in areas surrounded or inside *Rastrojo* is worth giving *Potrero* an independent category. First, it resembles what is known as Pasture in Anderson's (1976) classification scheme (which makes these easier to compare). And second *potreros* are used for cattle raising, an economic activity that diverges from the more traditional uses of land by local communities. *Potreros* are predominantly men spaces with very few exceptions. During my fieldwork research there was only one woman involved in this activity, although she was conducting business together with three more brothers.

These land use type, although still incipient in the study area (but apparently expanding), is now embedded inside most of the *Rastrojo* (i.e. alluvial plains of main and secondary rives, beach ridges, and at the road corridor connecting the El Cedro with Ciudad Mutis/Bahia Solano) (see figures 80, 81, and 82). By the *Sendero Utria* (on the southern beach ridges) many lots were bought and cleared by persons from the interior of the country aimed at establishing *Potrero* for cattle raising. Preferred cattle breed is "cebu" (in Colombia this breed is appropriate for altitudes below 1000 meters and temperatures between 23 and 32 degrees Celsius that commonly include mixed Brahman, Gyr, and Guzera breeds. Source: http://asocebu.com/Inicio/Comunidad/Razas.aspx last accessed on May 18, 2011). Clearing for cattle raising purposes began around the 1970s and is increasingly growing.

At Levels I and II of Anderson's classification system, in the El Cedro the distinction of Pasture from the Shrub-Brushland Rangeland category, and from the Forest Land category require auxiliary concepts and supplemental information. Many of the pastures (here considered as *Potrero*) that were abandoned to Rangelands and *Monte Viche* categories during my fieldwork campaign were owned by persons from the interior of the country who passed away (according to research subjects) and thus, never came back. After many years, due to the local population's respect and fear to the previous owners, only few of those pastures are now again in use for grazing activities, but most have been left to Rangelands or *Monte Viche* (Forest Land). On the other hand, it is also common that *Potrero* have at least ten percent or more of tree-canopy cover, which may result in misinterpretation of this lands when using remote sensor data alone. At level II these *Potrero* may comprise few corrals and beef-cattle feeding lots. Hog feedlots are inexistent at the agricultural areas as pigs customarily may roam throughout the *fincas* that have no fences. More so, roaming of hog hordes are accepted and welcome. Thus, the Anderson's Level II category of Other Agricultural Lands may also fit the *Potrero* considering that these are "holding areas for livestock such as corrals, breeding facilities…" (p. 25).

The Village

The El Valle Village was established during the last 70 to 80 years, as described in the study area chapter. Aerial photographs of this village allow identifying its growing trends. Under the Anderson's classification system Level I, this small town may be classified as Urban or Built-Up Land. Like agricultural patterns in the El Cedro, the intermingling of commercial and residential areas may result in a challenging classification into Level II categories without 'auxiliary concepts' and 'supplemental data'. Thus the village may resemble the Residential category at Level II of Urban or Built-up uses (see Figure 83, 84, 85, and 86).

On the other hand, hogs are also maintained in corrals in urban areas (the villages), but in the Anderson's classification scheme, pigs /hogs, as well as chicken and ducks are categorized as Agricultural Lands/ Confined feeding operations. In the El Cedro, families have brought their animals and confined them in corrals at their own houses, including few pigs, chicken and ducks (see Figure 78). Houses may be classified inside the Residential Level II category. However, villages of developed and developing countries often have large land use differences. Commercial and industrial uses are commonly found in Urban and Built-Up Areas of developed countries. In contrast, in more rural spaces of developing countries it is common to find horticultural areas (such as *Azoteas*) and animals in corrals or backyards inside houses (as is the case in the El Valle).

Additional Characteristics and Dynamics of GLUCC

In addition to the above, other environmental and social characteristics of lands make them to be differentially preferred by men or women. These include key features such as physiography (geomorphology/ landforms) where elevation (altitude) and soils are relevant (men are more keen to use lands at higher elevations than do women); the distance to settlements, rivers, beaches or roads (distance from these landmarks limit men less than women for working or possessing land); the age of lands under production or socialized by local settlers themselves (women landholders seem to have more than one farm when these have more years under production).

The more recent colonization processes by people from the interior of the country who are culturally different to the local afro-descendant settlers also play a role (outsiders seem to prefer using lands for cattle raising or for establishing eco-tourism hotels). More so, fluvial and marine landforms are more intensively and extensively used by both men and women (including children), whereas denudational landforms encompass spaces that are almost only used by men. Likewise, the *Monte* spaces are mainly used by men, whilst places inside the *Rastrojo* and to a lesser extent the *Respaldo,* are currently used both by women (including children) and men. *Azoteas*, a kind of container gardening/horticulture proper to afro-descendant communities, are basically a women space. Based on the above, we may consent that land uses have as well a gender dimension. In addition, the gender dimension relative to urban and rural assets of El Cedro/El Valle, particularly schools, with respect to other neighboring settlements will be also debated herein.

Although Gendered Space preferences have remained nearly the same in the last few decades, the gendered uses of such spaces have change to the point that many of them, particularly women-akin uses of the land, are now almost extinct (E) in the rural areas, and were progressively shifted/moved to the urban area. Table 53 depicts that the *Respaldo* is in the trend of becoming comprised only by Croplands and Pasture, while *Azoteas* (Gardening) have almost become extinct rurally (as evidenced during fieldwork). Likewise, animal husbandry which is a land use (almost exclusively) performed by women in the study area, is almost extinct in *Monte viche* (secondary forest), *Respaldo*, and *Rastrojo* (Agricultural lands). More general, exclusively women uses of the land are all vulnerable and tend to disappear, although Gathering still prevail. Likewise, the unique space of women in the rural area (*Azoteas*) is about to collapse. Conversely, the distinctive space of men prevails in the rural area, which is *Monte bravo* (primary forest), therefore men did not lose as much rural space up till now. Conversely, cattle raising (which is mainly but not exclusively performed by men) as well as the current Urban/ residential uses, were all incipient 30 to 40 years ago.

On the other hand, the oldness of a given land under cultivation and of the persons themselves are major social signifiers linked to land use dynamics within the El Cedro. Older land lots have being used more intensively and for more variable purposes (more uses). With respect to the people's age, the elder uses land more intensively for agricultural purposes, both women and men. To be sure, younger women are particularly diversifying their livelihoods into new urban activities.

Finally, middle age and young men, on one hand are now using more intensively and extensively the *Monte* and *Respaldo* for logging purposes, and on the other, are increasingly using the marine spaces for fishing with on board engines. In addition, the nuance of land use dynamics is linked to climatic seasons and festivities (Leal and Restrepo 2003), aside the economic opportunities and possibilities provided for locals.

SHIFT FROM SECONDARY TO PRIMARY LAND USE

The shift from primary land use to secondary land use and vice versa sometimes may be deliberate, and planned, while in other occasions may merely be a result of abrupt changes (e.g. natural disasters, armed conflict), very infrequent events, 'punctuated' events, or even providence (Bakker and Veldkamp 2008, Walker and Peters 2007). Thus, it has been claimed that land use and land cover change is not always a linear process as it is assumed in many land use change models and that temporal heterogeneity must be considered (Guyer et. Al 2007): Urbanization, for example, (which is mainly a non-linear process) may be an important impact over land use change, its patterns and dynamics, making the rural-to-urban gradient a worthy approach to integrate historical data into land use change assessment, and to analyzing effects of its growth or decline (Haase and Nuissl 2010). In addition, disparity between land use statistics and land cover observations (e.g. using remote sensing) suggests that secondary uses (e.g. gendered land uses) should be considered when interpreting primary land use into land cover, as to allow trade-off analyses between these primary and secondary uses (Bakker and Veldkamp 2008).

Empirical evidence during my fieldwork campaign suggested the need of taking into account both 'temporal heterogeneity' and deeper history approaches to better understand land use and land cover change trajectories on one part, and to raise the necessity of translating and accounting (when possible) both primary and secondary land uses into land cover. Indeed currently, as noted above, *Azoteas* (gardening) are almost extinct/inexistent in *Rastrojo* (Agricultural lands), as well as does animal husbandry in both agricultural lands and secondary forest (*Monte viche*) as the result of either long-term, rarely occurring events or 'punctuated' processes yet to be uncovered. We may assert that presently in the rural research area, men (secondary) land uses (logging, hunting) are under the trend of almost completely controlling Forest land cover in the near future. Whilst the now (women) secondary uses linked to rural agricultural lands (*Rastrojo*), as are gardening and animal husbandry, are practically extinct, thus shifting to only agriculture (a primary use) more general. More so, also in *Rastrojo*, young women are in the trend of either abandoning the gender-neutral/inclusive agricultural-use or reducing its frequency. The effects of these shifts from secondary to primary land uses and of gendered land uses (on both food security and livelihoods), to the community's subsistence haven't been untangled. Although (women) secondary land uses do not have an explicit area demand in terms of land cover (perhaps only at very detailed spatial resolutions), as primary land productivity possibly diminishes as the consequence of these shifts, they may translate into a certain implicit area demand (Bakker and Veldkamp 2008).

EVERYDAY LIFE VERSUS LONGER-TERM LAND USE/COVER CHANGE

An unusual event took place 30 to 40 years ago in El Cedro that most probably affected the subsequent trajectories of land cover/use in the area. As was referred in the overview to this dissertation, this rural area, with traditional land uses and livelihoods was largely emptied (but still essentially in use) and locals are now clustered inside the El Valle village. With aid of participatory observation, and unstructured interviews to local community members, it was found that women abandoned the fields even at the expense of leaving back their husbands during the referred period.

While I was conducting walkthroughs in the different subareas comprised in the El Cedro, I evidenced that extremely few inhabitants were still living in the rural part. Land was cultivated and worked but mostly uninhabited by local people. As described in Chapter 5, I had to conduct most structured interviews under the current circumstances in the El Valle village where the bulk of inhabitants are now settled.

Why is nobody living in the fields? A smiling face of a 70 year old Afro-Colombian women responded: "More than 30 years ago we (the women) decided to move to the village… we wanted our children to study in the recently established school… most of us don't know how to read and write… our parents didn't think this was important, we were meant to work in the fields… and now we don't know how to do anything else … we wanted our children other livelihoods for our children, we want them to learn different things… so we moved to the village for educating our children and left our husbands behind…"

As to learn more on the relocation process that led to almost completely emptied fields I conducted a phenomenogical study directed to elder persons (four men and five women) on the above question. Excerpts of female subjects' interviews are listed below:

"… the school nuns visited and encouraged us to bring our children to school… At first, we commuted everyday back and forth to bring our children to school…, sometimes we stood at houses of relatives or friends few days, even a week … but after too much effort we (the women) decided to move altogether to the village… my husband didn't want to move so I left him behind… we all did (laughing)…."

"I used to live in the beach, the school (which is still located in the El Valle village) was not as far for me as for others…but I spent 2 hours twice a day to bring my children to school… throughout time I also moved to the village…"

"it took time to make my decision… we lived in our farms and depended on a boat that travelled by the El Valle river every other week or three weeks selling the things we needed to buy… I miss sometimes those days… we left primarily because of the school… but we were also tired of the hard work in our farms…."

Likewise, the few male interviewees confirmed women's claims even adding some more information. Quotations from men's accounts are described below:

"Almost 35 years ago…women left us all… we didn't want to leave our farms… we resisted, but with time, as they didn't return… we started to dismantle our homes and brought these materials to the village to reconstruct our houses…"

"… women went to live in the village to have our children in school around 30 year ago, my wife too… she left me… I didn't want to leave by myself, so nowadays I have two houses … I live in the farm and my wife's house is in the village… I come to visit her when I want…but I'm a hunter during nights… and that's my life…"

"…women are the ones to blame… they said they wanted our children to attend the new school but I think they didn't want to work in the fields anymore… she (the wife) used to come to our farm more often to work the land, then less and less… now our daughters come to our farm not very frequently but they still work the land, however our granddaughters, they want other lives … one of my sons is a hard worker, he likes farming… the other is a fisherman…"

I also talked with the nuns that run the school. Unfortunately, the School Chair was in office since less than one year and did not have information on the referred women's movement to the village. Other nuns always referred me to the Chair. Thus, based on the referred above semi-structured interviews, synthesis of this phenomenology is as follows:

An elementary school run by Catholics (which nowadays has also secondary level) was established in the village of El Valle (within the El Cedro) three to four decades ago. The school officials campaigned within the community (particularly women) to incentive their children's education attainment. For many families it was the first opportunity to engage their members into formal education. Most local people had no education attainment (indeed they were illiterate, a longstanding inheritance from the colonial rule). Women wanted their children into formal education more than men did, so they began commuting on a daily basis to the school and back to their farms with their children, which implied much time and effort invested on this endeavor (from one to three hours twice per day). Strategies to fulfill their needs included staying few days or during weekdays at houses of relatives or friends inside the village. The latter practice progressively became more frequent (and unbearable) also implying longer periods of time in the village. Women talked to each other and decided collectively to never return to the fields. It is not clear what kind of intrahousehold conflicts and power relations arose as result of such decisions. The priest of the single Catholic Church in El Valle village (who is not Afro-descendant) commented that intrahousehold violence exists among the community; however, neither women nor men ever talk about it. Once women and children established in the village, a prudential time elapsed before men progressively decided to move their houses to the village. As houses customarily belong to Afro-descended women (Camacho 1999) materials of old farm houses were transported into the village.

How many years the relocation process took (of both humans and animals), and the unveiled consequences on the local and sub-regional production systems remain being interesting research questions. Indeed, consequences impacting land cover by the use change (resulting of the women's social drive) at the wider El Cedro's extension should have placed a new momentum for rural-urban transitions more general. The same undue effort invested into bringing children to school (more so in the area comprising the El Cedro that has amongst the highest precipitation regime in the world) certainly was needed to commuting from the village to farms as to continuing cultivating the land (the community's subsistence base even today), as well as for keeping their extended livelihood practices. Throughout time, in the rural area, some secondary (gendered) uses had become almost extinct including gardening, and animal husbandry. While farms were progressively abandoned in some cases, the landholding system undoubtedly was also dynamized. In the renewed urban setting as well, gender relations most certainly readjusted in manners yet to be untangled. During my fieldwork campaign it was evident that abandoned farms were covered by weeds resembling pastures, and many farms were showing this uncontrolled / overgrown /abandoned / unattended aspect. It is reasonable to suggest that this weeding progression was similar during the referred resettlement processes. On the other hand, farm-weeding may also complicate land cover classification decisions (and change detection) when applying the remote sensing process as described in chapter 4.

It was evident, that the found rearrangement of settlement spaces and production systems was not only explained as the transformation of gender division of labor, authority and resource management as showed/proposed by feminist political ecologists (Rocheleau, Thomas-Slayter, and Wangari 1996). Nor this could be elucidated only by off-farm employment opportunities or changes in agricultural prices (Angelsen and Kaimanovitz 1999). Instead, locally, this resettlement was in part fostered 30 to 40 years ago by a women's movement, which pushed for the community's relocation to the intersection of fluvial and coastal environments where a new school was established. Women envisioning better livelihoods by way of their children's education clustered on what three to four decades later had become a larger village. Although recent theoretical insights on the co-production of land use and livelihoods acknowledge 'changes in each as reflective of changes in the other' (Carr and McCusker 2009), I suggest, that women's imaginary, in part encouraged by the Catholic Church running the school while acting as a second state, have also resulted in novel spatial rearrangements of land tenure and use in the study area. On the other hand, practical (scholarly) evidence had also showed that current gendered LULCC have resulted from historical events previous to the last few decades in which my research is focused; GLULCC might be embedded, and thus could be further explained, under broader and longer traditional societal processes leading to particular customary laws and practices controlling LULCC. My research area provides empirical evidence that women's role on LULCC is well beyond the establishment of small gardens and orchards, or the collection of fuel wood to provide for their families. In contrast, inside this collective title, women's decisions/strategies have also restructured settlement patterns, and thus, land use dynamics of larger areas at various (heterogeneous) spatial and temporal scales. Afro-descendant women as a group gave renewed momentum to rural-urban transitions yet to be untangled.

Temporal scale / heterogeneity

Many past and ongoing processes at heterogeneous times have shaped land use and land cover change in El Cedro. One of my hypotheses was that establishment of a collective title to Afro-descended communities including my research area was among the causes of land use and land cover change in the last decade, that I was keen to identify. However it was clear that the titling process was an official recognition of customary tenure and use of lands several decades ago in practice. Thus, causes and consequences of this collective titling (as far as my research has shown) must be regarded prospectively as opposed to retrospectively. Undeniably, the collective titling to this area in 2002 seemingly controlled unwanted devastating effects of novel colonization land uses by agents and organizations with different (possibly lucrative) interests that could have led to radically different land cover trajectories (and more impacted livelihoods) imaginably contrasting to those envisioned/constructed by the community. If this collective land has not been legally recognized, perhaps more unwanted and negative consequences could have been put in place for the detriment of the community. Hence, prospected trajectories could be the object of future research based in comparing (gendered) land use and land cover change at similar Afro-descendant communities with and without legal recognition of their collective land titles.

The claim that secondary (gendered) land uses not necessarily demand an explicit area that translates into land cover change was partially corroborated; indeed, everyday life endorses this assertion. In the longer term, the change of frequency of secondary land uses led (most) women landholders to progressively transporting women-akin secondary uses (e.g. gardening and animal husbandry) from the rural to the urban areas and to accommodating these inside their village residences. Farms in turn are gradually shifting to their lone primary land uses (i.e. agriculture, pastures, forest), controlling land cover (causal relation), and showing trends towards loss/downfall of gendered secondary uses in the fields. Gendered spaces of 30 to 40 year ago must have portrayed different land use/cover arrays in the rural-to-urban transitions than those of the current settings (given that land use shifts are causal causes of land cover change).

But today, the progressively affected productivity is saliently perceived by villagers as a reduced diversification of food-crops, cash-crops, and wood-products with respect to 'the past' (not only of a lower quality than previously in the rural-past). Structured and semi-structured interviews in the research area included questions on the perceived salient changes in land use during the longer-term of 10, 20 and 30 years. Yet, it was noted that time is not a homogeneous dimension for locals; difference between 10 to 20 or 30 years is (apparently) blurred and is more common to reference time as "before" and "today". However, there is agreement on that, remarkably, 10 years ago (or more) there were much more variety of cultivation, as well as better and varied timber. It is commonly affirmed that avocado disappeared in the area, manioc and pineapple were much more common now than before, the production of staple foods such as rice and maize dramatically decreased and are more difficult to obtain now than before; 'their' rice seeds disappeared and were changed by imported ones under governmental programs; the community harvested much more rice as cash-crop destined to surrounding communities before and nowadays rice is increasingly a food-crop often intended for family consumption only (and nowadays it is imported from other regions of the country too); there were much more cedar and guayacan wood; there were more container gardening (*Azoteas*); 'before' sugar cane was abundant and used for production of a home-made alcoholic beverage named "viche" whereas today is hardly seen; and maize that was grown before in many of the El Cedro farms nowadays is barely found. To be sure, throughout the longer-term, agricultural variety was reduced as well as did timber. Certainly, a local school-students' research determined that agricultural production has diminished, and that in 2004 main crops were rice, plantain, and maize (only one variety named *bomba* has survived while others disappeared) in 63%, 29% and 9% respectively of the sampled farms (Moreno and Monje 2006). During my fieldwork campaign, many of the farms were sown in plantain as one of preferred cash crops (although of several varieties). Indeed a young woman commented: "I want to be a great farmer and hope to have at least two hectares in plantain as cash-crop to be sold in Bahia Solano (the capital of the municipality)". In sum, various previously cultivated crops have now disappeared or soon to be, whilst few new crops have been introduced (e.g. anon, noni). Still, it is unsure which have been the consequences of a lesser agricultural diversification to the people's subsistence and livelihoods.

Likewise it has been asserted that traditional forms of local cooperation among Afro-Colombians are also progressively declining in El Cedro apparently due to that less time is dedicated to agriculture throughout time (Valencia and Mosquera 2006): Examples of these are the *mingas*, *mano cambiada*, and *mateo* (this last disappeared almost completely), which are group solidarity customs in which either a group of women, men, and children, or neighbors, collectively exchange man power for agricultural activities (mainly), with the aim of easing production and harvesting, while maintaining the community's solidarity, and enhancing social and cultural cohesion.

Based on the above, seemingly, age is also an indication of the process of 'extinction'/breakdown of some secondary land uses, and thus of changes in traditional subsistence livelihoods (under customary tenure). It was evident that elders are still involved in such practices and continue transferring their environmental knowledge to next generations. However, middle age people are in the interface of traditional subsistence practices and the search for paid labor or for profits from other sources for example, through their engagement with novel types of handcrafts, local ‘commercial’ organizations (selling pigs, jam, wood), or as intermediaries of timber and livestock products. Elder women also participate on the few organizations existing in the El Cedro, and most of them still engage in container gardening or *Azoteas* (a prevalent practice for villagers). However, many of the elders claim that traditional subsistence rehearses are not valued by younger generations who are not interested on learning their knowledge on these practices. Based on unstructured interviews, younger generations aspire to engage into small-scale tourism services or low-wage work in hotels and neighboring towns as an envisioned diversification of income strategies. Many of the younger population of less than 40 years seek leaving the El Cedro claiming that “*Monte* (meaning the forest or the rural more general) is for animals”. Many people with higher education attainment had been successful in making a living in other places outside the El Cedro. However, neither systematic data on outmigration nor of new livelihood configurations are available for the El Cedro. For example, young women aspire being secretaries, some of the young men who do not desire to leave the village seek to become sea-fishermen. A process of acculturation is ongoing; more so the establishment of television around one decade ago makes a middle age man to argue: “my wife and children just watch TV all day long”; Another young man commented: “when I was a child I used to play with stick and sand, with simple things… we all (the children) played together… now with TV this is over… as soon as children watch a movie, they act that movie...”

Statistical analyses on farm data (particularly farm-age under production) of the *Natura* 2004 census (see Chapter 5) depicts changes in land tenure types (i.e. inheritance, purchase, by work, etc.) according to classed periods. It is noteworthy that many farms are being acquired by way of purchase in the last decade predominantly by men, which suggests a future research to analyzing linkages between changes in land tenure, and the diversification of crops and livelihoods (particularly logging).

On the other hand, based on unstructured interviews it was apparent that around 15 years ago the Tundo-Chado Management Zone low-hills, near the beach, were cultivated with pineapple plantations while the beach itself was a favorite place for clam gathering. Villagers affirm that clams were so many that each of them could replenish their pots several times. Nowadays, clams completely disappeared as well as pineapple fields. In its place, four eco-hotels were constructed (before 2002) all of them owned by people from the interior of the country. Although under Law 70, customary land tenure is protected in the El Cedro since 2002 through a collective land title, this law provided that private property previously acquired inside collective titles would be allowed to remain as such. Management zone named "Beach and sendero Utria", continue being owned mainly by local afro-descendants who exercise traditional land uses; very few outsiders bough land parcels in this area. However, before the collective title was established, several parcels inside this management zone were bought by one man from the interior of the country to establish cattle breeding: according to villagers he probably died as he never returned to the area around one decade ago, so these land plots are recently possessed by locals and mestizos living in the area. The remainder management zones of El Cedro seem to be owned primarily by afro-descendants. Probably based on the above, the President of the Local Community Council commented they would like to know how many private properties exist within El Cedro, and how many of the requested private titles are still being processed.

MAPPING ACCESS OR THE "BUNDLE OF POWERS"

Past and current social and cultural patterns of El Cedro's Afro-Colombian communities are sustained by extended family, polygamy and matrilineal conformation (Camacho 2004), which among various other powers and mechanisms, play important roles in resource access and use.

The 'Theory of Access' by Ribot and Peluso (2003), partly based on previous theorizations in Property (MacPherson 1978), and environmental entitlements (Leach, Mearns and Scoones 1999) (see Chapter 2), helps mapping the 'bundles of powers' and mechanisms of access of Afro-Colombian women. Scholarly research on these communities support the tracing back of mechanisms of access to the significant New Granade period (1830-1863) occurring a couple of decades before the abolition of slavery in Colombia in 1851.

The Theory of Access (Ribot and Peluso 2003) encompasses explanations, definitions, and notions, to help understanding the complexities involved in human-environment relations. Property, as theorized by Macpershon (1978) and environmental entitlements, as defined by Leach, Mearns and Scoones (1999), are component parts of the theory of access amongst other constituents. These other components include a larger array of institutions, social and political-economic relations, and discursive strategies that shape benefit flows. Therefore, access analysis allows easier mapping of mechanisms of access including property as well as illicit relations, relations of production, and entitlement relations, within heterogeneous historical and spatial dimensions being dependent on empirical context and on time.

Access analysis framework for the El Cedro´s Afro-Colombian women is mapped in Figure 87, granting this is a coarse simplification that does not reflect all complexity of the research area resource access as per Ribot and Peluso (2003): Access analysis “is the process of identifying and mapping the mechanisms by which access is gained, maintained, and controlled” (Ribot and Peluso 2003 p. 160). Accordingly, three main steps for access analysis include the identification of particular flows of benefits from a resource; the identification of mechanisms for gaining, controlling, distributing and maintaining the benefit flow; and the analysis of the power relations underlying these mechanisms of access. Therefore, I the mapping of access in Figure 87 is based on a more detailed description of main mechanisms of access that are described in Table 52, is useful as a first step towards more detailed versions of this access framework, which is turn are based on one hand on empirical context and time frame as several relative theories suggest (Macpershon 1978, Leach et al 1999, Ribot and Peluso 2003), and on the another hand, on the continued and careful reviewing of pertinent scholarly contributions.

Research works detailing particular mechanisms of access, or component parts of the access theory are needed to reflect on the fairly different perspectives, theoretical frameworks and research methods that address access analysis. Indeed, methodologies and empirical research in one hand, and theorizations on the other, are indivisible parts for the development of coherent fields of inquiry.

The theory of access itself could potentially foster other initiatives. But as Ribot and Peluso (1993) expressed: their intent was “to enable scholars, planners, and policy makers to empirically ‘map’ dynamic processes and relationships of access” (p. 26).

Table 53 is divided into two periods: the New Granade (1830-1863), and the post-slavery period (1850 onwards). The selected bundle of powers that Afro-Colombian women used historically include: the Body; Mediation; Insurrection and Liberation; Witchcraft, Sorcery, and Healing; Urban Life; Family; and Territory (land). Each of these powers have given Afro-Colombian women (and to some extend men) both structural-relational access and rights-based mechanisms of access that were used to produce a chain of benefits, which reproduction have allowed in turn progressive social change of these communities (Figure 87).

Hence, I suggest a simplified chain of benefits throughout the referred historical periods (which most probably have been reproduced several times). These chains suggest a progression of benefits gained with both the few 'bundle of powers' and 'mechanisms of access' that Afro-Colombian women have had. Prominent mechanisms of access attributed to afro-Colombian women include (Camacho 2001): (i) gaining skills and knowledge to be used as free citizens; (ii) being pivotal to the conformation of (extended) family; (iii) access to land, initially by way of maroon movements and palenques followed by settlement processes as described in Chapter 3; (iv) social cohesion, construction of the community and reconstruction of identity; (v) development of a subsistence system of production, extraction, product transformation, exchange, transport, distribution, and consumption; (vii) diversification of livelihoods more general for the primary purpose of securing health for children and the community; and (vii) fostering social change for a progressive bettering of life.

But to what extend this bundle of powers and their mechanisms of access are still current? Although this dissertation objective do not focus on the historical research and insight of pertinent changes in access, we may attempt to lay out few comparisons with what was found in the research area during the field campaign, and the scholarly contributions that support the very coarse access framework provided here. In the previous chapters only those ‘powers’ and ‘mechanisms’ closely related to land use and land cover change have been emphasized. Particularly, the territory and the rural that gave rise to more cohesive and permanent settlements was openly appropriated after slavery manumission in 1850 (during slavery palenques were considered illegal settlements and thus were chased by the authorities – the process of complete manumission was delayed in practice for decades in many areas of the Colombian territory (Colmenares 1978). In the research area, this settlement process began in 1930 (Mosquera and April 2001 in Chapter 3), with collective legal rights on these customary lands only after 2002. To be sure, in the research area consolidation of land tenure (and use) has been a process of fairly less than one century.

The following paragraphs are based on Camacho (2004) unless explicitly noted from other sources. This author’s anthropological and historical accounts are borrowed to construct Table 53 and Figure 87. Based on the latter, the proposed access framework, including selection of ‘bundles of power’ (highlighted in bold) and ‘mechanisms of access’, is my own yield (Figure 87).

During slavery, besides a manpower-vehicle from the productive and reproductive perspectives, the **body** was an element of resistance, manipulation, power, and autonomy. It was used as merchandise, and to buy women’s (and their children) freedom. Alternatively, it allowed climbing the social ladder through bleaching. Their bodies were abused under the status of slaves, but also expanded women’s social relations. Through seduction and maternity bodies provided access to resources and privileges; which nowadays, are the more visible current mechanisms of access the body still provides (besides body as a merchandise to a minor extent).

In the New Granade, women's were active-protagonist subjects. Their **mediation-power** allowed bridging the relations and communications between slaves as crucial to their liberation. By means of their domestic and concubine roles, among many others, they were granted more mobility and played relevant roles in the transmission of their own culture, Christianity and the Castilian Spanish, as well as in consolidating trades and skills they used when they were free citizens. During my fieldwork campaign, it was evident that women were engaged in additional number of productive and labor activities that men did (the particular type of gardening named Azoteas is an example of this). Yet, statistical figures showed the opposite: Farms used and owned by men are directly and positively correlated with the total number of uses, although this may have resulted from a much larger number of farms now owned by men than by women. In addition, their mediation power was evident in other realms; the President of the El Cedro Community Council was a woman, and when the larger Community Council of "Los Delfines" faced corruption problems while chaired by a man, a woman was elected as next President. Notwithstanding, the extent of current mediation power of women would need further research.

During slavery, as stated above, women took an active part in maroon movements and the formation of *Palenques.* For these purposes, besides mediation, they also used their **insurrection/liberation-powers**. They fled seeking refuge from abuse but also were kidnapped during these liberations. Nonetheless, women privileged manumission's legal channels including purchase of freedom (According to Colmenares (1978) most of legal manumission in Choco registered in Popayán (1721-1800) came from women). But more currently, one cannot help linking this insurrection power with the women's movement of 30 to 40 years ago. Women 'fled' to the urban area to provide for their children's education (as was asserted by villagers), but also because of their will of 'escaping' from the harsh rural livelihoods, thus promoting liberation under envisioned social changes of increasing well-being. Longer-term consequences of gendered land use and land cover change were put in place.

Within the 'bundle of powers" were as well **witchcraft**, sorcery, healing religious and magical practices which still now are performed by afro-descendant communities. These include mechanisms for reaffirmation of identity, social cohesion and resistance, and for access to symbolic and material resources. But they served too for the social, cultural and symbolic reconstruction of the enslaved. Witchcraft was used in maroon and cultural resistance forms, and favored new social relations with other ethnic groups; indeed, spells, rituals, and potions integrated black, white and mulatto witches. Based on the fieldwork campaign it was evident that midwifery (which is a valuable women's special skill) today is still as important as it was in the past. The same is true of agricultural rituals: as locals do not invest in fertilizers or pesticides, 'praying to crops' is an effective and broadly used custom to control plagues notwithstanding the Catholic Church is against many of these practices. I also met one of the oldest witches in El Cedro, a 70 year old woman who was feared and respected by villagers because of her magical knowledge. Although arguably these practices may have been redefined by European and indigenous religious and ideological systems, today all these systems may coexist in the community.

It is recognized a greater female labor force in **urban** areas during the New Granade period who engaged in domestic services, parenting, breastfeeding. Urban experience offered black women a greater geographical mobility and the opportunity to participate in other activities such as street sales, crafts, and various forms of peonage, jobs, payments and prostitution. Urban life granted black women a greater range of control of their lives, and more importantly, allowed them to consolidate trades and skills that were very useful after manumission. The push of women 30 to 40 years ago to resettle in the El Valle village might be the reproduction of what was learnt by previous generations.

The most outstanding bundle of powers and mechanisms of access of afro-Colombian women are related to the **family**. During the New Granade, women were pivotal for the social reconstruction of groups, ethnic groups and individuals through kinship and family recomposition. Women exercised a leadership role and were central to the internal cohesion of the enslaved mining groups (the few female miners created families around them). Indeed matrifocality, the extended family, and polygyny responded to women's role as organizers and stabilizers of kinship. The myth of black matriarchy (Mena 1995) imaginarily gave black women a privileged status but it may have also blurred real situations of female subordination or of domestic violence (Camacho 1999). To be sure, Colombian black female identity is tied to motherhood, parenting, and socialization of children, but they are also characterized as promoters of economic autonomy and of multiple ways to addressing the larger society. In the El Cedro, kinship relations are still relevant. Current social and cultural patterns are supported by the extended family, polygamy, and matrilineal conformation. According to Mena (1995) post-slavery agricultural transformations were based on matriarchal and extended family; woman were commonly household heads (preponderance of household heads) controlling agricultural work, as well as responsible for the welfare of children;

they enjoyed more independence and freedom than today; there was a broader social recognition accorded to women by their economic role than today, and even land tenure was matrilinearly inherited. As evidenced by statistical analysis on the census data 2004 on farms, men's landownership nowadays in the El Cedro is preponderant, although there is a direct relationship between older farms under production and women who own more than one farm, giving some support to this claim. Women still play key roles in the family cohesion: children from successive unions and separations stay more commonly with mothers. It seems however that many factors, among them the effect of the Catholic Church have reduced women's autonomy and leadership in comparison to men nowadays.

Finally, the second most important bundle of power in my view is land holding and the construction of the community's **territory** (Galeano 1996, Losonczy 1997, Llano 1998, Camacho 2001)**.** In the rural areas, women have a key role in food security and the family health. Historical nourishing becomes a dual source of power for women as it both affect the health and welfare of their families, and is a source for harming and domination (Camacho 2004). The house is the domain of women, as well as meek (mansos) and open spaces, herbs and vegetables, the river banks and floodplains. In contrast, the *monte* is forbidden to them. They also play important roles in maintaining and improving biodiversity through their gardens. Indeed, black females' identity is closely linked to the command of food, medicinal, luck, and power plants. During fieldwork in El Cedro, it was evident however that knowledge associated with these plants are kept by elder women and is in trend of being lost as younger generations are not as interested in acquiring it. Women besides agriculture in the fields, are engaged with container gardening (for preservation of seeds and nursery), in animal husbandry (the latter two only performed by women), fishing, and gathering. There might be historical conditioning effects (perhaps from slavery) to the current traditional land uses and livelihoods of afro-Colombian women. And these livelihoods are age dependent. As noted above, elders perform most productive activities and hold more traditional knowledge than younger generations do. And the transmission of knowledge (by way of mothers) and culture, not alone in passage rites such as belly-button-burial and death, but on the environment, has also proved to be statistically significant to land use models (chapter 5).

With very few powers, forbidden education attainment, under complete dispossession and extreme abuse, afro-descendant women were crucial to social and cultural reconstruction and cohesion. They settled in marginal lands/territories, and resisted by all possible means. Jointly, with men and children, they formed extensive families and the black communities of Colombia. With alliances with other ethnic groups they learned agricultural practices of the new world besides other skills. I would like to propose naming the *Azoteas* hereafter as “Noah Arcs Gardening” for they are vessels of seeds, food plants, tree seedling, and are and nurseries to secure food provision, among other functions. By roaming through marginal lands, Afro-descendant communities at last established settlements in the Pacific region of Colombia. In the possessed lands agricultural practices, animal husbandry and other livelihoods flourished although precariously. Land use was dynamized. Finally they were able to put forward amongst the most radical territorial processes in Latin America (Offen 2003), and secured collective lands for future generations. Still with low education attainment, no doctor or hospital in the village, they have managed to survive. This showed how women more general under extreme situations will find ways (mechanisms) to create new societies and a chain of benefits for their kin. Thanks to the tenacity of these black communities who allowed me to share this research area, I may now claim that: land use and land cover change is definitively GENDERED.

It has been stressed that Afro-descendant communities' most valuable asset is land (Camacho 1999), making land use and cover dynamics even more closely linked to land tenure. Now that tenure has been secured for the El Cedro community under the sanctioned collective land title of 2002 (Law 70) the progression of kin relations and customary rules to their ethnic identities is yet to come to light. Decisions outside the collective land have affected these community in countless ways; but in the near future, one of strongest impacts will most probably be the proposed construction of a road connecting the interior of the country with Nuquí "Animas-Nuqui" (to the south of the research area) and further to the El Valle village. To be sure, interrelations between social and environmental processes will continue changing in many complex ways.

But which gendered 'bundles of powers' now do sanction access to resource use? Access to land has customarily been granted by kin relations as stated above, particularly by inheritance (more so for women) in the last few decades. Both women and men have the right to inherit land, and lands are inherited both from mothers, fathers and the extended family (under the terms of afro-Colombian communities). However, besides land property are the historical roles Afro-descendant women and men have played in the Pacific region of Colombia.

Conflicts over land and property have been particularly important in Latin American development theory and practice for many decades. However, important theorizations on property, and their respective definitions and justifications, have led to rethink that the rights associated with land alone cannot explain nor solve the potentially conflictive social relations shaping processes of access, use and control of natural resources (De Janvry 2001), and ultimately shaping the individual right to a (good) life (MacPherson 1978). On the other hand, “Any analysis of land- based resources must surely confront and incorporate politics inscribed in various social arenas: familial-(matrilocal), patriarchal, production- labor process, and the state” (Buroway 1985 in Watts and Peet 2004: 12.). Recognition of broader meanings of property (included land tenure), and theorizations in environmental entitlements, and access, have increasingly acknowledged new complexities in theses relations. Social actors, institutions and organizations interplay within a ‘bundle of rights’ and/or ‘bundle of powers’ (Macpherson 1978, Leach, Mearns and Scoones 1999, Ribot and Peluso 2003), which interpretation is not always as intuitive.

ELEMENTS FOR SPATIAL THEORY OF GLULCC?

Developing a “spatial theory” of gender-based land use and land cover change (GLULCC) is challenging. This dissertation seeks to contribute basic elements in the rural and the selected study area contexts, which in turn are based on simplifications and on a wealth of scholarly contributions. These basic elements are structured in three modules: 1) the proposed methods for collecting GLULCC data; 2) the gendered patterns of land use and land cover change; and 3) the potential factors and outcomes of GLULCC. A set of hypotheses/ statements / assertions / assumptions on the three mentioned items are further provided. A spatial explicit analysis /spatial theory will certainly need a more thorough review of case studies codified under fixed parameters of examination, a deeper understanding of feminist and other related theories on gender relations, and more empirical research studies on the complex causal relations of gender-based land use and land cover change. Following Rocheleau et al (1996), theory should be derived from practical experience.

The introduction of gender in LULCC research adds another dimension to the already complex causal relations of change. Consequently, I will focus only on the potential type of additions towards a spatial theory on GLULCC. More importantly, I recognize the cultural, socio-economic and political diversity of geographic locations around the globe. Thus, elements for a spatial theory of gendered land use and land cover change provided below should be read particularly in the context of collective lands titled to Afro-descendant communities in Colombia. These collective lands are located mainly in lowlands covered by tropical rain forests close to coastal areas.

First I synthesize some methods that aid the identification of gendered patterns of land use and land cover in similar study areas (Table 54). Second, based on gendered theoretical frameworks and case studies (which are found above) I present two manually structured 'contingency tables' on simplified gendered patterns of land use and land cover. The patterns depicted in tables 55 and 56 are rough simplifications in one hand, and in the other are based on findings of my fieldwork campaign. And third, I propose a matrix of factors (causal causes) of gender-dimension-changes that could sum up or detail commonly accepted proximate/underlying causes of LULCC land cover change (Table 57). These detailed factors are potentially driving the gendered-LULC change-processes.

Data Collection Methods in GLULCC Research

Table 54 depicts methods for data collection in GLULCC and LULCC research. Gendered patterns of land use and land cover may only be evidenced only with sensor data of detailed resolution. This means that change detection based on coarse resolution images (e.g., Landsat) will be useful for the spatial reference of primary land use and land cover change categories (Jiang (2003), whilst detailed and gendered LULCC changes could be mapped using participatory techniques and GPS (Kwan 2002, Robbins 2001, Turner 2003) and need more detailed spatial and temporal resolution of remote sensing data.

Gendered Land Use and Land Cover Patterns

For the purpose of present contributions to a 'gendered spatial theory of land use and land cover change' (GLULCC) Tables 55 and 56 show respectively the land use and land cover patterns in relation with Property Dependence (Carney and Watts 1990, Agrawal 1997, Jackson 1993, Schroeder 1993, Rocheleau and Edmunds 1996, Schroeder and Suryanata 1996, Valdivia 2001), and own experience.

These tables depict the use patterns that may occur in Commons controlled by men or women, and in individual plots of men or women. Property rights in individual plots could be acquired either by customary law or by legal means Note that in Tables 55 and 56, the first column -Property Dependence- relate to the assumed primary 'policy and institutional' underlying causes of change in the selected type of geographical area. This assumption is based on scholarly works and findings on my research area.

The land use patterns listed in tables 55 and 56 correspond to simplified land cover types where gendered LULCC are expected to be more sharply and easily identifiable (i.e. dense forests, less dense forests, mixed forests and pastures, pastures, and croplands). Other mixed land covers (e.g. pastures and bush lands, croplands and pastures) are oversimplified for the sake of developing a preliminary spatial theory of GLULCC. Urban agriculture is not included in the present (rural) spatial theory, although it is conducted almost exclusively by women in dooryard gardens and terraces (Keys 1999, Kimber 1973).

Table 55 depicts that (a) commons controlled by men, are differentially used by women. In forests, and mixed forests and pastures, women use land mainly for collecting fodder, fuelwood, non-timber products, medicinal plants, and wild food. While in mixed forests and pastures, women uses land for grazing and growing some subsistence crops for the household. Women are more dependent on communal resources (Agrawal 1997) and are reluctant to invest in 'landesque capital' (Blaikie and Brookfield 1987) in such areas. In contrast, men use these lands for timber, hunting, and growing cash crops, and are willing to invest in 'landesque capital' especially for timber extraction activities. Women may have prevention on possessing these lands for food-crops: indeed, one women commented during my fieldwork campaign: "I don't have land but if I choose a plot in the collective land and clear it out for my use, any man could claim it (by possession) and I will lose my work". Pasture lands and croplands are used similarly by women and by men. However, gardens and orchards will be controlled by women or men respectively. The Commons controlled by woman in (b) are largely the mangroves and riparian areas. Whereas women use mangroves mainly for fishing and collecting shellfish, men see those areas as timber stocks. Although riparian areas are used similarly by men and women - except for the type of grazing animals - (i.e., cattle or ruminants), land uses by women are more diverse in each of the land cover types.

Table 56 shows more diverse types of land uses by men and women in individual plots, in comparison with table 55. Similarly, trees in all land cover types are mainly controlled by men. Perhaps as a consequence of a greater land security given by individual land lots, this type of parcels encourages more variety of land uses, and increasing 'landesque capital' than the commons. However, is worth noting that most of these individual plots are 'owned' by men with some exceptions: Elder, widows and wealthier women also own some of these individual plots. Although both men and women build corrals in the croplands animal husbandry is more a women-akin land use; in contrast, pastures are almost exclusively for men use, in their individual plots (i.e. cash crops, orchard, corrals, and trees products).

In table 56 (b) women's individual plots have more diverse uses by women in comparison to individual plots used by men. However, men in both (a) and (b) will still have control over trees in all land cover types. Women will try to restrain logging and fishing by men in mangrove areas at their individual plots.

Gendered Causes of Change

For the purpose of addressing the gender causes of LULC change, a simplified matrix of factors is proposed in table 57, based on the underlying and proximate causes synthesized by Geist and Lambin (2002), and the literature on gendered resource access. Table 57 only depicts some of relevant gendered causes of LULC change for the purpose of a spatial theory of GLULCC. However, this simplified theory should reach more coherence and specificity based on empirical research, deeper insight, and thorough review of pertinent field based case studies. Table 57, first column, portrays the proximate and underlying causes of LULCC as synthesized by Geist and Lambin (2002) model. Columns two and three of this same table show the 'Gendered Detailed Factors', and 'Gendered Changes in Land Cover and Land Use' respectively.

These latter columns contain the hypothesized factors of change that potentially modify the patterns of land use and land cover showed in Tables 55 and 56. These potential (simplified) factors of change, the gendered patterns of land use and land cover, and the theories and methods described above, comprises the present spatial theoretical model of GLULCC in collective lands titled to Afro-Colombian communities, in areas covered by tropical rain forests near coastal areas.

Within the Proximate Causes, other factors, for example War is detailed as Women and Men abandoning fields: the expected Gendered Changes in Land Cover and Land Use are forest resurgence or stationary changes in other land cover types such as crop lands.

Similarly, the Underlying Causes, Cultural Factors, for example Individual Household Behavior is detailed as Shifts in household power relations: the Gendered Changes in Land Cover and Land Use are potentially the Consolidation of women's uses in existing plots, and/or new women's uses in new plots (e.g. orchards or gardens) according to the patterns of gendered LULCC shown in tables 55 and 56. All fields depicted in table 57 can be interpreted similarly. Is worth noting that the potential GLULCC corresponding to most Policy and Institutional Factors are expected to have particular and specific outcomes according to the geographic area under study and the historical moment; in other words, one could expect specific place and time-based outcomes of GLULCC as a consequence of particular policy/institutional dynamics in a geographic location.

FINAL REMARKS

This chapter brought a narrative perspective of gendered land use and land cover change GLULCC as a contribution to work streaming/ mainstreaming what I consider could be a scholarly-fertile research line. Key inputs included a map of the El Cedro produced by locals as well as the findings of my research campaign more general. It hoped to bond, with another perspective, previous theoretical, spatial and quantitative outcomes, under the lenses of the practical experience of fieldwork that also by way of participatory observation and semi-unstructured interviews brought to the researcher (me) valuable insights and information besides the previous outcomes. A preliminary access map (conceptually constructed) based on these narratives and on elements that endorse mainstreaming the gender dimensions of land use science (GLUSc) was also provided.

Today the territory of El Cedro (El Valle) may be broadly subdivided into four main or primary land use (and land cover) types openly differentiated and recognized by the community, namely, *Monte* of forest (*bravo* and *viche*), *Respaldo* (a land tenure classification), *Rastrojo* (cropland, pastures, and gardens) and the El Valle village. *Monte* is often part, or all, of the *Respaldo.* In this classification added uses (significances) diverging from land use and land cover properly (including those related to tenure and nuances of use conditions, or symbolic meanings) are included. These main land use categories were further compared with the Anderson et al. (1976) hierarchical "resource oriented" Land Use and Land Cover Classification System for Use with Remote Sensor Data, in land use planning and management activities, notwithstanding it was developed to meet the needs of Federal and State agencies in the US. The Anderson's "more fundamental and long-range objective is providing a standardized system of land use and land cover classification for national and regional studies"; hence due the broad difference of local usages of land that respond to the country's pluri-ethnic/pluri-cultural and biological diversity (among highest in the world), it helped to address assessment and to raising awareness on the insight needed when using classification systems.

In addition to the above, other environmental and social characteristics of lands make certain spaces to be differentially preferred by men or women. These include key features such as physiography (geomorphology/ landforms) where elevation (altitude) and soils are relevant (men are more keen to use lands at higher elevations than do women); the distance to settlements, rivers, beaches or roads (distance from these landmarks limit men less than women for working or possessing land); the age of lands under production or socialized by local settlers themselves (women landholders seem to have more than one farm when these have more years under production). It is noteworthy that many farms are being acquired by way of purchase in the last decade predominantly by men, which suggests a future research to analyzing linkages between changes in land tenure, and the diversification of crops and livelihoods (particularly logging).

The *Monte* spaces are mainly used by men, whilst places inside the *Rastrojo* and to a lesser extent the *Respaldo,* are currently used both by women (including children) and men. *Azoteas*, a kind of container gardening proper to afro-descendant communities are basically a women space. Based on the above, we may consent that land uses have as well a gender dimension. Although Gendered Space preferences have remained nearly the same in the last few decades, the gendered uses of such spaces have change to the point that many of them, particularly women-akin uses of the land, are now almost inexistent in the rural areas, and were progressively shifted/moved to the village.

We may assert that presently in the rural research area, men (secondary) land uses (logging, hunting) are under the trend of almost completely controlling Forest land cover in the near future. Whilst the now (women) secondary uses linked to rural agricultural lands (*Rastrojo*), as are gardening and animal husbandry, are practically extinct, thus shifting to only agriculture (a primary use) more general. More so, also in *Rastrojo*, young women are in the trend of either abandoning the gender-neutral/inclusive agricultural-use or reducing its frequency. The effects of these shifts from secondary to primary land uses and of gendered land uses (on both food security and livelihoods), to the community's subsistence haven't been untangled.

The shift from primary land use to secondary land use and vice versa sometimes may be deliberate, and planned, while in other occasions may merely be a result of abrupt changes (e.g. natural disasters, armed conflict), very infrequent events, 'punctuated' events, or even providence (Bakker and Veldkamp 2008, Walker and Peters 2007). Thus, it has been claimed that land use and land cover change is not always a linear process as it is assumed in many land use change models and that temporal heterogeneity must be considered (Guyer et. Al 2007): Urbanization, for example, (which is mainly a non-linear process) may be an important impact over land use change, its patterns and dynamics, making the rural-to-urban gradient a worthy approach to integrate historical data into land use change assessment, and to analyzing effects of its growth or decline (Haase and Nuissl 2010).

An unusual event took place 30 to 40 years ago in the El Cedro that most probably affected the subsequent trajectories of land cover/use in the area. As was referred above, this rural area, with traditional land uses and livelihoods was largely emptied (but still essentially in use) and locals are now clustered inside the El Valle village. With aid of participatory observation, and unstructured interviews to local community members, it was found that women abandoned the fields even at the expense of leaving back their husbands during the referred period: An elementary school run by Catholics was established in the village of the El Valle three to four decades ago. Women wanted their children into formal education more than men did, so they began commuting on a daily basis to the school and back to their farms with their children. Once women and children finally established in the village, a prudential time elapsed before men progressively decided to move their houses to the village. As houses customarily belong to Afro-descended women (Camacho 1999) materials of old farm houses were transported into the village. How many years the relocation process took (of both humans and animals), and the unveiled consequences on the local and sub-regional production systems remain being interesting research questions. Indeed, consequences impacting land cover by the use change (resulting of the women's social drive) at the wider the El Cedro's extension should have placed a new momentum for rural-urban transitions more general. While farms were progressively abandoned in some cases, the landholding system undoubtedly was also dynamized. In the renewed urban setting as well, gender relations most certainly readjusted in manners yet to be untangled.

It was evident, that according to the found rearrangement of settlement spaces and production systems, women´s role on LULCC is well beyond the establishment of small gardens and orchards, or the collection of fuel wood to provide for their families. In contrast, inside this collective title, women's decisions/strategies have also restructured settlement patterns, and thus, land use dynamics of larger areas at various spatial and temporal scales.

One of my hypotheses was that establishment of a collective title to Afro-descended communities in my research area was among the causes of land use and land cover change in the last decade. However it was clear that the titling process was an official recognition of customary tenure and use of lands in practice several decades ago. Thus, causes and consequences of this collective titling in land use and cover change (as far as my research has shown) must be regarded prospectively as opposed to retrospectively. Undeniably, the collective titling to this area in 2002 seemingly controlled unwanted devastating effects of novel colonization land uses by agents and organizations with different (possibly lucrative) interests that could have led to radically different land cover trajectories (and more impacted livelihoods), imaginably contrasting to those envisioned/constructed by the community.

But today, the progressively affected productivity is saliently perceived by villagers as a reduced diversification of food-crops, cash-crops, and wood-products with respect to 'the past' (not only of a lower quality than previously). Various formerly cultivated crops have now disappeared or soon to be, whilst few new crops have been introduced (e.g. anon, noni). Still, it is unsure which have been the consequences of a lesser agricultural diversification to the people's subsistence and livelihoods. Likewise it has been asserted that traditional forms of local cooperation among Afro-Colombians are also progressively declining in the El Cedro apparently due to that less time is dedicated to agriculture throughout time (Valencia and Mosquera 2006):

Based on the above, seemingly, age is also an indication of the breakdown process of some secondary land uses, and thus of changes in traditional subsistence livelihoods (under customary tenure). It was evident that elders are still involved in such practices and continue transferring their environmental knowledge to next generations. However, middle age people are in the interface of traditional subsistence practices and the search for paid labor or for profits from other sources for example, through their engagement with novel types of handcrafts, local 'commercial' organizations (selling pigs, jam, wood), or as intermediaries of timber and livestock products. It is noteworthy that many farms are being acquired by way of purchase in the last decade predominantly by men, which suggests a future research to analyzing linkages between changes in land tenure, and the diversification of crops and livelihoods (particularly logging).

Farms in turn are gradually shifting to their lone primary land uses (i.e. agriculture, pastures, forest), controlling land cover (causal relation), and showing trends towards a downfall of gendered secondary uses in the fields. Gendered spaces of 30 to 40 year ago must have portrayed different land use/cover arrays in the rural-to-urban transitions than those of the current settings.

In addition, past and current social and cultural patterns of El Cedro's Afro-Colombian communities are sustained by extended family, polygamy and matrilineal conformation (Camacho 2004), which among various other powers and mechanisms, play important roles in resource access and use. The 'Theory of Access' by Ribot and Peluso (2003), partly based on previous theorizations in Property (MacPherson 1978), and environmental entitlements (Leach, Mearns and Scoones 1999) helped mapping the 'bundles of powers' and mechanisms of access of Afro-Colombian women in historical periods. Scholarly research on these communities support the tracing back of mechanisms of access to the significant New Granade period (1830-1863) occurring few decades before the abolition of slavery in Colombia in 1851.

The mapped access-analysis framework for the El Cedro´s Afro-Colombian women proposed in this chapter is a coarse simplification that does not reflect all complexity of the research area resource access as per Ribot and Peluso (2003). Accordingly, three main steps for access analysis included the identification of particular flows of benefits from a resource; the identification of mechanisms for gaining, controlling, distributing and maintaining the benefit flow; and the analysis of the power relations underlying these mechanisms of access.

The selected bundle of powers that Afro-Colombian women used historically include: the Body; Mediation; Insurrection and Liberation; Witchcraft, Sorcery, and Healing; Urban Life; Family; and Territory (land). Each of these powers have given Afro-Colombian women (and to some extend men) both structural-relational access and rights-based mechanisms of access that were used to produce a chain of benefits, which reproduction have allowed in turn progressive social change of these communities.

Finally, elements for developing a "spatial theory" of gender-based land use and land cover change (GLULCC) are proposed. These basic elements are structured in three modules: 1) the proposed methods for collecting GLULCC data; 2) the gendered patterns of land use and land cover change; and 3) the potential factors and outcomes of GLULCC. A set of hypotheses/ statements / assertions / assumptions on the three mentioned items are further provided. A spatial explicit analysis /spatial theory will certainly need a more thorough review of case studies codified under fixed parameters of examination, a deeper understanding of feminist and other related theories on gender relations, and more empirical research studies on the complex causal relations of gender-based land use and land cover change. Following Rocheleau et al (1996), theory should be derived from practical experience.

It has been stressed that Afro-descendant communities' most valuable asset is land (Camacho 1999), making land use and cover dynamics even more closely linked to land tenure. Now that tenure has been secured for the El Cedro community under the sanctioned collective land title of 2002 (Law 70) the progression of kin relations and customary rules to their ethnic identities is yet to come to light. Decisions outside the collective land have affected these community in countless ways; but in the near future, one of strongest impacts will most probably be the proposed construction of a road connecting the interior of the country with Nuquí “Animas-Nuqui” (to the south of the research area) and further to the El Valle village. To be sure, interrelations between social and environmental processes will continue changing in many complex ways.

How is LULCC gendered? (What is missing based on methods and perspectives used above?) I suggest that gendering the LULCC process further requires a global perspective on the masculinist supremacy in the production of geographic/geospatial information: how it is produced, used, and controlled, in the context of the ‘information society’, the “novel grids of power and surveillance” (Giddens 1990 in Johnston et al 2000), and the production of space and nature (Gregory 1998).

Chapter 7: Conclusions

We have learned from previous chapters how contrasting but complementary subfields of investigation, Political Ecology and Land Use Science, have contributed ontological, epistemological and practical scholarly works to address the critique and practice of Gender Dimensions of Land Use and Land Cover Change (GLULCC), tested at a collective land titled to Afro-descendant communities in the Pacific region of Colombia. Land Change Science aligns with interdisciplinary interests engaging global environmental change and thus seeks to inform land use planning, policy and decision making. Historical and current information on environmental, socioeconomic and settlement processes provided a comprehensive portrait of the study area, a collective land titled to Afro-descendant communities in 2002 established by enforcement of Law 70, which consent traditional Afro-descendant communities with ancestral livelihoods in the Pacific region of Colombia to safeguard collective land titles over the land in which they were settled. Based on the above, an Afro-Colombian Women Access-Analysis Framework was proposed.

The remote sensing process (a mainstream method for identifying land use and land cover change) helped exploring the spatial setting of land cover/use in the study area, and to reflect on the opportunities and constrains of the steps undertaken during this procedure under the lenses of researching gendered dimensions of land cover/use. A practical example using Landsat images of 1986, 1999, and 2011 was provided, for which a classification scheme with few land cover/primary land-use units were chosen (i.e. Forest, Secondary Forest, Cropland, Pastures, and Beach-bare soil) in order to explore how to link secondary land uses (gendered uses) -that may be hidden by- with land cover/ primary-use features. Extending the analysis of this remote sensing procedure, additional emphasis was given to the share of Land Change Modeling which contributed spatially explicit information on the gains, losses, and persistence of the selected land cover / primary-use classes, as well as on the trends of change of these categories throughout time. It was evident that the men-akin uses, particularly logging, and gender-neutral/inclusive uses (e.g. agriculture) that are considered primary land uses, were more easily linked to land cover or thus controlling its spatially explicit change; whereas women-akin uses (e.g. gathering, gardening, and animal husbandry) did not claim a spatial extension, nor they seem to control land cover change throughout time (at least at the spatial resolution of the chosen Landsat satellite images).

Subsequent statistical analyses on both census data (secondary data) and survey sample data (fieldwork data) allowed to establish a set of three groups of gendered land uses, namely, women-akin (gardening, gathering, and animal husbandry), men-akin (hunting, logging and sea fishing), and gender-neutral/inclusive uses (agriculture, cattle raising, and river fishing). Exploratory statistics, pairwise correlations, and binary and multinomial logit regression models helped to reassert the latter gendered categories' assertions. Indeed, regression models gave more support to the above affirmations by highlighting statistically significant relationships between primary and secondary land uses and the gender of the landowner (landholder) and/or land-user. Quantitative analysis also helped to further characterize the local population, the differences among farms with respect to their location, age under production, and their land use types, as well as other gendered dimensions of land access (e.g. by inheritance, purchase, etc.) and management.

Chapter 6 provided the narrative perspective of gendered land use and land cover change GLULCC in the study area as a way to hide the discontinuities of the intended meaning of this research, as Cronon (1992) puts it. During the writing process, it was not completely resolved by me whether this narrative should have been the starting or ending section on the research results, but I left it to the end. This hoped to bond, with another perspective, previous theoretical, spatial and quantitative outcomes, under the lenses of the practical experience of fieldwork, which also by way of participatory observation and semi-unstructured interviews brought to the researcher (me) valuable insights and information besides the previous outcomes. A preliminary access map (conceptually constructed) based on these narratives and on elements that endorse mainstreaming the gender dimensions of land use science was also provided.

This final section is a concluding contribution to furthering research in gendered land use and land cover change (GLULCC) as to work streaming/ mainstreaming what I consider will be a scholarly-fertile research line.

HYBRID ECOLOGIES

My research was mainly a 'pragmatic knowledge claim' which took place out of "situations, actions, and consequences rather than on antecedent conditions" (Creswell 2003 p.11). The strategy associated with this inquiry was one that used mixed methods. Within this strategy I chose concurrent approaches where I joint qualitative and quantitative data and information, in order to integrate and interpret these together as to obtain my general results.

By acknowledging that both political ecology and a parallel approach, land-change science (Chapter 4), provide understanding about changes in the coupled human-environment system, albeit their different emphases on causes and consequences of land transformations (Turner and Robbins 2008, National Research Council 2010), I applied three perspectives to address the critique and practice of Gender Dimensions of Land Use and Land Cover Change (GLULCC): the narrative, a spatially explicit method (the remote sensing process), and a quantitative/statistical approach. Indeed, the ample fusion in problem framing and methods of land change science and political ecology, led Turner and Robbins (2008) to raise the concept of a 'hybrid land change' or ecology to be soon realized as a sound perspective to the analysis of the coupled human-environment / nature-society relationships.

Although pertinent scholarly contribution on this 'hybrid ecology' have brought key insights to LULCC assessments (Jiang 2003, Porro 2005, Buzzelli 2008, Moseley and McCusker 2008, Aldrich et al 2012, King 2013), very few inputs have particularly focused on addressing its gender dimensions (Radel et al 2013). Thus, much more case studies in varied geographic locations as well as theoretical approaches are needed to mainstreaming/ workstreaming the gendered dimensions of land use science (GLUS).

HIDDEN GENDERED LAND USES AND SPACES

The Land Use and Land Cover Change LULCC literature is fundamentally a spatial examination that seeks to identify the aerial extent of lands (cover) that may or may not change; and it uses spatially explicit models to either statistically explain or predict such spatial outcomes (Walker, 2004). This dissertation critiqued the traditional Land Use and Land Cover Change (LULCC) remote sensing process (Chapter 4), with the purpose of highlighting issues considered important to gendered LULCC analyses built on the basic steps undertaken in this process: 1) definition of the study area; 2) statement of the problem; 3) collection and use of geospatial data; 4) radiometric and geometric correction; 5) classification process; and 6) change detection / modeling.

Additional emphasis was given using a practical digital image processing application accompanying these explanations.

However, a central problem of the Land Use and Land Cover Change (LULCC) project is the recognition that land use properties and land cover properties are closely related but fundamentally different -and that there is a ‘causality’ between these two where land cover is constantly transformed by land use changes: While 'primary land use', refers to the traditional concept of land use that directly affects and controls the land cover (e.g. Agriculture and forest as the dominant primary land uses), the secondary land-use does not claim a certain area, nor it has a significant impact on the land cover (e.g. leisure/tourism, extensive grazing and hunting) and can co-exist with primary land uses and with each other and are not easily expressed in quantitative terms.” (Bakker and Veldkamp 2008 p.208)

On one hand, this research has shown that the gendered land uses of interest in the study area (including hunting, logging, gardening, gathering, and animal husbandry) may all be considered as secondary land use functions. In contrast, only logging which is exclusively performed by men, as well as agriculture and cattle raising (both gender-neutral/inclusive land uses) clearly co-exist or are linked to primary land use which is closely associated with land cover and its change (i.e. Forest, agriculture, and pastures respectively). In addition, disparity between land use statistics and land cover observations (e.g. by using remote sensing) suggests that secondary uses (e.g. gendered land uses) should be considered when interpreting primary land use into land cover, as to allow trade-off analyses between these primary and secondary uses (Bakker and Veldkamp 2008).

Therefore, based on practicing the remote sensing process for assessing GLULCC (Chapter 4), which relies on the massive repositories of Earth Observation data to convert into information, it seems that gender-neutral/inclusive land uses more general, and some men-akin land uses (as logging), directly effect and are associated with land cover dynamics in the study area. Instead, secondary land uses that are women-akin (i.e. container gardening, gathering, and animal husbandry), do not significantly affects or control land cover. Consequently, the processing and classification of the chosen Landsat images were hiding the gendered land uses that were evident in the study area with other research approaches referred above. But at the same time, this method provided the spatial explicit configuration (patterns) of gendered uses and spaces locally (albeit understanding of these needed more ancillary data as explained in chapters 5 and 6 respectively). In multi-functional land cover such as in the research area, at least one secondary land use is combined with a primary land use; therefore, LU/LC ratios of the multi-functional nature of land may help to better understand the gender dimensions in coupled land use and land cover change modeling in future research endeavors. Similarly, the effects of these shifts from secondary to primary land uses and of gendered land uses (on both food security and livelihoods), to the community's subsistence haven't been untangled. Although (women-akin) secondary land uses do not have an explicit area demand in terms of land cover (at least at the spatial resolution of the images used in this research), considering that primary land productivity possibly diminishes as the result of these shifts, they may translate into a certain implicit area demand (Bakker and Veldkamp 2008). Therefore, more research is needed as to precise which gendered land uses and spaces are hidden and how to unhidden these when practicing the remote sensing process in GLULCC assessments.

To be sure, one may assert that assessing the spatial configuration of the land cover and its change did provide additional insights on the requirements of the secondary land uses of interest as a way to contribute for furthering multi-functional land cover pattern modeling that takes into account (gendered) secondary land uses.

On the other hand, empirical evidence during my fieldwork campaign suggested also the need of taking into account both 'temporal heterogeneity' and deeper history approaches to better understand land use and land cover change trajectories on one part, and to raise the necessity of translating and accounting (when possible) both primary and secondary land uses into land cover.

Indeed, Longer-term land use and land cover change was also found to be hidden by the above referred remote sensing practice (Chapter 4) due to that selected Landsat images tackle only the years 1986, 1999, and 2011. This assertion is mainly based on that during field research it was evident that an unusual event took place 30 to 40 years ago in the El Cedro that most probably affected the subsequent trajectories of land cover/use in the area. As was referred in Chapter 6, the El Cedro's rural area, with traditional land uses and livelihoods was largely uninhabited during my fieldwork campaign (but still essentially in use) and locals were now clustered inside the El Valle village. Locally, this resettlement was in part fostered by a women's movement, which pushed for the community's relocation to the intersection of fluvial and coastal environments where a new school was established. Women envisioning better livelihoods by way of their children's education left their husbands and clustered on what three to four decades later had become a larger village. Although recent theoretical insights on the co-production of land use and livelihoods acknowledge 'changes in each as reflective of changes in the other' (Carr and McCusker 2009), I suggest, that women's imaginary, in part encouraged by the Catholic Church running the school while acting as a second state, have also resulted in novel spatial rearrangements of land tenure and use in the study area. It is not clear what kind of intrahousehold conflicts and power relations arose as result of such decisions. Once women and children established in the village, a prudential time elapsed before men progressively decided to move their houses to the village. As houses customarily belong to Afro-descended women (Camacho 1999) same materials of old farm houses were transported into the village.

Practical (scholarly) evidence had also showed that current gendered LULCC have resulted from historical events previous to the last few decades in which my research is focused; GLULCC might be embedded, and thus could be further explained, under broader and longer traditional societal processes leading to particular customary laws and practices controlling LULCC. My research area provides empirical evidence that women's role on LULCC is well beyond the establishment of small gardens and orchards, or the collection of fuel wood to provide for their families. In contrast, inside this collective title, women's decisions/strategies have also restructured settlement patterns, and thus, land use dynamics of larger areas at various (heterogeneous) spatial and temporal scales. Afro-descendant women as a group gave momentum to rural-urban transitions yet to be untangled. How many years the above relocation process took (of both humans and animals), and the unveiled consequences on the local and sub-regional production systems remain being interesting research questions. Indeed, consequences impacting land cover by the use change (resulting of the women's social drive) at the wider the El Cedro's extension should have placed a new impetus for rural-urban transitions more general. While farms were progressively abandoned in some cases, the landholding system undoubtedly was also dynamized. In the renewed urban setting as well, gender relations most certainly readjusted in manners yet to be studied. It was evident, that the found rearrangement of settlement spaces and production systems was not only explained as the transformation of gender division of labor, authority and resource management as showed/proposed by feminist political ecologists (Rocheleau, Thomas-Slayter, and Wangari 1996). Nor this could be elucidated only by off-farm employment opportunities or changes in agricultural prices (Angelsen and Kaimanovitz 1999), thus opening opportunities for further pertinent research.

NON STRUCTURAL STATISTICAL MODELS

Statistical procedures conducted to both primary and raw secondary datasets on socioeconomic, cadastral, and land use questions at the research area provided valuable insights (ancillary data) for gendered land use assessment. Raw secondary data of a twofold census survey (NGO *Natura* 2004) on the relative location of *fincas* (farms) including their land use and tenure types, and on demographic information with emphasis on the education attainment of local inhabitants were analyzed. Exploratory statistics and cross-tab and pairwise correlations of the above secondary datasets are presented in Chapter 5. Primary data was obtained by conducting structured (survey sample) and semi-structured interviews during my dissertation fieldwork campaign that took place in 2006-2007. The resulting figures, together with findings discussed in Chapter 6 sought to assess whether or not statistic models could also help explain or reinforce evidence on gendered land use obtained by qualitative and spatially explicit research methods.

Statistical Pearson Correlations and Frequency procedures were calculated for the survey sample (n=151 and n=134). A binary/dichotomous variable named GENDER that describes the gender of each of the interviewees (woman=1; man=0) was included. As specified above, correlation results showed in general very weak figures, but at the same time confidence/significance levels at 0.05 or less were common. Significance levels and respective correlation coefficients of pairwise statistical relationships between the variable GENDER and the remainder questions, were obtained with the Frequency and Pearson's Correlation procedures. Of these results is worth noting the inverse/negative (-) and direct/positive (+) signs of these numbers' relationships between the above variables. Indeed, these correlation figures and signs highlighted gender dimensions to specific land uses, which were also evident during fieldwork: Women-akin land uses (gardening, gathering, and animal husbandry); Men-making land uses (logging, hunting, Ocean-fishing), and Gender-neutral/inclusive land uses (agriculture, cattle raising, river-fishing).

As shown above, land and water uses that are equally practiced by men or women, do not show statistically significant relationships with any of the GENDER variables and thus, these seem to have a neutral-to-gender tendency (gendered inclusive). In contrast, relationships between the GENDER variables and the remainder considered questions with relevant significance levels are showing a gendered dimension or preference. Based on the latter, it was inferred that women and men land and water use preferences are mirrored in the above statistical figures' signs and confidence levels. Hence, it may also be assumed that relationships between the GENDER variables and those of land (and water) use types with irrelevant significance levels are showing land (and water) use types that are gender-neutral or inclusive.

On the other hand, Binary Logit Models (BLM) for particular land (and water) uses, namely Hunting, Logging, Fishing, Container Gardening, Collection of fuel fodder/seeds/plant products, Animal husbandry, Agriculture, and Cattle raising, were regressed on varying number of independent variables. Subsequently, the independent

GENDER variables were included and regressed together with the previous explanatory variables in all best specified BLMs, with the aim of testing if the models improved or worsen with the inclusion of the gender variables. This was done as one suggested method for identifying/ acknowledging gender dimensions in land use and land cover assessments. In effect all gendered land-use models improved when including the variable GENDER, whilst those gender-neutral/inclusive land use models worsen by the inclusion of a GENDER variable within. In addition, once the marginal significance of each independent variable was established on its own, multinomial logistic regression (MLR) models were fitted to each dependent variable to determine which independent variables influence the characterization of gendered land-use/tenure after controlling for, or conditional on, the influence of other independent variables.

The above statistics confirmed, reassert or highlighted (new) gender dimension of land use and land cover in the El Cedro. Other interesting finding was a positive or negative spike found in many of these statistical analyses around years 23 to 35, which may confirm the narrative of the women's relocation movement of 30 to 40 years ago.

Notwithstanding the above results, Binary and Multinomial Logit models assessing GLULCC could not yet be considered structural. Due to that coefficients and significance levees depend on the sample, dependent and explanatory variables chosen, situated knowledge, and the researcher stand point, more research including different geographic locations and communities, besides larger survey samples are needed to reassert and contribute to the above findings. More so, innovative questions pertinent to myriad other research interest may allow the better understanding of GLULCC in countries with similar traits and worldwide as to empowering women based on better informed land use planning, policy and decision making.

THE NARRATIVE

The narrative hoped to bond, with another perspective, previous theoretical, spatial and quantitative outcomes, under the lenses of the practical experience of fieldwork, which also by way of participatory observation and semi-unstructured interviews brought to the researcher (me) valuable insights and information besides the previous outcomes. A preliminary access map (conceptually constructed) based on these narratives and on elements that endorse mainstreaming the gender dimensions of land use science was also provided.

It allowed detailing the nuances of local perceptions on their land use / tenure categories, as well as additional social signifiers that are temporally and spatially heterogeneous. Today the territory of El Cedro (El Valle) (Figure 70) is broadly subdivided into four main or primary land use (and land cover) types openly differentiated and recognized by the community, namely, *monte* (*bravo* and *viche*), *respaldo, rastrojo* and the El Valle village (Chapter 6). The above renders the classification process problematic considering that added uses (significances) diverging from land use and land cover properly (including those related to tenure and use conditions, or that are symbolic) may be also important for a thorough local classification scheme. Main land use categories in the El Cedro were further compared with the Anderson et al. (1976) hierarchical "resource oriented" Land Use and Land Cover Classification System for Use with Remote Sensor Data, in land use planning and management activities. Notwithstanding that this classification was developed to meet the needs of Federal and State agencies in the US.

Although the above local classification are widely used in the Colombian Pacific region, nuances of these classes are encroached inside local perceptions and believes. It is unclear how perceptions of younger generations towards land and its uses will contunue endosing current classifications. Shifting values towards land may result into fluctuating customary laws throughout time, leading to future assessment opportunities.

Indeed (as of my field campaign), *Azoteas* (gardening) are almost extinct/inexistent in *Rastrojo* (Agricultural lands), as well as does animal husbandry in both agricultural lands and secondary forest (*Monte viche*) as the result of either long-term, rarely occurring events or ‘punctuated’ processes yet to be uncovered. We may assert that currently in the rural research area, men-akin (secondary) land uses (logging, hunting) are under the trend of almost completely controlling Forest land cover in the near future. Whilst the now (women-akin) secondary uses linked to rural agricultural lands (*Rastrojo*), as are gardening and animal husbandry, practically collapsed, thus shifting to only agriculture (a primary use) more general. More so, also in *Rastrojo*, young women are in the trend of either abandoning the gender-neutral/inclusive agricultural-use or reducing its frequency.

Current social and cultural patterns of the El Cedro’s Afro-Colombian communities are supported by extended family, polygamy and matrilineal conformation (Camacho 2004), which among various other powers and mechanisms, play important roles in resource access and use.

Access analysis framework for El Cedro´s Afro-Colombian women was mapped in three main steps including: the identification of particular flows of benefits from resources; the identification of mechanisms for gaining, controlling, distributing and maintaining the benefit flow; and the analysis of the power relations underlying these mechanisms of access. I found that the simplified mapping of access analysis proposed in this dissertation based on the description of main mechanisms of access is useful as a first step towards a more detailed future version, which is turn depends on one hand on empirical context and time frame as several relative theories suggest (Macpershon 1978; Leach, Mearns and Scoones 1999; Ribot and Peluso 2003), and on the another hand, on the continued and careful reviewing of scholarly contributions under the lens of Access Theory. I suggest a simplification of chain of benefits throughout historical periods, which most probably could have been reproduced several times. These chains suggest a progression of benefits gained with both the few 'bundle of powers' and 'mechanisms of access' that Afro-Colombian women have had. Salient mechanisms of access attributed to Afro-Colombian women include: (i) gaining skills and knowledge to be used as free citizens; (ii) being pivotal to the conformation of (extended) family; (iii) access to land, initially by way of maroon movements and palenques followed by settlement processes as described in Chapter 3; (iv) social cohesion, construction of the community and reconstruction of identity; (v) development of a system for subsistence production, extraction, product transformation, exchange, transport, distribution, and consumption; (vii) diversification of livelihoods more general for the primary purpose of securing health for children and the community; and (vii) fostering social change for a progressive bettering of life.

While this dissertation objective did not focus on the historical research and insight of pertinent changes in access, in previous chapters only those 'powers' and 'mechanisms' closely related to land use and land cover change have been emphasized.

With very few powers, forbidden education attainment, under complete dispossession and extreme abuse, Afro-descendant women were key to social and cultural reconstruction and cohesion. They settled in marginal lands/territories, and resisted by all possible means. Jointly, with men and children, they formed extensive families and the black communities of Colombia. With alliances with other ethnic groups they learned agricultural practices of the new world besides other skills. In their Noah Arcs (the Azoteas) they transported seeds and nurseries to secure food provision. By roaming through marginal lands at last they established settlements in the Pacific region of Colombia. In the possessed lands agricultural practices, animal husbandry and other livelihoods flourished although precariously. Land use dynamized. Finally they were able to put forward amongst the most radical territorial titling processes (Offen 2003) in Latin America, and secured collective lands for future generations. Still with low education attainment, no doctor or hospital in the village, they have managed to survive. This showed how women more general under extreme situations will find ways (mechanisms) to create new societies and a chain of benefits.

COROLLARY

I may now claim that land use and land cover change is definitively GENDERED.

Could one of the research approaches described in chapters 4, 5 and 6 autonomously provided enough insights as to arrive to same conclusions of this dissertation? I contend not. It was the integration of all of these which allowed a stronger answer to main research questions and to pose a genuine proposition to scholars, practitioners and policy makers worldwide to workstreaming / mainstreaming GLULCC.

Afro-Colombian communities have resisted and endorsed us to offer this contribution to knowledge production! Our gratitude to them.

Table 1: Historical land use in the Pacific region

Pacific Region - Historic Period	**Economic Activities/ Land Uses (Spatial resolution 100s km2)**
Pre-Spanish <1500	Shifting agriculture, fishing (1) Forest recovery (2)
Conquest 1500–1600	Mining, shifting agriculture, fishing (1) Forest recovery, first cattle imports in 1540 (2)
Colonial 1600–1800	Mining, shifting agriculture, fishing (1) Forest recovery (2)
Independence 1800–1850	Mining, shifting agriculture, fishing (1) reduced mining (2)
Antioqueño colonization 1850–1920	Shifting agriculture, fishing, plant ivory (7,000 tons/year) (1), rubber, paid labor based plantations, land tenure concentration (2),
Early twentieth century 1920–1970	Timber, mining, shifting agriculture, fishing, industrial mining (1), road and train infrastructure expands transforming forests, industrialization, Main cities: Quibdo (exploitation center for gold and platinum, Buenaventura and Tumaco (harbors) (2)
Late twentieth century 1970–2000	Timber, shifting agriculture, aquaculture, oil Palm, Industrialization, Metropolitization (1)

* Extracted from (1) Etter et al 2008; and (2) Marquez 2001

Table 2: Percentage of slaves sold in Cartagena

Age	**1705-13**		**1715-27**		**1730-38**	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
<10	5,4	0,8	6	2,6	1,3	2
11-15	17,1	4,6	13	7,3	23,9	15
16-20	36,7	11,2	29,3	19,6	36,5	18,7
21-25	13,3	4,5	14,9	1,3	2,3	0,4
26-30	5,3	0,3	3,7	0,5	0	0
>30	0,5	0,2	0	1,6	0	0
	78,3	**21,6**	**66,9**	**32,9**	**64**	**36,1**

Source: Colmenares (1991) p.28

Table 3: Extractive economy in the Pacific region after 1850

Pacific Region - Historic Period	Extractive economy products After 1850
1850-1950	Plant ivory, latex/rubber, platinum
1916-1980	New gold cycle with drags
1940-present	Logging, new gold cycle
1948-1980	Red mangroves tannin extraction
1977-1996	Naidi palm
1980- present	Other minor natural products: e.g. fish and pelt products

Adapted from Leal and Restrepo (2003)

Table 4: Landsat TM and ETM sensor system characteristics

Band	Spectral Resolution (μm)	Spectral region	Spatial resolution (meters)
1	0.45 - 0.52	Blue	30
2	0.52 - 0.60	Green	30
3	0.63 - 0.69	Red	30
4	0.76 - 0.90	Near Infrared (IR)	30
5	1.55 - 1.75	Middle IR	30
6	10.40 - 12.50	Thermal IR	120 (TM) - 60 (ETM)
7	2.08 - 2.35	Middle IR	30
8	0.52-0.9	Panchromatic	15 (ETM)

Revisit = 16 days

Altitude = 705 km (Sun-synchronous)

Adapted from Jensen (2007)

Table 5: Selected Landsat images for Land Use Change Modelling

Year	Path/Row	Date	Mission	Coordinate System
1986	10/056	3/23/1986	Landsat 5TM	UTM WGS 84 Zone 18
1999	10/056	8/10/1999	Landsat 7ETM+	UTM WGS 84 Zone 18
2011	10/056	3/12/2011	Landsat 5TM	UTM WGS 84 Zone 18

Table 6: Land Use/Cover Classification Scheme

Level I	level II
Urban or Built-up Land	
Agricultural Land	Cropland Pasture
Forest Land	Evergreen Forest Land Intervened Forest Land
Water	River Streams Ocean
Barren Land	Beaches
No Information	Clouds and shadows

Table 7: Contributors to Net Change of Forest (1986-1999)

Land cover / Primary-use Class (km2)	Broad Area	El Cedro
Forest Land	0	0
Intervened/Secondary Forest Land	-35,42	-9,48
Agricultural Land- Cropland	-5,27	-2,05
Agricultural Land -Pasture	-4,99	-2,35
Rivers	-0,04	0,03
Urban or Built-Up Land	-0,22	-0,17
Beaches	0,36	-0,21
Seawater	0,26	0,11
Without information/clouds and shade	168,17	5,04

Table 8: Contributors to Net Change of Secondary Forest (1986-1999)

Land cover / Primary-use Class (Km2)	Broad Area	El Cedro
Forest Land	35,42	9,48
Intervened Forest Land	0	0
Agricultural Land- Cropland	-5,56	-3,45
Agricultural Land -Pasture	-3,23	-2,1
Rivers	-0,04	-0,01
Urban or Built-Up Land	-0,03	-0,02
Beaches	0,05	0
Seawater	0	-0,01
Without information/clouds and shade	38,96	1,56

Table 9: Contributors to Net change of Croplands (1989-1999)

Land cover / Primary-use Class (km2)	Broad Area	El Cedro
Forest Land	5,27	2,05
Intervened Forest Land	5,56	3,45
Agricultural Land- Cropland	0	0
Agricultural Land -Pasture	11,11	7,64
Rivers	0	0,03
Urban or Built-Up Land	-0,12	-0,08
Beaches	-0,14	-0,11
Seawater	0	0
Without information/clouds and shade	6,53	0,4

Table 10: Contributors to Net change of Pastures (1986-1999)

Land cover / Primary-use Class (km2)	Broad Area	El Cedro
Forest Land	4,99	2,35
Intervened / Secondary Forest Land	3,23	2,1
Agricultural Land- Cropland	-11,11	-7,64
Agricultural Land -Pasture	0	0
Rivers	-0,26	-0,17
Urban or Built-Up Land	-0,01	0
Beaches	0,04	0
Seawater	-0,01	-0,01
Without information/clouds and shade	4,83	-0,08

Table 11: Contributors to Net Change of Built-Up Areas (1986-1999)

Land cover / Primary-use Class (km2)	Broad Area	El Cedro
Forest Land	0,22	0,17
Intervened / Secondary Forest Land	0,03	0,02
Agricultural Land- Cropland	0,12	0,08
Agricultural Land -Pasture	0,01	0
Rivers	0,01	0
Urban or Built-Up Land	0	0
Beaches	0,06	0,03
Seawater	0	0
Without information/clouds and shade	0	0

Table 12: Contributors to Net Change of Forest (1999-2011)

Land cover / Primary-use Class (km2)	Broad Area	El Cedro
Forest Land	0	0
Intervened / Secondary Forest Land	-26,98	-11,01
Agricultural Land- Cropland	-2,13	-7,6
Agricultural Land -Pasture	-6,91	-4,49
Rivers	0,53	-0,31
Urban or Built-Up Land	-0,01	-0,35
Beaches	0,21	-0,28
Seawater	-0,02	-0,1
Without information/clouds and shade	-6,52	4,6

Table 13: Contributors to Net Change of Secondary Forest (1999-2011)

Land cover / Primary-use Class (km2)	Broad Area	El Cedro
Forest Land	26,98	11,01
Intervened / Secondary Forest Land	0	0,00
Agricultural Land- Cropland	-5,25	-9,63
Agricultural Land -Pasture	-17,6	-5,99
Rivers	-0,17	0,03
Urban or Built-Up Land	-0,01	-0,13
Beaches	0,01	-0,04
Seawater	0	-0,07
Without information/clouds and shade	-4,18	1,46

Table 14: Contributors to Net Change of Cropland (1999-2011)

Land cover / Primary-use Class (km2)	Broad Area	El Cedro
Forest Land	2,13	7,6
Intervened / Secondary Forest Land	5,25	9,63
Agricultural Land- Cropland	0	0
Agricultural Land -Pasture	-16,23	4,34
Rivers	-0,26	0,51
Urban or Built-Up Land	-0,03	-0,1
Beaches	0	-0,06
Seawater	0	0
Without information/clouds and shade	-1,72	1,6

Table 15: Broad Area Contributors to Net Change of Pastures (1999-2011)

Land cover / Primary-use Class (km2)	Broad Area	El Cedro
Forest Land	6,91	4,49
Intervened / Secondary Forest Land	17,6	5,99
Agricultural Land- Cropland	16,23	-4,34
Agricultural Land -Pasture	0	0,00
Rivers	0,2	0,34
Urban or Built-Up Land	-0,09	-0,06
Beaches	0,11	0,01
Seawater	0,01	-0,05
Without information/clouds and shade	-0,61	0,99

Table 16: Contributors to Net Change of Built-Up Areas (1999-2011)

Land cover / Primary-use Class (km2)	Broad Area	El Cedro
Forest Land	1,0	0,35
Intervened / Secondary Forest Land	1,0	0,13
Agricultural Land- Cropland	3,0	0,10
Agricultural Land -Pasture	9,0	0,06
Rivers	3,0	0,04
Urban or Built-Up Land	0,0	0,00
Beaches	3,0	0,05
Seawater	0,0	0,02
Without information/clouds and shade	0,0	0,06

Table 17: Broad Area- Land Cover 1986, 1999, and 2011

Land cover / Primary-use Class (km2)	1985	1999	2011
Forest Land	3,375,405	4,603,995	4,185,873
Intervened / Secondary Forest Land	732,402	1,387,872	138,564
Agricultural Land- Cropland	116,658	398,736	290,025
Agricultural Land -Pasture	265,815	282,915	686,502
Rivers	32,517	40,761	37,413
Urban or Built-Up Land	0,45	0,909	11,115
Beaches	47,988	63,081	34,533
Seawater	1,197,855	1,135,458	141,948
Without information/clouds and shade	284,526	696,492	567,819
Total	861,84	861,84	861,84

Table 18: El Cedro Land Cover 1986, 1999, and 2011

Land cover / Primary-use Class (km2)	1985	1999	2011
Forest Land	85,9	76,8	66,4
Intervened / Secondary Forest Land	33,0	38,5	29,6
Agricultural Land- Cropland	4,2	17,6	27,7
Agricultural Land -Pasture	13,7	10,2	21,0
Rivers	2,0	2,3	1,6
Urban or Built-Up Land	0,0	0,3	0,8
Beaches	0,9	1,3	1,1
Seawater	0,5	0,1	0,7
Without information/clouds and shade	10,1	3,1	1,3
Total	150,3	150,3	150,3

Table 19: El Cedro Management Zones and Farms

Zone # And Name		Zone Area			Farms			
		HA	km2	%	#	%	#/km2	Mean # HA
1	Nimiquia	4,464	45	31	33	8	1	135
2	Pozamansa	2,111	21	14	32	8	2	66
3	Boroboro	1,172	12	8	81	20	7	14
4	Angia and Caimanera	2,274	23	16	77	19	3	30
5	Tundo and Chado	3,637	36	25	93	23	3	39
6	Beach - Sendero Utria	944	9	6	84	21	9	11
Total		14,602	146	100	400	100	3	37

Table 20: Landholding and Land Use per Management Zone

Zone Name	Main Land Tenure Characteristics	Main Land Use Characteristics
1. Nimiquia	All land managers are men Fewest # of persons that manage more than one farm	Highest % of farms with cattle raising Lowest river fishing Not a high proportion of farms in use/production under 30 years old - redistribution processes of land property Highest rankings of farms in the 30-49 years range under usage 2nd Hunting's highest percentage of usage in *Respaldo* - good hunting resources
2. Pozamansa	Highest % of men land owners/ managers	2nd Highest % of farms with cattle raising 2nd Lowest river fishing- 2nd Highest in Hunting, timber, and the construction of boats Highest proportion of farms with ages of more than 50 years of usage Lowest % of its total farms' *Respaldo* is used by no one
3. Boroboro	Highest # of persons that own/ manage more than one farm	2nd Highest usage in agriculture Highest in river fishing Highest in Hunting, timber, and the construction of boats 2st ranking of farms in the 30-49 years range of usage
4. Angia and Caimanera	Highest # of persons that manage more than one farm Oldest area under production - Large proportion of women land managers	Highest usage in agriculture 3rd Highest ranking of plots in the 30-49 years range under usage
5. Tundo and Chado	Highest # of farms Lower number of land tenants than other areas of highest # of farms (i.e. Beach and Boroboro) Highest # of persons that manage more than one farm 2nd Oldest area under production Large proportion of women land owners/ managers	3rd Lowest in river fishing 2nd Highest proportions of farms in use/production under 30 years old - redistribution processes of land property 2nd Highest proportion of plots with ages of more than 50 years Hunting's highest percentage of usage in *Respaldo* - good hunting resources
6. Beach and Sendero Utria	Highest % of women land managers 3rd Oldest area under production	2nd Highest in fishing Highest proportions of farms in use/production under 30 years old - redistribution processes of land property

Table 21: Gendered Land Tenure in El Cedro (Year 2004)

#	ZONE NAME	TOTAL PLOTS		LAND TENANTS (LT)			LT WOMEN			LT MEN		
		#	**%**	**#**	**% of total**	**> 1 plot**	**#**	**% zone**	**> 1 plot**	**#**	**% zone**	**> 1 plot**
1	NIMIQUIA	33	8	28	10	4	7	25	0	21	75	4
2	POZAMANSA	32	8	24	8	5	4	17	0	20	83	5
3	BOROBORO	81	20	52	18	17	8	15	1	44	85	16
4	ANGIA AND CAIMANERA LOW AND MID AREAS	77	19	56	19	12	13	23	0	43	77	12
5	TUNDO AND CHADO	93	23	65	22	19	13	20	4	52	80	15
6	BEACH - SENDERO UTRIA	84	21	67	23	13	18	27	2	49	73	11
	Total / Mean	**400**	**100**	**292**	**100**	**70**	**63**	**21** Mean	**7**	**229**	**79** Mean	**63**

Based on: *Natura* census 2004

Table 22: Classification Schemes for Farms under Production (years)

Defined by Researcher	Natural Breaks 3 classes	4 classes	5 classes
< 30	1-17	1-13	1-11
30-49	18-38	14-28	12-22
>50	39-90	29-45	23-35
		46-90	36-55
			56-90

Table 23: Population Cohorts per Gender in El Cedro (Year 2004)

	Women			Men			Total		
Age	**#**	**%**	**Cum***	**#**	**%**	**Cum***	**#**	**%**	**Cum***
0-4	112	10	10	149	12	12	261	11	11
5-9	147	14	24	185	15	27	332	14	26
10-14	178	16	40	188	15	43	366	16	42
15-19	160	15	55	173	14	57	333	14	56
20-24	79	7	62	83	7	64	162	7	63
25-29	54	5	67	62	5	69	116	5	68
30-34	74	7	74	57	5	74	131	6	74
35-39	65	6	80	71	6	79	136	6	80
40-44	50	5	84	58	5	84	108	5	84
45-49	31	3	87	48	4	88	79	3	88
50-54	38	3	91	36	3	91	74	3	91
55-59	32	3	94	30	2	93	62	3	94
60-64	20	2	96	26	2	96	46	2	96
65-69	11	1	97	14	1	97	25	1	97
70-74	19	2	98	15	1	98	34	1	98
75-79	8	1	99	18	1	99	26	1	99
80-84	4	0	99	4	0	100	8	0	100
>=85	6	1	100	3	0	100	9	0	
Total	1088	100		1220	100		2308	100	

Based on: *Natura* census 2004 *Cumulative Percentage

Table 24: Illiterate People in El Cedro in 2004 (%).

Neighborhood	Women		Women>15		Men		Men>15	
	#	%	#	%	#	%	#	%
Miraflores	110	13	40	18	139	16	38	16
La Esperanza	27	17	15	41	32	20	11	20
Maria Inmaculada	15	13	5	16	21	18	8	24
Buenos Aires	25	12	9	18	42	19	17	28
Lourdes	15	14	8	23	17	16	3	10
Las Palmeras	11	11	5	13	8	8	4	17
El Centro	1	8	0	0	0	0	0	0
Pueblo Nuevo	4	7	1	6	4	7	2	7
Maria Auxiliadora	39	17	9	19	51	22	15	25
San Rafael	7	7	2	6	8	8	1	4
Cinco de Mayo	19	15	10	33	27	21	5	13
Nagles	15	18	6	27	10	12	3	18
Candelaria	2	3	0	0	7	11	2	11
Las Malvinas	5	15	0	0	8	24	1	13
Av. Punta Roca	1	6	0	0	1	6	0	0
Rural	4	12	4	57	11	32	7	37
Total / average	**300**	**13**	**114**	**19**	**386**	**17**	**117**	**18**

Based on: *Natura* census 2004

Table 25: Education Attainment per Gender in El Cedro (2004).

Education Attainment Category per age class	Women Average %	Men Average %
KG/3-5	49	23
PS/6-11	81	86
SS/12-15	58	50
MV/16-17	9	2
HE/>= 18	10	9
Average	41	34

Based on: *Natura* census 2004

Table 26: Correlation Figures on the Number of Farms (2004)

Variable (Number or Percentage per Management Zone MZ)	**Total Number of Farms /MZ (N_PLOTS/ MZ)**
Men who are Land Tenants/Managers (LTMEN)	0.99677***
Men with more than one farm parcels (M>1FARM)	0.89011*
Farms Land Parcels used in Agriculture (AGR)	0.97977***
Farms used in Cattle Raising (CATTLE)	-0.87738*
Farms used for gathering Handcraft materials (CRAFTS)	0.83478*
Farms used in Hog Breeding (F_PIGS)	-0.98069***
Farms older than 50 years in use (F>50y)	0.83968*
Farms of less than 30 years of use (F<30y)	0.98576***
Farms of less than 17 years of use (F<17y)	0.91229*
Farms between 18 and 38 years of use (F18_38y)	0.91404*
Farms between 39 and 90 years of use (F39_90y)	0.98632***
Farms of 13 years or less of use (F1_13y)	0.89355*
Farms between 14 and 28 years of use (F14_28y)	0.90418*
Farms between 46 and 90 years of use (F46_90y)	0.84878*
Farms of 11 years or less of use (F1_11y)	0.91275*
Farms between 12 and 22 years of use (F12_22y)	0.90957*
Farms (%) between 23 and 35 years of use of Total Lots per MZ (%F23_35y)	-0.85687*
Farms between 35 and 55 years of use (P36_55y)	0.87164*
Farms Purchased/Bought (BOUGHT)	0.8425*
Farms acquired through Work or Labor (WORK)	0.82184*
Farms which *Respaldo* is used by Family members (RFAMILY)	0.95919**
Farms which *Respaldo* is used by Nobody or have No-Use (RNONE)	0.75398

* Significance level: 0.05 ** Significance level: 0.01 *** Significance level: 0.001

Table 27: Correlations of aggregated Land Use (2004)

Land Lots Number or Percentage per each Management Zone MZ)	**Land Use of Farms per Management Zone (MZ)**						
	Agriculture	**Livestock (%)**	**Fishing**	**Hunting**	**Logging**	**Handcrafts**	**Boats**
Farms (%) for Livestock breeding/Cattle Raising (%CATTLE)	-0.87877*						
Farms for Logging (WOOD)				0.79311/*	1		
Farms for Gathering Handcraft materials (CRAFTS)	0.89605*		0.8124*			1	
Farms for Logging for Boat Construction (BOATS)				0.99381***	0.7485		1
Hog Breeding (PIGS)	-0.99621***	0.89376*				-0.875*	
Farm less than 30 years of use (F<30y)	0.949**	-0.92515**				0.81109/*	
Farm less than 17 years of use (F1_17y)	0.89188*	-0.78657				0.84875*	
Farm (%) less than 17 years of use / MZ (%F1_17y)					0.73658		
Farm between 18 and 38 years of use (F18_38y)	0.94493**	-0.80202/*					
Farm between 39 and 90 years of use (F39_90y)	0.95635**	-0.7995/*					
Farm 13 years or less of use (F1_13y)	0.89078*					0.86991*	0.75774
(%) 13 years or less of use / MZ (%F1_13y)					0.8322*	0.78914	0.89068*
Farm between 14 and 28 years of use (F14_28y)	0.85948*	-0.90738*					
Farm between 46 and 90 years of use (F46_90y)		-0.77646					
Farm 11 years or less of use (F1_11y)	0.93333**	-0.75933				0.91871**	0.75312
(%) of 11 years or less of use / MZ (%F1_11y)				0.86561*	0.87643*	0.90125*	0.86991*
Farm between 12 and 22 years of use (P12_22y)	0.8289*	-0.8082/*					
Farm between 23 and 35 years of use (F23_35y)	0.85418*						
Farm (%) between 23 and 35 years of use / MZ (%F23_35y)	-0.76764	0.81606*					
Inherited (INHERIT)		-0.73764					
Acquired by Possession/Custody (POSSES)				0.79169			0.83346*
(%) acquired by Possession or Custody / MZ (%POSSES)				0.86998*	0.76644		0.88636*
Farm acquired through Work or Labor (WORK)	0.8172*						
Farm with Respaldo used by Family (RFAMILY)	0.97787***	-0.76927				0.83936*	
Farm with Respaldo for Gathering Handcrafts (RCRAFT)		0.86799*				-0.79057	
Farm with Respaldo used by Neighbors (RNEIGHBOUR)			0.9402**				

* Significance level: 0.05 ** Significance level: 0.01 *** Significance level: 0.001 /* Significance level: >0.05 -<0.06

Note: Blank spaces are figures outside the considered significance levels

Table 28: Correlations of aggregated Land Tenants

Variables per Management Zone	Land tenants of all genders (LTENANT)	Persons with >1 farm (LTENANT>1)
Women who are Land Tenants/managers (LTWOM)	0.89639*	
Men who are Land Tenants/managers (LTMEN)	0.98708***	0.89704*
Farms that are used in Agriculture (AGR)	0.93084**	0.92557**
Farms with Livestock breeding/Cattle Raising (CATTLE)	-0.87639*	-0.74659
Farms used for Gathering Handcraft materials (CRAFTS)		0.89504*
Hog Breeding (PIGS)	-0.95126**	-0.89504*
Farms Older than 50 years in use (F>50y)	0.81242*	0.80894/*
Farms of Less than 30 years of use (F<30y)	0.97754***	0.88285*
Farms of 17 or less years of use (Yr1_17)	0.80874/*	0.97516***
Between 18 and 38 years of use (Yr18_38)	0.89627*	0.79409/*
Farms Between 39 and 90 years of use (F39_90y)	0.96815**	0.91105*
13 years or less of use (Yr1_13)		0.99476***
Between 14 and 28 years of use (Yr14_28)	0.93987**	
Between 46 and 90 years of use (Yr46_90)	0.83648*	0.7957/*
Farms of 11 years or less of use (F<11y)	0.79322/*	0.99378***
Between 12 and 22 years of use (Yr12_22)	0.89611*	0.83066*
Farms (%) between 23 and 35 years of use per MZ (%F23_35y)	-0.85054*	-0.80565/*
Between 36 and 55 years of use (Yr36_55)	0.85116*	0.80705/*
Farms Purchased/Bought (BOUGHT)	0.8249*	0.8184*
Farms Inherited (INHERIT)	0.77023	
Farms Acquired by Possession/Custody (POSSES)		0.91318*
Farms Acquired through Work or Labor (WORK)		0.86962*
Respaldo used by Family members (RFAMILY)	0.91281*	0.91331*
Respaldo used by Nobody or No-Use (RNONE)	0.84228*	

* Significance level: 0.05 ** Significance level: 0.01

*** Significance level: 0.001 /* Significance level: >0.05 -<0.06

Note: Empty records are results with very weak correlation figures

Table 29: Correlations of aggregated Gendered Land Tenure (2004)

Land Lots Number or Percentage per each Management Zone MZ)	Farms of Women (LTWOM)	Farms (%) of Women (LTWOM%)	Women with >1 farm (W>1FARM)	Farms of Men (LTMEN)	Farms (%) of Men (LTMEN%)	Men with >1 Lots (M>1FARM)
Farm used in Agriculture (AGR)				0.96515**		0.92569**
Farms (%) used in Livestock breeding/Cattle Raising (%CATTLE)	-0.7406			-0.88132*		
Farms used in Hunting (HUNT)						0.7638
Farms (%) used in Hunting per MZ (%HUNT)		-0.91767**			0.91767**	
Farms used in Logging (WOOD)					0.78837	
Farms (%) in Logging per MZ (%WOOD)	-0.82803*	-0.78773			0.78773	
Farms used for Gathering Handcraft materials (CRAFTS)				0.80245/*		0.9402**
Farms used fro Logging for Boat Construction (BOATS)						0.80301/*
Farms (%) Logging for Boat Construction per MZ (%BOATS)		-0.89095*			0.89095*	
Hog Breeding (PIGS)				-0.97211**		-0.89319*
Farms older than 50 years in use (AGE_M50)			0.89923*	0.84799*		
Less than 30 years of use (AGE_L30)	0.80402/*			0.99102***		0.83298*
Between 39 and 90 years of use (Yr39_90)	0.78284			0.98637***		0.87474*
13 years or less of use (Yr1_13)				0.8622*		0.97066**
Farms of (%) 13 years or less of use per MZ (Yr1_13P)		-0.77609			0.77609	0.83502*
Between 46 and 90 years of use (Yr46_90)			0.89204*	0.86214*		
11 years or less of use (Yr1_11)				0.87927*		0.99074***
(%) 11 years or less of use per MZ (Yr1_11P)						0.89806*
Farms (%) between 23 and 35 years of use per MZ (Yr23_35P)			-0.76068	-0.87265*		
Between 35 and 55 years of use (Yr36_55)				0.86299*		0.83748*
Between 56 and 90 years of use (Yr56_90)			0.87625*			
Farms Purchased/Bought (BOUGHT)			0.90007*	0.85376*		
Farms Inherited (INHERIT)	0.85263*					
Farms Acquired by Possession/Custody (POSSES)						0.8823*
Farms Acquired through Work or Labor (WORK)				0.79098		0.82181*
(%) acquired through Work or Labor (WORKP)				0.74946		0.80029/*
Respaldo used by Family members (RFAMILY)				0.94419**		0.91819**
Respaldo used on Hunting (RHUNT)			0.7984/*			
Respaldo used on Logging (RLOG)			0.94388**			
Respaldo used by Nobody or No-Use (RNONE)	0.87599*			0.78766		

* Significance level: 0.05 ** Significance level: 0.01 *** Significance level: 0.001 /* Significance level: >0.05 -<0.06

Note: Blank spaces are figures outside the considered correlation and significance levels

Table 30: Correlations of aggregated Land Access

LOTS/LOTS	BOUGHT	BOUGHP	INHERI	POSES	POSESP	WORK	WORKP	DONAT	DONATP
AGE_M50	0.94553**			0.73421		0.7764			
AG_M50P									0.73276
AGE_L30	0.84854*					0.77114			
Yr1_17	0.85468*			0.90825*	0.74695	0.90039*	0.83532*		
Yr1_17P					0.77305			0.79442	
Yr18_38						0.81892*	0.84155*		
Yr39_90	0.86281*					0.79083	0.76365		
Yr39_90P								-0.82059*	
Yr1_13	0.81988*			0.94596**	0.80083/*	0.88973*	0.84358*		
Yr1_13P				0.92438**	0.95299**				
Yr14_28	0.75773					0.7464			
Yr46_90	0.9463**					0.7391			
Yr1_11	0.75869			0.90333*	0.74787	0.87939*	0.84711*		
Yr1_11P				0.86392*	0.85299*				
Yr12_22	0.93194**					0.8472*	0.76985		
Yr23_35		-0.80917/*					0.77153		
Yr23_35P	-0.8962*								
Yr36_55			0.77226						
Yr36_55P									-0.88896*
Yr56_90P									0.83345*
BOUGHT	1			0.75547		0.76018			
INHERI			1						
INHERP					-0.78629				
POSES				1		0.84931*	0.80273/*		

* Significance level: 0.05 *** Significance level: 0.001

** Significance level: 0.01 /* Significance level: >0.05 -<0.06

Table 31: Correlations on aggregated Use of the Respaldo

	RFAMILY	RFAMIP	RHUNT	RCRAFT	RCRAFTP	RLOG	RNEIGP	RNONE	RNONEP
AGE_M50						0.82078*			
AG_M50P		-0.93888**							0.75178
AGE30_50	0.85247*								-0.87102*
AG30_50P		0.96185**		0.83728*	0.83728*				
AGE_L30	0.90145*							0.83655*	
AG_L30P				-0.94017**	-0.94017**			0.85796*	
Yr1_17	0.84613*								
Yr1_17P					-0.80281/*				
Yr18_38	0.9415**	0.79585/*					-0.80129/*		
Yr18_38P					0.75491				
Yr39_90	0.96826**	0.75921							
Yr39_90P				0.91928**	0.91928**				
Yr1_13	0.87399*								
Yr14_28	0.79322/*						-0.77846	0.93463**	
Yr46_90						0.78717		0.752	
Yr46_90P		-0.9433**							0.77266
Yr1_11	0.9127*								
Yr12_22	0.77918					0.76847	-0.74948	0.78692	
Yr12_22P						0.81226*			
Yr23_35	0.85935*	0.80442/*							
Yr23_35P								-0.74126	
Yr56_90						0.88379*			
Yr56_90P		-0.95227**							0.82862*
BOUGHT	0.73294		0.73191			0.80962/*			
INHERI								0.73148	
INHERP						-0.7323			
WORK	0.80598/*		0.84172*				-0.82207*		
WORKP	0.81212*		0.80971/*				-0.8457*		
RFAMILY									-0.76024
RFAMIP									-0.90914*
RHUNT						0.92395**	-0.78358		
RHUNTP						0.75917			

* Significance level: 0.05 *** Significance level: 0.001

** Significance level: 0.01 /* Significance level: >0.05 -<0.06

Table 32: Direct (+) and Inverse (-) Correlations on individual records

Land Tenure Variable	Correlations With Other Variables
Women Land Tenants/ Managers	-Cattle breeding*, -Hunting**, -Logging for Boats*, +Farm Oldness**, -Farms acquired by possession*
Women owning/ managing more than one farm	No correlations found
Men Land Tenants / Managers	-Farms acquired by work* (this relationship is conflicting with correlations based on aggregated records)
Men owning/ managing more than one farm	+Total number of land uses***, +Fishing**, +Hunting*, +Materials for Handcrafts**, +Logging for Boats**, -Lands acquired by Inheritance/*, Lands acquired by Donation/*

* Significance level: 0.05 ** Significance level: 0.01 *** Significance level: 0.001 /* Significance level: >0.05 -<0.06

Direct (+) and Inverse (-) Correlations

Table 33: Direct (+) and Inverse (-) Correlations on MZ individual records

Management Zone		Correlations With Other Variables
1	Nimiquia	+Cattle raising**, +Hog breeding*, +Respaldo for Handcraft materials**
2	Pozamansa	+Logging**, +Hog breeding*, +Farms accessed by donation**, -Respaldo used by family**, +Respaldo used by neighbors*, +Respaldo used by nobody**
3	Boroboro	+ Total number of land uses***, +Agriculture*, +Fishing**, +Hunting***, +Logging for boats***, +Farms acquired by possession*, -Respaldo used by nobody**
4	Angia and Caimanera	+Agriculture*, -Farms acquired by purchase*, -Respaldo used by neighbors*
5	Tundo and Chado	-Total number of land uses*, -Agriculture*, -Fishing*, -Farms acquired by inheritance***, +Farms acquired by possession*, +Farms acquired by work*, +Respaldo used for Hunting***, +Respaldo used for logging***, -Respaldo used for neighbors**
6	Beach and Sendero Utria	-Total number of uses*, -Hunting**, -Logging**, -Logging for Boats*, +Farms acquired by inheritance**, -Farms acquired by possession**, -Respaldo used for Hunting**

* Significance level: 0.05 ** Significance level: 0.01 *** Significance level: 0.001 /* Significance level: >0.05 -<0.06

Table 34: Population Sample *n*= 151

El Valle village	Population of El Cedro *			Households *			n=151 Subjects Interviewed					
Neighborhood	**Total**	**Women**	**Men**	**Total**	**Women**	**Men**	**Total**	**%**	**Women**	**%**	**Men**	**%**
Miraflores	847	404	443	164	42	122	48	6	22	5	26	6
La Esperanza	161	64	97	30	5	25	5	3	3	5	2	2
Maria Inmaculada	115	55	60	27	5	22	17	15	8	15	9	15
Buenos Aires	216	98	118	40	7	33	7	3	5	5	2	2
Lourdes	107	53	54	26	6	20	4	4	3	6	1	2
Las Palmeras	98	56	42	23	10	13	6	6	4	7	2	5
El Centro	13	7	6	3	0	3	2	15	1	14	1	17
Pueblo Nuevo	61	26	35	17	3	14	4	7	3	12	1	3
Maria Auxiliadora	235	112	123	40	10	30	24	10	13	12	11	9
San Rafael	96	51	45	21	2	19	4	4	2	4	2	4
Cinco de Mayo	126	54	72	28	6	22	3	2	2	4	1	1
Nagles	85	44	41	20	2	18	5	6	3	7	2	5
Candelaria	63	28	35	12	1	11	3	5	1	4	2	6
Las Malvinas	34	16	18	7	0	7	2	6	1	6	1	6
Avenida Punta Roca	17	10	7	3	0	3	-		-		-	
Rural Area**	34	10	24	11	1	10	17	50	3	30	14	58
Total	**2308**	**1088**	**1220**	**472**	**100**	**372**	**151**	**6.5**	**74**	**3.2**	**77**	**3.3**

* Natura 2004. **12 interviewees claimed to live in the rural area. 5 subjects were interviewed in the rural area properly.

Table 35: Population Sample *n*=134 (excluding landless)2004)

`El Valle	Population of El Cedro *			Households *			Subjects Interviewed					
Neighborhood	**Total**	**Women**	**Men**	**Total**	**Women**	**Men**	**Total**	**%**	**Women**	**%**	**Men**	**%**
Miraflores	847	404	443	164	42	122	44	5	20	5	24	5
La Esperanza	161	64	97	30	5	25	5	3	3	5	2	2
Maria Inmaculada	115	55	60	27	5	22	14	12	6	11	8	13
Buenos Aires	216	98	118	40	7	33	7	3	5	5	2	2
Lourdes	107	53	54	26	6	20	4	4	3	6	1	2
Las Palmeras	98	56	42	23	10	13	6	6	4	7	2	5
El Centro	13	7	6	3	0	3	2	15	1	14	1	17
Pueblo Nuevo	61	26	35	17	3	14	3	5	3	12	0	0
Maria Auxiliadora	235	112	123	40	10	30	18	8	11	10	7	6
San Rafael	96	51	45	21	2	19	3	3	2	4	1	2
Cinco de Mayo	126	54	72	28	6	22	1	1	0	0	1	1
Nagles	85	44	41	20	2	18	5	6	3	7	2	5
Candelaria	63	28	35	12	1	11	3	5	1	4	2	6
Las Malvinas	34	16	18	7	0	7	2	6	1	6	1	6
Avenida Punta Roca	17	10	7	3	0	3	-		-		-	
Rural Area **	34	10	24	11	1	10	17	50	3	30	14	58
Total	**2308**	**1088**	**1220**	**472**	**100**	**372**	**134**	**132**	**66**	**6**	**68**	**6**

* Natura 2004. * 12 interviewees claimed to live in the rural area. 5 subjects were interviewed in the rural area properly.

Table 36: Chi Square (CHISQ) and Fisher tests for W_FARM

		Women that own / use at least one farm (W_FARM) (*n* = 134)[1]			(*n* = 151)[1]		
Independent Variables	**Coding**	**Frequency Procedure CHISQ**	**FISHER**	**Correlation CHISQ**	**Frequency Procedure CHISQ**	**FISHER**	**Correlation CHISQ**
Education [2]		0.0821 [a]	0.0808 [a]		0.0727 [a]	0.0709 [a]	
None [2]	0						
Elementary School[2]	1						
High school [2]	2						
Vocational School [2]	3						
University [2]	4						
Age	Continuous						
Born-Place							
El Valle / El Cedro[1]	1, 0		/*				
Bahia Solano [1]	1, 0						
Choco [1]	1, 0		/*			/*	
Other [1]	1, 0						
# Years Abroad [4]	Continuous						
Land Uses (LU) / Livelihoods (L) [1]							
Agriculture [1]	1, 0						
Cattle Raising [1]	1, 0						
Gardening/Azoteas [1]	1, 0	***	***	0.63177***	***	***	0.56105***
Handcrafts [1]	1, 0	0.0844 [a]	0.0701 [a]	0.18692*			
Gathering[1]	1, 0	***	***	0.37708***	***	***	0.3068***
Animal Husbandry [1]	1, 0	***	***	0.50828***	***	***	0.51224***
Hunting [1]	1, 0	***	***	-0.38233***	***	***	-0.35416***
Logging [1]	1, 0	***	***	-0.42649***	***	***	-0.36651***
Fishing [1]	1, 0						
River Fishing in [1]	1, 0						
Sea Fishing [1]	1, 0	**	**	-0.24381**	**	**	-0.24866**
School Teacher [1]	1, 0	*	*	0.19932*	*	*	0.17865*
Cookers [1]	1, 0	***	***	0.88078***	***	***	0.78725***
Total # of LU/ L [4]	1, 0	***		0.52708***	***		0.49884***
Env. Knowledge Tran.[1]							
By Mother [1]	1, 0	**	**	0.27981**	**	***	0.27146***
By Father [1]	1, 0	**	**	-0.24757**	*	*	-0.18222*
Themselves [1]	1, 0	**	**	-0.28373***	**	*	-0.22916**
Taught by Others [1]	1, 0	*	*	0.20952*	**	**	0.23117**

[1] Binary Variable (1=Yes; 0=No) — * Significance level: 0.05 — CHISQ: Chi-Square Test
[2] Interval Variable — ** Significance level: 0.01 — FISHER: Fisher's Exact Test
[3] Categorical Variable — *** Significance level: 0.001 — (P) = Probability
[4] Continuous Variable — / * Significance level: >0.05-<=0.07 — [a] Significance level >0.07
Blank entries indicate a very weak correlations without conventional statistical significant levels

Table 36 (continued)

		Women that own / use at least one farm (W_FARM) (*n* = 134)[1]			(*n* = 151)[1]		
Independent Variables	**Coding**	**Frequency Procedure**		**Correlation**	**Frequency Procedure**		**Correlation**
		CHISQ	**FISHER**	**CHISQ**	**CHISQ**	**FISHER**	**CHISQ**
Animal Husbandry							
None[1]	1, 0	***	***	-0.50687***	***	***	-0.48859***
Consumption (cs)[1]	1, 0	***	***	0.29540***	**	**	0.25406 **
For Sale (s) [1]	1, 0		/*		*	*	0.16399*
For (cs + s)[1]	1, 0	**	**	0.25139**	**	***	0.26392**
Income/ Month [4]	Continuous	0.0796 [a]			0.0592 [a]		
Fixed Income [1]	1, 0			0.18692*	**	*	0.2071*
Income/ Month COL$[3]		***	***	-0.34028***	**	**	-0.28789***
<=150,000 COL$ [3]	1						
151,000-550,000 [3]	2						
>551,000 [3]	3						
# of Key Goods[4]	Continuous						
Income Nat. Breaks [3]		**	**	-0.31872***	*	**	-0.27571***
<=400,000 COL$ [3]	1						
401,000-1'500,000 [3]	2						
>1'500,000 [3]	3						
Expenses / Month [4]	Continuous				0.0978 [a]		
PI Expenses COL$ [3]		*	*	-0.2472**	*	*	-0.21694**
<=150,000 COL$ [3]	1						
151,000-550,000 [3]	2						
>551,000 [3]	3						
Expenses Nat Breaks [3]		*	*	-0.26237**	*	*	-0.23043**
<=900,000 COL$ [3]	1						
901,000-1'700,000 [3]	2						
>1'700,000 [3]	3						
Civil status							
Married or Free Union[1]	1, 0						
Divorced[1]	1, 0						
Single[1]	1, 0						
Widow[1]	1, 0						
Other[1]							
Female=1; Male=0 [1]							
Total # of Children [4]	Continuous						
# Children 0, 1-5, >5 [3]	0, 1, 2						

[1] Binary Variable (1=Yes; 0=No) — * Significance level: 0.05 — CHISQ: Chi-Square Test
[2] Interval Variable — ** Significance level: 0.01 — FISHER: Fisher's Exact Test
[3] Categorical Variable — *** Significance level: 0.001 — (P) = Probability
[4] Continuous Variable — / * Significance level: >0.05-<=0.07 — [a] Significance level >0.07
Blank entries indicate a very weak correlations without conventional statistical significant levels

Table 36 (continued)

		Women that own / use at least one farm (W_FARM) (*n* = 134)[1]			(*n* = 151)[1]		
Independent Variables	**Coding**	**Frequency Procedure**		**Correlation**	**Frequency Procedure**		**Correlation**
		CHISQ	**FISHER**	**CHISQ**	**CHISQ**	**FISHER**	**CHISQ**
Land Tenure Type							
Collective [1]	1, 0						
Private [1]	1, 0						
Inherited /donation[1]	1, 0						
To be Inherited [1]	1, 0						
Possession [1]	1, 0						
Bought [1]	1, 0						
Of the husband [1]	1, 0			0.18078/*			0.18076/*
Work/ clearing / will[1]	1, 0						
Farm Distance Hours [4]	1, 2, 3						
# Farms Owned [4]	Continuous				*	**	
Person with >1 Farm[1]	1, 0						
Management Zone [1]							
1: Nimiquia[1]	1, 0						
2: Pozamansa[1]	1, 0						
3: Boroboro[1]	1, 0						
4: Angia & Caimanera[1]	1, 0						
5: Tundo & Chado[1]	1, 0		/*		*	*	0.16394*
6: Beach & S. Utria[1]	1, 0						

[1] Binary Variable (1=Yes; 0=No) * Significance level: 0.05 CHISQ: Chi-Square Test
[2] Interval Variable ** Significance level: 0.01 FISHER: Fisher's Exact Test
[3] Categorical Variable *** Significance level: 0.001 (P) = Probability
[4] Continuous Variable / * Significance level: >0.05-<=0.07 [a] Significance level >0.07
Blank entries indicate a very weak correlations without conventional statistical significant levels

Table 37: Chi Square (CHISQ) and Fisher tests for M_FARM

		Men that own / use at least one farm (M_FARM)					
		(*n* = 134)[1]			**(*n* = 151)[1]**		
Independent Variables	**Coding**	**Frequency Procedure CHISQ**	**Frequency Procedure FISHER**	**Correlation CHISQ**	**Frequency Procedure CHISQ**	**Frequency Procedure FISHER**	**Correlation CHISQ**
Education [2]							
None [2]	0						
Elementary School[2]	1						
High school [2]	2						
Vocational School [2]	3						
University [2]	4						
Age	Continuous						
Born-Place							
El Valle / El Cedro[1]	1, 0		/*			*	
Bahia Solano [1]	1, 0						
Choco [1]	1, 0		/*			/*	
Other [1]	1, 0						
# Years Abroad [4]	Continuous						
Land Uses (LU) / Livelihoods (L) [1]							
Agriculture [1]	1, 0				*	0.0516 [a]	0.16545*
Cattle Raising [1]	1, 0						
Gardening/Azoteas [1]	1, 0	***	***	-0.63177***	***	***	-0.5845***
Handcrafts [1]	1, 0	*	*	-0.18692*	**	**	-0.23368**
Gathering[1]	1, 0	***	***	-0.37708***	***	***	-0.35688***
Animal Husbandry [1]	1, 0	***	***	-0.50828***	***	***	-0.42294***
Hunting [1]	1, 0	***	***	0.38233***	***	***	0.38268***
Logging [1]	1, 0	***	***	0.42649***	***	***	0.44261***
Fishing [1]	1, 0						
River Fishing in [1]	1, 0						
Sea Fishing [1]	1, 0	**	**	0.24381**	**	**	0.22684**
School Teacher [1]	1, 0	*	*	-0.19932*	**	*	-0.21375**
Cookers [1]	1, 0	***	***	-0.88078***	***	***	-0.78112***
Total # of LU/ L [4]	1, 0	***		-0.52708***	***		-0.42786***
Env. Knowledge Tran.[1]							
By Mother [1]	1, 0	**	**	-0.27981**	*	*	-0.18926*
By Father [1]	1, 0	**	**	0.24757**	***	***	0.28255***
Themselves [1]	1, 0	***	**	0.28373***	***	***	0.29685***
Taught by Others [1]	1, 0	*	*	-0.20952*	*	*	-0.19322*

[1] Binary Variable (1=Yes; 0=No) * Significance level: 0.05 CHISQ: Chi-Square Test
[2] Interval Variable ** Significance level: 0.01 FISHER: Fisher's Exact Test
[3] Categorical Variable *** Significance level: 0.001 (P) = Probability
[4] Continuous Variable / * Significance level: >0.05-<=0.07 [a] Significance level >0.07
Blank entries indicate a very weak correlations without conventional statistical significant levels

Table 37 (continued)

Independent Variables	Coding	Men that own / use at least one farm (M_FARM) (*n* = 134)[1] Frequency Procedure CHISQ	FISHER	Correlation CHISQ	(*n* = 151)[1] Frequency Procedure CHISQ	FISHER	Correlation CHISQ
Animal Husbandry							
None[1]	1, 0	***	***	0.50687***	***	***	0.44027***
Consumption (cs)[1]	1, 0	***	***	-0.29540***	***	***	-0.28255***
For Sale (s) [1]	1, 0		/*				
For (cs + s)[1]	1, 0	**	**	-0.25139**	*	**	-0.20951**
Income/ Month [4]		0.0594 [a]					
Fixed Income [1]	1, 0	*	*	-0.18692*	*	*	-0.17744*
Income/ Month COL$[3]	Continuous	***	***	0.34028***	**	**	0.29782***
<=150,000 COL$ [3]	1						
151,000-550,000 [3]	2						
>551,000 [3]	3						
# of Key Goods[4]	Continuous						
Income Nat. Breaks [3]		**	**	0.31872***	*	**	0.27667***
<=400,000 COL$ [3]	1						
401,000-1'500,000 [3]	2						
>1'500,000 [3]	3						
Expenses / Month [4]	Continuous	0.0947 [a]					
PI Expenses COL$ [3]		*	*	0.2472**	*	*	0.20244*
<=150,000 COL$ [3]	1						
151,000-550,000 [3]	2						
>551,000 [3]	3						
Expenses Nat Breaks [3]		*	**	0.26237**	0.0601 [a]	*	0.22566*
<=900,000 COL$ [3]	1						
901,000-1'700,000 [3]	2						
>1'700,000 [3]	3						
Civil status							
Married or Free Union[1]	1, 0					/*	
Divorced[1]	1, 0						
Single[1]	1, 0					/*	
Widow[1]	1, 0						
Other[1]							
Female=1; Male=0 [1]	1, 0	***	***	-0.95527***	***	***	-0.88485***
Total # of Children [4]	Continuous						
# Children 0, 1-5, >5 [3]	0, 1, 2						

[1] Binary Variable (1=Yes; 0=No) — * Significance level: 0.05 — CHISQ: Chi-Square Test
[2] Interval Variable — ** Significance level: 0.01 — FISHER: Fisher's Exact Test
[3] Categorical Variable — *** Significance level: 0.001 — (P) = Probability
[4] Continuous Variable — / * Significance level: >0.05-<=0.07 — [a] Significance level >0.07
Blank entries indicate a very weak correlations without conventional statistical significant levels

Table 37 (continued)

		Men that own / use at least one farm (M_FARM) (*n* = 134)[1]			(*n* = 151)[1]		
Independent Variables	**Coding**	**Frequency Procedure**		**Correlation**	**Frequency Procedure**		**Correlation**
		CHISQ	**FISHER**	**CHISQ**	**CHISQ**	**FISHER**	**CHISQ**
Land Tenure Type							
Collective [1]	1, 0						
Private [1]	1, 0						
Inherited /donation[1]	1, 0						
To be Inherited [1]	1, 0						
Possession [1]	1, 0						
Bought [1]	1, 0						
Of the husband [1]	1, 0	0.0568 [a]	0.0939 [a]	-0.18078/*	0.0557 [a]	0.0924 [a]	-0.17765/*
Work/ clearing / will[1]	1, 0						
Farm Distance Hours [4]	1, 2, 3						
# Farms Owned [4]	Continuous				*	**	
Person with >1 Farm[1]	1, 0				**	***	
Management Zone [1]							
1: Nimiquia[1]	1, 0		/*				
2: Pozamansa[1]	1, 0						
3: Boroboro[1]	1, 0					/*	
4: Angia & Caimanera[1]	1, 0						
5: Tundo & Chado[1]	1, 0				*	*	
6: Beach & S. Utria[1]	1, 0					/*	

[1] Binary Variable (1=Yes; 0=No) * Significance level: 0.05 CHISQ: Chi-Square Test
[2] Interval Variable ** Significance level: 0.01 FISHER: Fisher's Exact Test
[3] Categorical Variable *** Significance level: 0.001 (P) = Probability
[4] Continuous Variable / * Significance level: >0.05-<=0.07 [a] Significance level >0.07
Blank entries indicate a very weak correlations without conventional statistical significant levels

Table 38: Statistical Significance of Correlations for GENDER1

Variable	GENDER1 (151 records)[1]			GENDER1 (134 records)[1]		
	Frequency Procedure		Correlation	Frequency Procedure		Correlation
Name and Code	CHISQ	FISHER	CHISQ	CHISQ	FISHER	CHISQ
Education Attainment (EDU)[2]	0.212	0.2147	0.08568	0.133	0.1333	0.10451
None (EDU_0)[2]						
Elementary School (EDU_1)[2]						
High school (EDU_2)[2]						
Vocational School (10th, 11th) (EDU_3)[2]						
University (EDU_4)[2]						
Land Uses / Productive Activities[1]						
Agriculture (AGR)[1]	0.4855	0.5601	-0.05676	0.8181	0.8205	-0.01986
Cattle Raising (CATT)[1]	0.2228	0.2409	-0.09921	0.3037	0.3327	-0.08885
Container Gardening/Azoteas (AZO)[1]	***	***	0.61826***	***	***	0.61001***
Handcrafts (CRAF)[1]	*	*	0.2015*	*	*	0.19291*
Fuel Fodder/ Seeds/ Plants Gathering (COLLE)[1]	***	***	0.34968***	***	***	0.389***
Animal Husbandry (ANIM)[1]	***	***	0.47121***	***	***	0.49147***
Hunting (HUNT)[1]	***	***	-0.3837***	***	***	-0.37666***
Logging (LOGG)[1]	***	***	-0.40028***	***	***	-0.41958***
Fishing (FISH)[1]	0.2955	0.3201	-0.08513	0.9117	1	-0.00958
Fishing in Rivers (FSHRIV)[1]	0.7852	0.8643	-0.02218	0.6983	0.7216	0.03349
Fishing in the Ocean (FSHOCE)[1]	**	**	-0.25079**	*	*	-0.19752*
Persons Teaching at School (TECH)[1]	0.1916	0.2628	0.10627	0.0836	0.1165	0.14947
Persons who are cookers (COOK)[1]	***	***	0.81423***	***	***	0.83547***
Other Land Uses/Activities (OTHE)[1]	0.9741	1	-0.00264	0.8319	0.8636	0.01834
Total Number of Land Uses/ Activities (TACTI)[4]	***	NC	0.43328***	***	NC	0.48784***
Environmental Knowledge[1]						
Transferred by the Mother (KMOTH)[1]	**	**	0.24274**	**	**	0.26246**
Transferred by the Father (KFATH)[1]	**	**	-0.21687**	*	*	-0.21095*
Learned by Themselves (KTHEM)[1]	**	**	-0.24094**	**	**	-0.26542**
Transferred by Other Person (KOTHE)[1]	*	*	0.17811*	*/	0.0601	0.16503*/

[1] Binary Variable (1=Yes; 0=No) * Significance level: 0.05 CHISQ: Chi-Square Test

[2] Interval Variable ** Significance level: 0.01 FISHER: Fisher's Exact Test

[3] Categorical Variable *** Significance level: 0.001 NC = Not Computed

[4] Continuous Variable */ Significance level: >0.05-<=0.06

Table 38 (continued)

Variable Name and Code	GENDER1 (151 records)[1] Frequency Procedure CHISQ	FISHER	Correlation CHISQ	GENDER1 (134 records)[1] Frequency Procedure CHISQ	FISHER	Correlation CHISQ
Monthly Income (INCOME)[4]	0.1502	NC	-0.09181	0.1147	NC	-0.10459
Fixed Income (INFIX)[1]	0.2364	0.3367	0.09636	0.223	0.311	0.10528
Customized Monthly Income COL$ (INCOMCO1)[3]	***	***	-0.32635***	***	***	-0.37222***
<=150,000 COL$ (INCOMCO1_1)[3]						
151,000-550,000 (INCOMCO1_2)[3]						
>551,000 (INCOMCO1_3)[3]						
Monthly Income Natural Breaks (INCOMCO2)[3]	**	***	-0.31232***	***	***	-0.35427***
<=400,000 COL$ (INCOMCO2_1)[3]						
401,000-1'500,000 (INCOMCO2_2)[3]						
>1'500,000 (INCOMCO2_3)[3]						
Animal Consumption/Sales (ANCSVT)[3]	***	***	0.40782***	***	***	0.40995***
Monthly Expenses (EXPENSE)[4]	0.1604	NC	-0.11454	0.1396	NC	-0.1246
Customized Monthly Expenses COL$ (EXPENCO1)[3]	**	**	-0.23584**	**	**	-0.28255**
<=150,000 COL$ (EXPENCO1_1)[3]						
151,000-550,000 (EXPENCO1_2)[3]						
>551,000 (EXPENCO1_3)[3]						
Monthly Expenses Natural Breaks (EXPENCO2)[3]	**	**	-0.26622**	**	***	-0.29975***
<=900,000 COL$ (INCOMCO2_1)[3]						
901,000-1'700,000 (INCOMCO2_2)[3]						
>1'700,000 (INCOMCO2_3)[3]						
Land Tenure Type (TTYPE)[3]	0.6549	0.718	0.03426	0.6644	0.7273	0.0338
Collective (TTYPE1)[1]	0.9635	1	-0.00424	0.905	1	-0.01132
Private (TTYPE2)[1]	0.9649	1	0.00408	0.9771	1	0.00273
Inherited /donation / as a present (TTYPE3)[1]	0.7146	0.8446	-0.03395	0.8206	0.8443	-0.02153
To be Inherited (TTYPE4)[1]						
Possession (TTYPE5)[1]	0.8244	1	-0.0206	0.8165	1	-0.02202
Bought (TTYPE6)[1]	0.8773	1	0.01433	0.9656	1	0.00409
Of the husband (TTYPE8)[1]	*/	0.0872	0.18076*/	*/	0.0884	0.18409*/
By working it / by clearing it / by will (TTYPE9)[1]	0.561	0.6897	-0.05398	0.5533	0.6885	-0.05627

[1] Binary Variable (1=Yes; 0=No) * Significance level: 0.05 CHISQ: Chi-Square Test

[2] Interval Variable ** Significance level: 0.01 FISHER: Fisher's Exact Test

[3] Categorical Variable *** Significance level: 0.001 NC = Not Computed

[4] Continuous Variable */ Significance level: >0.05-<=0.06

Table 38 (continued)

Variable Name and Code	GENDER1 (151 records)[1] Frequency Procedure CHISQ	FISHER	Correlation CHISQ	GENDER1 (134 records)[1] Frequency Procedure CHISQ	FISHER	Correlation CHISQ
Other[1]						
Gender (Female=1; Male=0) (GENDER)[1]						
Person who live in the rural area (LIVRUR)[1]	**	**	-0.22839**	**	**	-0.22891**
Number of Houses Owned (NHOUS)[4]	0.677	0.6975	-0.06947	0.3986	0.39	-0.10225
Age (AGE)[4]	0.6443	0.7717	-0.09565	0.5421	0.6202	-0.13754
Civil Status (CIVST)[3]	0.3311	0.3367	0.02959	0.4679	0.4749	0.03521
Total Number of Children (CHILDT)[4]	0.6886	0.7156	0.00694	0.7663	0.7899	-0.04474
Number of Children 0, 1-5, >5 (CHILD)[3]	0.7682	0.7783	-0.05884	0.3271	0.3435	-0.11675
Land Plot Area in HA (LAREAHA)[4]	0.8153	0.8968	0.07258	0.8456	0.9188	0.088
Distance to Land Plot in Hours (LDISTHR)[4]	0.658	0.6806	-0.08551	0.7218	0.7122	-0.07715
Total Number of Land Lots (TLOTS)[4]	0.7813	0.8151	0.00425	0.8001	0.85	0.0206
Persons with one or more lot (TLOTS2)[1]	0.6411	0.6799	-0.01165	0.6472	0.7961	0.03953
Number of years Living Abroad (ABROAD)[4]	0.4565	0.5157	-0.0606	0.3829	0.3937	-0.07538
Number of Key Goods (KGOODS)[4]	0.6825	0.6813	-0.03309	0.1626	0.1611	-0.11936
Study Area Management Zone (ZONE)[2] OR [4]	0.3781	0.3979	0.08422	0.647	0.654	-0.01043

[1] Binary Variable (1=Yes; 0=No) * Significance level: 0.05 CHISQ: Chi-Square Test

[2] Interval Variable ** Significance level: 0.01 FISHER: Fisher's Exact Test

[3] Categorical Variable *** Significance level: 0.001 NC = Not Computed

[4] Continuous Variable */ Significance level: >0.05-<=0.06

Table 39: Statistically Significant Results for GLULCC

VARIABLE = GENDER1 (women=1)						
	n = 151 Records			*n* = 134 Records (only landholders)		
	Sign (+)	**Sign (-)**	**Neutral (/)**	**Sign (+)**	**Sign (-)**	**Neutral (/)**
Land Uses /Tenure Variables	AZO ***	HUNT ***	CATT	AZO ***	HUNT ***	CATT
	CRAF *	LOGG ***	FISH	CRAF *	LOGG ***	FISH
	COLLE ***	FSHOCE **	AGR[3]	COLLE ***	FSHOCE *	AGR
	ANIM ***		FSHRIV	ANIM ***		FSHRIV
Other variables	COOK ***	LIVRUR **	ZONE	COOK ***	LIVRUR	ZONE
	TACTI ***(NC)	INCOMCO ***	TLOTS	TACTI ***(NC)	INCOMCO ***	TLOTS
	ANCSVT ***	EXPENCO **	NHOUS	ANCSVT ***	EXPENCO ***	NHOUS
	TTYPE8 */[1]	KFATH **	AGE	TTYPE8 */[1]	KFATH *	AGE
	KMOTH **	KTHEM **	CIVST	KMOTH **	KTHEM **	CIVST
	KOTHE *		CHILD	KOTHE */[2]		CHILD
			EDU			EDU
			BORN			BORN
			ABROAD			ABROAD
			KGOOD			KGOOD
			TECH			TECH
			OTH			OTH
			TENTYP			TENTYP
			TTYPE1			TTYPE1
			TTYPE2			TTYPE2
			TTYPE3			TTYPE3
			TTYPE5			TTYPE5
			TTYPE6			TTYPE6
			TTYPE9			TTYPE9
			LAREAHA			LAREAHA
			LDISTHR			LDISTHR
			INFIX			INFIX

* Significance level: 0.05.
** Significance level: 0.01.
*** Significance level: 0.001.
*/ Significance level: >0.05-<=0.06

[1] Fisher's Exact Test Not computed (NC). CHISQ Test depicted.
[2] Fisher's Exact Test non-significant. CHISQ value=0.0561
[3] Between the GENDER0 variable it has a */ Significance level
CHISQ: Chi-Square Test

Table 40: Descriptive statistics of variables in gendered BLMs

Variable	Number of records	Average	Standard Deviation	Maximum	Minimum	Units
Land Lots (TLOTS)	151	1.54	1.18	7	0	Number of Land Lots
	134	1.69	1.15	7	1	
Age (AGE)	151	45.82	17.54	18	90	Number of years old
	134	46.87	17.49	18	90	
Children (CHILDT)	151	4.74	3.06	11	0	Number of children
	134	4.86	2.99	11	0	
Key Goods (KGOODS)	151	0.83	0.84	2	0	Number of key goods owned
	134	0.81	0.83	2	0	
Land Uses/ Activities (TACTI)	151	3.97	1.88	8	0	Number of land uses/ activities
	134	4.04	1.88	8	0	
Distance to Land (LDISTHR)	151	1.97	0.76	3	1	Hours
	134	1.96	0.77	3	1	
Monthly Income (INCOME)	151	190	471	3,971	0	US$ Year 2007
	134	194	494	3,971	0	
Monthly Expenses (EXPENSE)	151	171	311	2,482	5	US$ Year 2007
	134	175	327	2,482	5	

Table 41: BLM comparative results for *Y*=F_WOM

BLM Model:	*Y*=F_WOM(1) ; *X*s= AZO, LOGG, ANIM, INFIX, KMOTH, KTHEM			
	***n* = 134**		***n* = 151**	
	F_WOM	**F_MEN**	**F_WOM**	**F_MEN**
Model Fit Statistics: Intercept and Covariates				
AIC	82.192	82.192	118.951	108.808
SC	102.477	102.477	140.072	129.929
-2 Log L	68.192	68.192	104.951	94.808
Analysis of Maximum Likelihood Estimates				
Parameter	**Estimate**			
Intercept	0.00919	-0.00919	-0.3758	-0.3574
AZO	-2.2448***	2.2448***	-1.2068***	2.1748***
LOGG	2.3054**	-2.3054**	1.472*	-2.3154**
ANIM	-0.9803*	0.9803*	-0.9768**	0.5206
INFIX	-1.3556**	1.3556**	-1.2093**	0.8699*
KMOTH	-1.1208*	1.1208*	-0.938*	0.2779
KTHEM	1.5881***	-1.5881***	1.047***	-1.1565***

* Significance level: 0.05. *** Significance level: 0.001.

** Significance level: 0.01. */ Significance level: >0.05-<=0.06

Table 42: BML comparative results for *Y*=F_MEN

BLM Model:	Y=F_MEN(1) ; Xs=AGE, LOGG, FSHOCE, TACTI, and KTHEM			
	***n* = 134**		***n* = 151**	
	F_WOM	**F_MEN**	**F_WOM**	**F_MEN**
Model Fit Statistics: Intercept and Covariates				
AIC	69.638	69.638	107.528	102.316
SC	87.025	87.025	125.632	120.42
-2 Log L	57.638	57.638	95.528	90.316
Analysis of Maximum Likelihood Estimates				
Parameter	**Estimate**			
Intercept	-8.7151***	8.7151***	-7.2000***	5.1969***
AGE	-0.0571*	0.0571*	-0.0211	0.0379*
LOGG	3.6407***	-3.6407***	2.5655***	-2.7897***
FSHOCE	2.1893**	-2.1893**	1.5329**	-1.0794**
TACTI	1.8038***	-1.8038***	1.2188***	-1.1774***
KTHEM	0.8729*	-0.8729*	0.7135*	-1.0259**

* Significance level: 0.05. *** Significance level: 0.001.

** Significance level: 0.01. */ Significance level: >0.05-<=0.06

Table 43: Correlations pertinent to Male-akin land use-types

Variable Name and Code	**HUNT**	**LOGG**	**FSHOCE**
Study Area Zone (ZONE)[2] or [4]			0.26835**
Total Number of Land Lots (TLOTS)[4]	0.18132*	0.29463***	
Persons with one or more lots (TLOTS2)[1]		0.22035*	-0.17351*
Land Lot Owned / Used by Women (LOTW)[1]	-0.38233***	-0.42649***	-0.24381**
Land Lot Owned / Used by Men (LOTM)[1]	0.38233***	0.42649***	0.24381**
Person who live in the rural area (LIVRUR)[1]	0.29473***		
Number of Houses Owned (NHOUS)[4]	0.22144*	0.1854*	
Number of Key Goods (KGOODS)[4]			0.17927*
Hunting (HUNT)[1]	1	0.42929***	0.22696**
Fishing (FISH)[1]	0.17368*		0.48179***
Agriculture (AGR)[1]	0.17459*		
Container Gardening/Azoteas (AZO)[1]	-0.26616**	-0.24099**	
Fuel Fodder/ Seeds/ Plants Gathering (COLLE)[1]		-0.21759*	
Logging (LOGG)[1]	0.42929***		
Animal Husbandry (ANIM)[1]		-0.22506**	
Fishing in Rivers (FSHRIV)[1]	0.20778*		0.36164***
Fishing in the Ocean (FSHOCE)[1]	0.22696**		
Animal Consumption/Sales (ANCSVT)[3]		-0.19559*	
Land Tenure Type (TENTYP)[3]			-0.26396**
Private Land Tenure (TTYPE2)[1]			0.18128*/
Land Tenure by Purchase (TTYPE6)[1]			-0.21873*
Land Area (LAREACO 1-3, 3-9, >10HA)[3]		0.28508**	
Distance to Land Plot in Hours (LDISTHR)[4]	0.21883*		
Monthly Income (INCOME)[4]	0.18522*	0.16826*/	0.29881***
Customized Monthly Income (INCOMCO1)[3]	0.19027*	0.34295***	
Monthly Income Natural Breaks (INCOMCO2)[3]	0.24213**	0.34779***	0.20175*
Monthly Expenses (EXPENSE)[4]		0.17061*/	0.28674***
Customized Monthly Expenses (EXPENCO1)[3]	0.23098**	0.30525***	0.24584**
Monthly Expenses Natural Breaks (EXPENCO2)[3]		0.3174***	0.18549*
Knowledge Transferred by the Mother (KMOTH)[1]	-0.18141*		-0.27844**
Knowledge Learned by Themselves (KTHEM)[1]	0.18437*		0.28726***
Knowledge Transferred by Others (KOTHE)[1]	-0.18097*		

* Significance level: 0.05.
** Significance level: 0.01.
*** Significance level: 0.001.
*/ Significance level: >0.05-<=0.06

[1] Binary Variable (1=Yes; 0=No)
[2] Interval Variable
[3] Categorical Variable
[4] Continuous Variable

Table 44: Correlations pertinent to Female-akin land use-types

Variable Name and Code	AZO	COLLE	ANIM
Land Lot Owned / Used by Women (LOTW)[1]	0.63177***	0.37708***	0.50828***
Land Lot Owned / Used by Men (LOTM)[1]	-0.63177***	-0.37708***	-0.50828***
Age (AGE)?	0.26557**		0.26779**
Customized Age Code (AGECO1)	0.25701**		0.24723**
Age Code Natural Breaks (AGECO2)	0.27864**		0.24099**
Number of Children 0, 1-5, >5 (CHILD)[3]	0.24236**	0.18106*	0.14421
Education Attainment (EDU)[2]	-0.28994***	-0.28217***	
Hunting (HUNT)[1]	-0.26616**		
Fishing (FISH)[1]	0.27597**	0.18321*	0.24827**
Agriculture (AGR)[1]	0.29946***		0.22454**
Container Gardening/Azoteas (AZO)[1]		0.49749***	0.61109***
Handcrafts (CRAF)[1]	0.34713***	0.36731***	0.27424**
Cooking (COOK)[1]	0.55612***	0.37023***	0.50491***
Fuel Fodder/ Seeds/ Plants Gathering (COLLE)[1]	0.49749***		0.33892***
Logging (LOGG)[1]	-0.24099**	-0.21759*	-0.22506**
Animal Husbandry (ANIM)[1]	0.61109***	0.33892***	
Other Land Uses/Activities (OTH)[1]	-0.27641**	-0.16655*/	-0.21642*
Total Number of Land Uses/ Activities (TACTI)?	0.70559***	0.5559***	0.6629***
Fishing in Rivers (FSHRIV)[1]	0.30046***	0.18372*	0.25834**
Animal Consumption/Sales (ANCSVT)[3]	0.55375***	0.30454***	0.8072***
Collective Land Tenure (TTYPE1)[1]		0.20191*	
Land Plot Area in HA (LAREAHA)[4]		0.18362*/	
Customized Monthly Income (INCOMCO1)[3]	-0.25705**	-0.24995**	-0.19444*
Monthly Income Natural Breaks (INCOMCO2)[3]	-0.26106**	-0.28588***	-0.17266*/
Monthly Expenses (EXPENSE)[4]		-0.17934*	
Customized Monthly Expenses (EXPENCO1)[3]	-0.17569*	-0.16787*/	
Monthly Expenses Natural Breaks (EXPENCO2)[3]	-0.24246**	-0.31487***	
Knowledge Transferred by the Mother (KMOTH)[1]	0.23415**		0.19988*
Knowledge Transferred by Others (KOTHE)[1]			0.16772*/

* Significance level: 0.05.
** Significance level: 0.01.
*** Significance level: 0.001.
*/ Significance level: >0.05-<=0.06

[1] Binary Variable (1=Yes; 0=No)
[2] Interval Variable
[3] Categorical Variable
[4] Continuous Variable

Table 45: Correlations pertinent to Gender-neutral land use-types

Variable Name and Code	AGR	FSHRIV	CATT
Number of Houses Owned (NHOUS)[4]	0.31127***	0.21565*	
Age (AGE)[4]	0.39084***		0.20817*
Customized Age Code (AGECO1)[3]	0.36817***		0.19953*
Age Code Natural Breaks (AGECO2)[3]	0.37004***		
Civil Status (CIVST)[3]	-0.24668**		
Number of Children 0, 1-5, >5 (CHILD)[3]	0.33423***	0.30643***	
Education Attainment (EDU)[2]		-0.30263***	
Number of Key Goods (KGOODS)[4]	0.18905*		
Hunting (HUNT)[1]	0.17459*	0.20778*	
Fishing (FISH)[1]		0.92358***	
Container Gardening/Azoteas (AZO)[1]	0.29946***	0.30046***	
Handcrafts (CRAF)[1]		0.29906***	
Fuel Fodder/ Seeds/ Plants Gathering (COLLE)[1]		0.18372*	
Animal Husbandry (ANIM)[1]	0.22454**	0.25834**	
Other Land Uses/Activities (OTH)[1]	-0.24966**		
Total Number of Land Uses/ Activities (TACTI)[4]	0.36568***	0.49754***	
Fishing in the Ocean (FSHOCE)[1]		0.26835**	
Animal Consumption/Sales (ANCSVT)[3]	0.23987**		
Land Tenure Type (TENTYP)[3]			0.19567*
Inherited /donation / as a present (TTYPE3)[1]		0.20361*	
Bought (TTYPE6)[1]		-0.19616*	0.22783*
Distance to Land Plot in Hours (LDISTHR)[4]		-0.52372***	
Fixed Income (INFIX)[1]		0.18596*	
Monthly Income (INCOME)[4]		0.17732*	
Monthly Income Natural Breaks (INCOMCO2)[3]		0.17752*	
Monthly Expenses (EXPENSE)[4]		0.24238**	
Monthly Expenses Natural Breaks (EXPENCO2)[3]		0.28415**	
Knowledge Transferred by the Father (KFATH)[1]	0.28186***		
Knowledge Learned by Themselves (KTHEM)[1]	0.1771*		

* Significance level: 0.05.
** Significance level: 0.01.
*** Significance level: 0.001.
*/ Significance level: >0.05-<=0.06

[1] Binary Variable (1=Yes; 0=No)
[2] Interval Variable
[3] Categorical Variable
[4] Continuous Variable

Table 46: Results of BLMs for Men-Akin Land Use Types

Men-Akin Land Use Group (Hunting, Logging, Sea-Fishing						
Dependent Variable	Hunting (HUNT)					
	BLM[a]		BLM[b]		**Best BLM**	
Intercept		-4.6322**		-18.5749		-18.5749
Independent Variables	FISH	-1.2394*	FISH	-1.6956*	FISH	-1.6956*
	LOGG	-1.7328***	LOGG	-1.7073*	LOGG	-1.7073*
	LDISTHR	1.2532*	LDISTHR	1.5815*	LDISTHR	1.5815*
	INCOME	1.42E-07	INCOME	2.03E-06	INCOME	2.03E-06
	KOTHE	0.9761*	KOTHE	1.2689	KOTHE	1.2689
			GENDER1	12.7195	GENDER0	-12.7195
Model Fit Statistics	AIC	60	AIC	48	AIC	48
	SC	75	SC	66	SC	66
	-2 Log L	48	-2 Log L	34	-2 Log L	34
Dependent Variable	Logging (LOGG)					
	BLM[a]		BLM[b]		**Best BLM**	
Intercept		-1.5274**		-3.2595***		-3.2595***
Independent Variables	TLOTS +	0.4932*	TLOTS +	0.7496*	TLOTS +	0.7496*
	HUNT +	-1.3012***	HUNT +	-0.8252*	HUNT +	-0.8252*
	INCOMCO1(1) +	-1.3891**	INCOMCO1(1) +	-1.0226*	INCOMCO1(1) +	-1.0226*
	INCOMCO1(2)	0.7895*	INCOMCO1(2) +	0.8505*	INCOMCO1(2) +	0.8505*
			GENDER1	1.6917**	GENDER0	-1.6917**
Model Fit Statistics	AIC	95	AIC	82	AIC	82
	SC	110	SC	99	SC	99
	-2 Log L	85	-2 Log L	70	-2 Log L	70
Dependent Variable	Fishing in the Ocean (FSHOCE)					
	BLM[a]		BLM[b]		**Best BLM**	
Intercept		-1.2012		-1.5329		-1.5329
Independent Variables	TLOTS +	-1.2181*	TLOTS +	-1.2134*	TLOTS +	-1.2134*
	FSHRIV +	-1.1879***	FSHRIV +	-1.3784***	FSHRIV +	-1.3784***
	EXPENSE +	1.383E-6*	EXPENSE +	1.398E-6*	EXPENSE +	1.398E-6 *
	KTHEM	-1.2179*	KTHEM +	-1.1240*	KTHEM +	-1.1240*
			GENDER1	0.9457*	GENDER0	-0.9457*
Model Fit Statistics	AIC	87	AIC	81	AIC	81
	SC	101	SC	98	SC	98
	-2 Log L	77	-2 Log L	69	-2 Log L	69

* Significance level: 0.05.

** Significance level: 0.01.

/ No Statistical Significance.

BLM[a] and BLM[b] = Preliminary Models

*** Significance level: 0.001.

*/ Significance level: >0.05-<=0.06

[1] Validity of the model fit is questionable.

Best BLM = Final Model

Table 47: Results of BLMs for Women-Akin Land Use Types

Women-Akin Land Use Group (Gardening, Gathering, Animal Husbandry)						
Dependent Variable	Gardening / Azoteas (AZO)					
	BLM[a]		BLM[b]		**Best BLM**	
Intercept		-8.9905***				-8.9813***
Independent Variables	CHILDT	0.1583	CHILDT	0.4379*	CHILDT	0.4379*
	TACTI	1.3814***	TACTI	1.0445***	TACTI	1.0445***
	KMOTH	-1.3174*	KMOTH	-0.3884	KMOTH	-0.3884
			GENDER1	-2.2385***	GENDER0	2.2385***
Model Fit Statistics	AIC	82	AIC	60	AIC	60
	SC	93	SC	75	SC	75
	-2 Log L	74	-2 Log L	50	-2 Log L	50
Dependent Variable	Gathering / Collection (COLLE)					
	BLM[a]		BLM[b]		**Best BLM**	
Intercept		-4.2497***		-3.4992***		-3.4992***
Independent Variables	EDU0+	1.5020*	EDU0	1.7507*	EDU0	1.7507*
	EDU1	-0.1407	EDU1	-0.014	EDU1	-0.014
	EDU2	-0.4668	EDU2	-0.4322	EDU2	-0.4322
	EDU3	-0.3676	EDU3	-0.5866	EDU3	-0.5866
	CHILDT	0.0767	CHILDT	0.0706	CHILDT	0.0706
	TACTI	0.8158***	TACTI+	0.6540***	TACTI	0.6540***
	TTYPE1	-0.5589	TTYPE1	-0.6706*	TTYPE1	-0.6706*
			GENDER1	-0.5586	GENDER0	0.5586
Model Fit Statistics	AIC	109	AIC	108	AIC	108
	SC	130	SC	132	SC	132
	-2 Log L	93	-2 Log L	90	-2 Log L	90
Dependent Variable	Animal Husbandry (ANIM)					
	BLM[a]		BLM[b]		**Best BLM**	
Intercept		-6.5253***		-6.4879***		-6.4879***
Independent Variables	AGE	0.0262	AGE	0.0489**	AGE	0.0489**
	TACTI	1.1001***	TACTI	0.9046***	TACTI	0.9046***
	KMOTH	-0.7250*	KMOTH	-0.364	KMOTH	-0.364
			GENDER1	-0.9212**	GENDER0	0.9212**
Model Fit Statistics	AIC	112	AIC	106	AIC	106
	SC	124	SC	120	SC	120
	-2 Log L	104	-2 Log L	96	-2 Log L	96

* Significance level: 0.05.

*** Significance level: 0.001.

** Significance level: 0.01.

*/ Significance level: >0.05-<=0.06

/ No Statistical Significance.

[1] Validity of the model fit is questionable.

BLM[a] and BLM[b] = Preliminary Models

Best BLM = Final Model

Table 48: Results of BLMs for Gender-Neutral Land Use Types

Gender-Neutral Land Use Group (Agriculture, River-Fishing, Cattle Raising)						
Dependent Variable	Agriculture (AGR)					
	BLM[a]		BLM[b]		**Best BLM**	
Intercept		-4.9977***		-4.9516***		-4.9516***
Independent Variables	AGE	0.0710**	AGE	0.0653*	AGE	0.0653*
	TACTI	0.9423***	TACTI	1.0021***	TACTI	1.0021***
	KFATH	-1.2551**	KFATH	1.1911**	KFATH	-1.1911**
			GENDER1	0.233	GENDER0	-0.233
Model Fit Statistics	AIC	78	AIC	80	AIC	80
	SC	90	SC	94	SC	94
	-2 Log L	70	-2 Log L	70	-2 Log L	70
Dependent Variable	Fishing in rivers (FSHRIV)					
	BLM[a]		BLM[b]		**Best BLM**	
Intercept		0.4919		0.4857		0.4857
Independent Variables	HUNT	-1.0624**	HUNT	-1.0283**	HUNT	-1.0283**
	AZO	-1.1298***	AZO	-1.3347**	AZO	-1.3347**
	TTYPE1	-0.5773*	TTYPE1	-0.5846*	TTYPE1	-0.5846*
	KTHEM	-0.6806*	KTHEM	-0.6690*	KTHEM	-0.6690*
			GENDER1	0.2561	GENDER0	-0.2561
Model Fit Statistics	AIC	120	AIC	121	AIC	121
	SC	133	SC	137	SC	137
	-2 Log L	110	-2 Log L	109	-2 Log L	109
Dependent Variable	Cattle Raising (CATTLE)					
	BLM[a]		BLM[b]		**Best BLM**	
Intercept		-3.0169**		-3.0313**		-3.0313**
Independent Variables	AGE	0.0305	AGE	0.0309	AGE	0.0309
	TTYPE6	-0.6731*	TTYPE6	-0.6754*	TTYPE6	-0.6754*
			GENDER1	-0.0785	GENDER0	0.0785
Model Fit Statistics	AIC	92	AIC	94	AIC	94
	SC	100	SC	105	SC	105
	-2 Log L	86	-2 Log L	86	-2 Log L	86

* Significance level: 0.05.   *** Significance level: 0.001.

** Significance level: 0.01.   */ Significance level: >0.05-<=0.06

/ No Statistical Significance.   [1] Validity of the model fit is questionable.

BLM[a] and BLM[b] = Preliminary Models   Best BLM = Final Model

Table 49: Variables used in Multinomial Logit Models (MLM)

	Variable code	Possible responses	Variable coding
Dependent variables			
What is the gender of the land-owner/user of a Farm?	W_FARM	Female	1
		Landless	2
		Male	3
What is the gender of the land-owner/user of a Farm?	M_FARM	Male	1
		Landless	2
		Female	3
Independent Variables			
Land-Use / Livelihoods			
Agriculture	AGR	Yes	2
		No	1
Cattle Raising	CATT	Yes	2
		No	1
Gardening/Azoteas	AZO	Yes	2
		No	1
Gathering	COLLE	Yes	2
		No	1
Animal Husbandry	ANIM	Yes	2
		No	1
Hunting	HUNT	Yes	2
		No	1
Logging	LOGG	Yes	2
		No	1
Fishing	FISH	Yes	2
		No	1
Fishing in Rivers	FSHRIV	Yes	2
		No	1
Fishing in the Ocean	FSHOCE	Yes	2
		No	1
Demographic factors			
Age (years) - Natural Breaks	AGE	18-33	1
		34-48)	2
		49-65	3
		66-90	4
Civil Status	CIVST	Married/Union	1
		Divorced	2
		Single	3
		Widow	4
Number of Children	CHILDT	Continuous	

Table 49 (continued)

	Variable code	Possible responses	Variable coding
Financial and physical assets			
Key goods (TV, Fridge)	KGOOD		0
			1
			2
Land-Tenure Type	TENTYP	Collective	1
		Private	2
		Inherited /donation / as a present	3
		To be Inherited	4
		Possession	5
		Bought	6
		Of husband	8
		Work / Will	9
Land area (HA)	LAREACO	No land	0
		<=1 - 3 ha	1
		>3 - 9	2
		>=10	3
Land distance (hours)	LDISTHR	Continuous	
Fixed Income	INFIX	Yes	1
		No	0
Monthly Income ($COL) ($US=1,810 $Col)	INCOMCO2	<=200,000	1
		220,000-828,000	2
		>828,000	3
Monthly Expenses ($COL) ($US=1,810 $Col)	EXPENCO2	<=497,000	1
		497,000-939,000 [3]	2
		>939,000	3
Human assets			
Education Attainment	EDU	None (N)	0
		Elementary	1
		High school	2
		Vocational	3
		University	4
Place where being born	BORN	El Valle	1
		Bahia Solano	2
		Choco	3
		Other	4
Livelihood Knowledge Transfer by Father	KFATH	Yes	1
		No	0
Livelihood Knowledge Transfer by Mother	KMOTH	Yes	1
		No	0
Livelihood Knowledge Acquired by Themselves	KTHEM	Yes	1
		No	0
Livelihood Knowledge Transfer by Others	KOTHE	Yes	1
		No	0

Table 50: MLM for Gender of Land Owner/User (Land Use)

W_FARM 1	**Estimate**	**Standard error**	**M_FARM 1**	**Estimate**	**Standard error**
Intercept	9.6937***	2.3109	Intercept	-9.6937***	2.3109
HUNT	-8.0840#		HUNT	8.0840#	
CATT	-0.2895	0.8949	CATT	0.2895	0.8949
AGR	-0.7096	0.6149	AGR	0.7096	0.6149
AZO	3.8899***	1.1317	AZO	-3.8899***	1.1317
COLLE	0.4924	0.607	COLLE	-0.4924	0.607
LOGG	-3.6964*	1.4919	LOGG	3.6964*	1.4919
ANIM	1.2634*	0.6268	ANIM	-1.2634*	0.6268
FSHRIV	-0.7734	0.7841	FSHRIV	0.7734	0.7841
FSHOCE	-1.7888/*	0.9654	FSHOCE	1.7888/*	0.9654

Reference categories: W_FARM=1 (farm owned/used by women) and M_FARM=1 (farm owned/used by men) (n=151)

Parameters marked with '#' are regarded to be infinite

* Significance level: 0.05   ** Significance level: 0.01

*** Significance level: 0.001   / * Significance level: >0.05-<=0.075

Table 51: MLM for Gender of Land Owner/User (Assets)

W_FARM 1	Estimate	Standard error	M_FARM 1	Estimate	Standard error
Intercept	16.5366*	5.06	Intercept	-15.7476**	5.0594
AGECO2	1.8673*	0.8053	AGECO2	-1.8686*	0.8053
CIVST	-0.1824	0.5047	CIVST	0.1836	0.5044
CHILDT	1.2137*	0.5553	CHILDT	-1.2128*	0.5549
CHILD	-4.9544*	2.393	CHILD	4.9500*	2.3906
EDU	0.144	0.7665	EDU	-0.144	0.7664
BORN	-2.6394*	1.2439	BORN	2.6413*	1.2431
KGOOD	-0.3584	0.9589	KGOOD	0.3594	0.9589
TENTYP	0.8143#		TENTYP	-0.9461#	
TTYPE1	5.1672#		TTYPE1	-5.8227#	
TTYPE2	8.7609#		TTYPE2	-9.2929#	
TTYPE3	4.5588***	1.2772	TTYPE3	-4.9538***	1.2769
TTYPE5	3.1383	6.1353	TTYPE5	-3.2720	6.1293
TTYPE6	-1.8428	1.53	TTYPE6	1.8425	1.5286
TTYPE8	12.6424#		TTYPE8	-13.6134#	
TTYPE9	-1.1003	2.2603	TTYPE9	1.4952	2.2609
LAREAHA	0.5242/*		LAREAHA	-0.5241	0.294
LAREACO	-3.5503/*	1.9111	LAREACO	3.5516/*	1.9113
LDISTHR	0.3611	0.7949	LDISTHR	-0.3610	0.7949
INFIX	15.1647**	4.9543	INFIX	-15.1601**	4.9468
INCOMCO2	0.0875	2.6519	INCOMCO2	-0.092	2.65
EXPENCO2	-4.4535/*	2.4863	EXPENCO2	4.4551/*	2.4838
KFATH	-22.1191#		KFATH	22.1243#	
KMOTH	9.3531*	3.7077	KMOTH	-9.3559*	3.705
KTHEM	-5.9825***	1.5316	KTHEM	5.9849***	1.5306
KOTHE	0.9511	1.3994	KOTHE	-0.9537	1.3993

Reference categories: W_FARM=1 (farm owned/used by women) and M_FARM=1 (farm owned/used by men) (n=151)

Parameters marked with '#' are regarded to be infinite

* Significance level: 0.05 ** Significance level: 0.01

*** Significance level: 0.001 / * Significance level: >0.05-<=0.075

Table 52: Current Gendered Spaces and Uses in the El Cedro

Local (USA)* Classification schemes			Gendered Space			Gendered Use	
Level I	**Level II**	**Physical Characteristics**	♀	♂	B	♀	♂
Monte (Forest Land - Tropical rain forest - may include Forested Wetland)	Monte bravo (Primary Forest)	Denudational terrain, higher relief, relatively less fertile soils, slash and mulch shifting cultivation		♂			Logging, Hunting
	Monte Viche (Secondary Forest)	Hill slopes, upstream tributary floodplains, upstream main river floodplain			B	Gathering, Animal husbandry (E),	Logging, Hunting, Fishing
Respaldo (Forest and Transition between Forest and Agriculture)	Partial or complete overlap with Monte (Forest land)	Marginal lands and/or to be inherited			B	Gathering, Fishing, Animal husbandry (E),	Logging, Hunting, Fishing None
Rastrojo (Agricultural Lands)	Cropland	Best soils, flatter relief; closer to rivers, the village, and the sea			B	Agriculture, Animal husbandry (E), Gathering, Fshing	Agriculture, Fishing
	Azoteas (Nurseries, Horticulture)	Neighboring to houses	♀ E			Gardening (Nurseries, Horticulture) (E)	
	Potrero (Pastures)	Farther to the village, close to rivers and roads, low relief, soils of any quality			B	Cattle raising (I), Gathering, Animal husbandry (E)	Cattle- raising (I)
El Valle village(Urban or built-up area)	Residential	Multiple-unit structures of urban cores, high to low density, farmsteads, rural residential and recreational subdivisions, may have forest or agriculture			B	Paid labor (I), Handcrafts (I), Gardening (I), Animal husbandry (I)	Paid labor (I), Handcrafts (I), Residential

♀ = Women ♀ B = Gender-blind (I)= Incipient 30-40 years ago

♂ = Men ♂ Animal husbandry (E) = Almost Extinct

* Anderson et al. (1976) Classification scheme Levels I and II

Table 53: Access Map for Afro-Colombian Women (1830 onwards)

Bundle of Powers	**Mechanisms of Access**	
New Grenade*	**Structural-Relational Access**	**Rights-based Access**
Body	element of resistance, manipulation, power, autonomy merchandise of use, exchange, and pleasure expanded social relations forged leadership vehicle from productive to reproductive perspectives Seduction/maternity - resource and privilege access most resistant substrate of African memory	Violence against women recipient of cultural memory domination purposes buy own and their children's freedom climb the social ladder through bleaching female solidarity for manumission
Mediation	Protagonist of slaves' relations/communications transmission of culture, Christianity, Spanish consolidation of trades, skills	liberate their significant others by all means
Insurrection and liberation		instrumental to maroon movements (Palenque) Most of legal manumission in Choco from women privileged legal liberation- purchase of freedom
Witchcraft, sorcery, healing	Religious/magical, agricultural rituals, midwifery social, symbolic reconstruction of the enslaved redefinition of foreign religious/ideological systems integrated black, white and mulatto witches	as maroon or cultural resistance forms to deploy terror against whites granted autonomy and access to resources favor new social relations with other ethnic groups
Urban	more female labor - domestic, breastfeeding granted greater geographical mobility	consolidation of trades/skills used as free citizens street sales, crafts, peonage, payments, prostitution
Family	social reconstruction –kinship/family re-composition identity tied to motherhood, parenting, children key role in preserving collective memory community construction – spiritual reproduction facilitator of rites of initiation and transit to death matriarchy myth gives women privileged status leadership to internal cohesion of mining groups improvising articles and inventor of solutions prolific maternity positive valuation (biological/social)	blurs real situations of female subordination hidden domestic violence slave miners' unit and principle of social, family and cultural organization miners created families around them transmitter of legal slavery to children- Matrifocality/ polygyny as kinship organizer/stabilizer economic autonomy promoter/ address larger society unions/separations- double strategy to increase alliances kinship extends from the mother
Post-slavery**	matriarchal and extended family controlling agricultural work and children welfare flexible, honest, less subservient gender relations social recognition of women for their economic role preponderance of household head	land tenure inherited by matrilineal line
Territory ***	Mild/open spaces, the house, herbs, river banks historical nourishing - a dual power source family health and welfare, food security key role in maintaining and improving biodiversity identity linked to food, medicinal, power plants exchange/reciprocity at work, housework, parenting	the house is the domain of women source for harming and dominate wills the vegetable universe is of females women are forbidden to go to the *Monte* women protagonist in family and community health transmission of passage rites (ombligada, death)

* Camacho 1999 ** Mina 1995 *** Losonczy 1997, Galeano 1996, Camacho 2001, Llano 1998

Table 54: Field collection methods proposed for GLULCC research

	Research Method	Data Collection
Un-gendered LULCC	Digital Image Processing	LANDSAT, Spot Images
	Classification verification	GPS
	Socio-economic data	
	Quantitative analysis	Surveys, questionnaires
	Qualitative analysis (alternatively)	(Semi)-Structured interviews
		GPS, participatory mapping
	Mapping gendered LULC in the field	GeoEye images, etc (detailed
Gendered LULCC	Situated knowledge	spatial/ temporal resolutions)
	Socio-economic data	Surveys, questionnaires
	Qualitative analysis	(Semi)-Structured interviews

Table 55: Gendered Land Use Patterns in Commons

Property Dependence	**Land Cover Type**	**Land Use**	
		Women	**Men**
(a) Commons controlled by men	Dense Forests	Fodder Fuel wood non-timber products Medicinal Plants Wild foods	Timber Hunting
	Less Dense Forest	Subsistence crops Tree products Fodder Fuel wood non-timber products Medicinal Plants Wild foods	Timber Hunting Landesque capital Cash crops
	Mixed forests and pastures	Grazing land (ruminants) Trees products Fodder Fuel wood Subsistence crops non-timber products Medicinal Plants Wild foods	Grazing areas cattle Timber Hunting Landesque capital Cash crops
	Pastures	Grazing land ruminants Wild foods	Grazing areas cattle Landesque capital
	Crop land	Corrals Fruit and vegetables Medicinal Plants Cash crops Gardens Landesque capital	Corrals Orchards Fruit and vegetables Cash crops Trees Landesque capital
(b) Commons controlled by women (and children)	Mangroves	Fishing (Shellfish) Wild foods	Fishing Timber
	Riparian lands	Fishing Cash crops	Fishing Cash crops
	Beaches	Grazing land ruminants Wild foods Tree products Shellfish Gathering	Grazing areas cattle Tree products

Table 56: Gendered Land Use Patterns in Individual Plots

Property Dependence	Land Cover Type	Land Use	
		Women	**Men**
(a) Men's individual plots	Mixed forests and pastures	Fodder, Fuel wood Subsistence crops Medicinal Plants Wild foods	Grazing areas cattle Timber, Hunting Landesque capital Cash crops
	Pastures	Wild foods	Grazing areas cattle Landesque capital
	Crop land	Corrals Fruit and vegetables Medicinal Plants Cash crops, Gardens	Corrals Orchards Fruit and vegetables Cash crops, Trees Landesque capital
	Mangroves	Fishing (Shellfish) Wild foods	Fishing Timber
	Riparian lands	Cash crops Wild foods Trees products	Fishing Cash crops Grazing areas cattle Trees products
(b) Women's individual plots	Mixed forests and pastures	Grazing land ruminants Trees products Fodder, Fuel wood Subsistence crops non-timber products Medicinal Plants Orchards Wild foods Landesque capital	Grazing areas cattle Timber Hunting Cash crops
	Pastures	Grazing land ruminants Wild foods	Grazing areas cattle
	Crop land	Corrals Fruit and vegetables Medicinal Plants Cash crops Gardens Landesque capital	Corrals Orchards Fruit and vegetables Cash crops Trees Landesque capital
	Mangroves	Fishing (Shellfish) Wild foods Medicinal Plants	Fishing Timber
	Riparian lands	Fishing Cash crops Grazing land ruminants Trees products	Fishing Cash crops Trees products

Table 57: General Potential Factors and Outcomes of GLULCC

Proximate Causes		
Other Factors *	**Gendered Detailed Factors**	**Gendered Changes in Land Cover and Land Use**
Social Trigger Events	New Social Movements	Place-specific
War	Women and Men abandon fields	Forest resurgence/ or stationary changes
Abrupt Displacements	Men search for off-farm jobs	Stabilized or retreating agricultural expansion
	Women replace men in their land uses	More orchards and gardens
Abrupt Policy Shifts	Legal titles of collective lands	Table 53 on land uses
	More Women's Participation in NRM	More individual /common lands allocated to women
	New resource Management Institutions	New Conservation and agricultural areas

Underlying Causes		
Demographic Factors*	**Gendered Detailed Factors**	**Gendered Changes in Land Cover and Land Use**
Migration (In/Out)	Young men out-migrate more than women	Forest resurgence/ or stationary changes
Life Cycle Features	Widow/ elders use plots farther from village	Women Commons' scarce & farther of UC
	Elders do more agriculture	Agriculture to secondary forests in commons
Policy and Institutional Factors*		
Formal Policies	Reduction/ increment in gender inequalities	Place and time -specific
Policy Climate	Degree of participation on women/ men	Place and time -specific
(e.g. corruption and	Corruption favoring class or gender	Place and time -specific
mismanagement)	Unsustainable organizations in NRM	Place and time -specific
Property Rights	Legal titles of collective lands	Table 53 on land uses
(e.g. land titling)	New Women's and Men's Organizations	Place and time -specific
Cultural Factors*		
Public attitudes,	Former and new cultural reconstruction	Place and time -specific
values and beliefs	New values for natural resources	Place and time -specific
(unconcerned about	(e.g. bioengineering, tourism)	
forest, frontier mentality)	Increased household equity	Place and time -specific
Individual Household behavior	Shifts in household power relations	Consolidation of women's uses in existing plots
		New women's uses in new plots

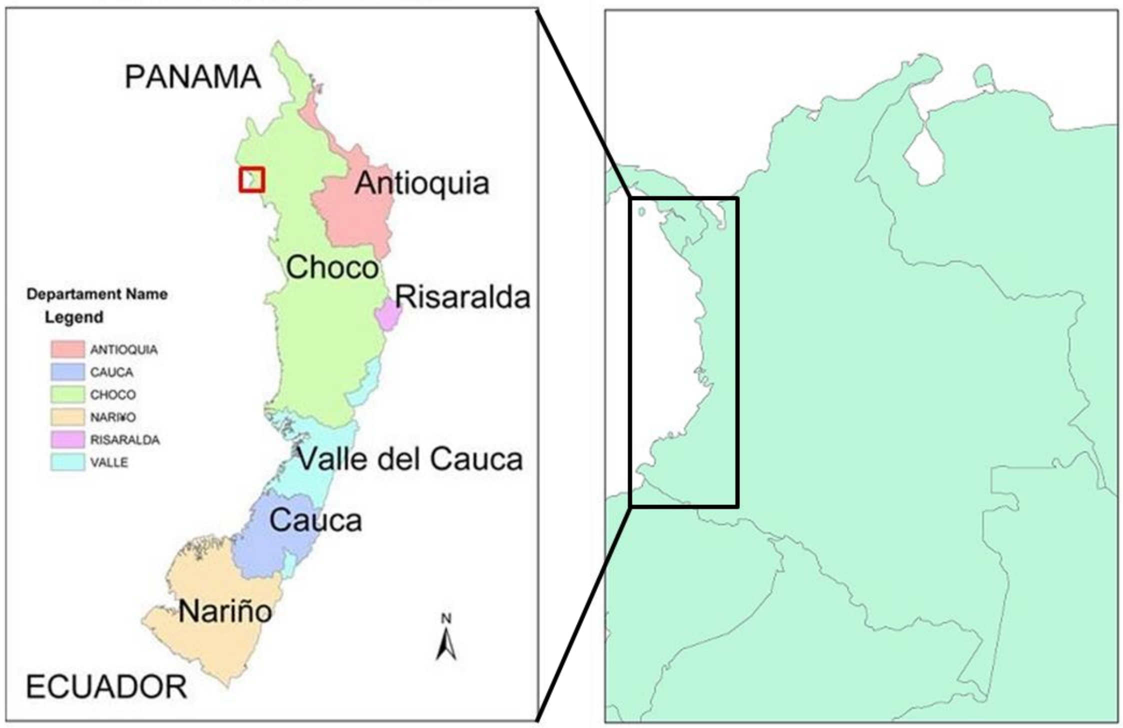

Figure 1: Departments of the Pacific Region of Colombia

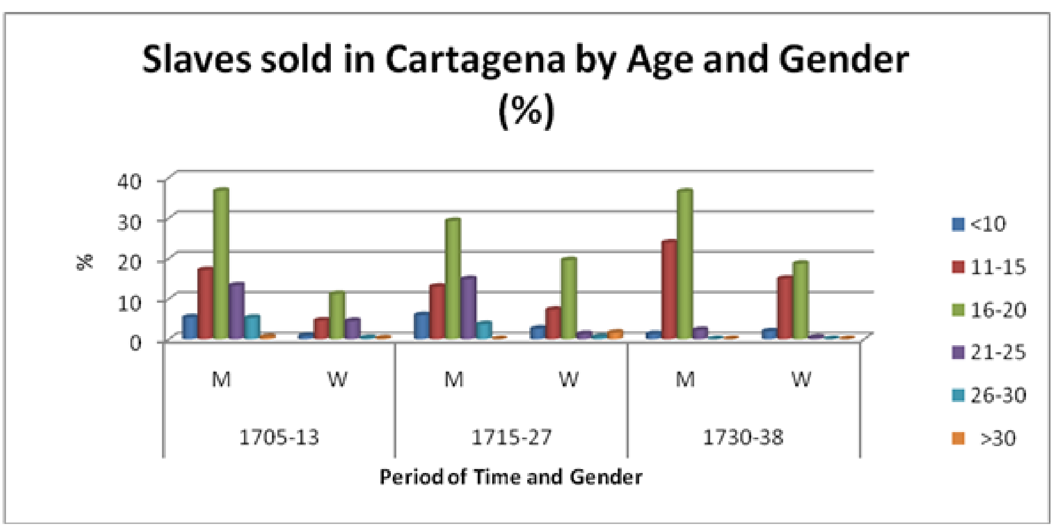

Figure 2: Slaves Sold (1705-1738). Source: Colmenares (1991 p.28)

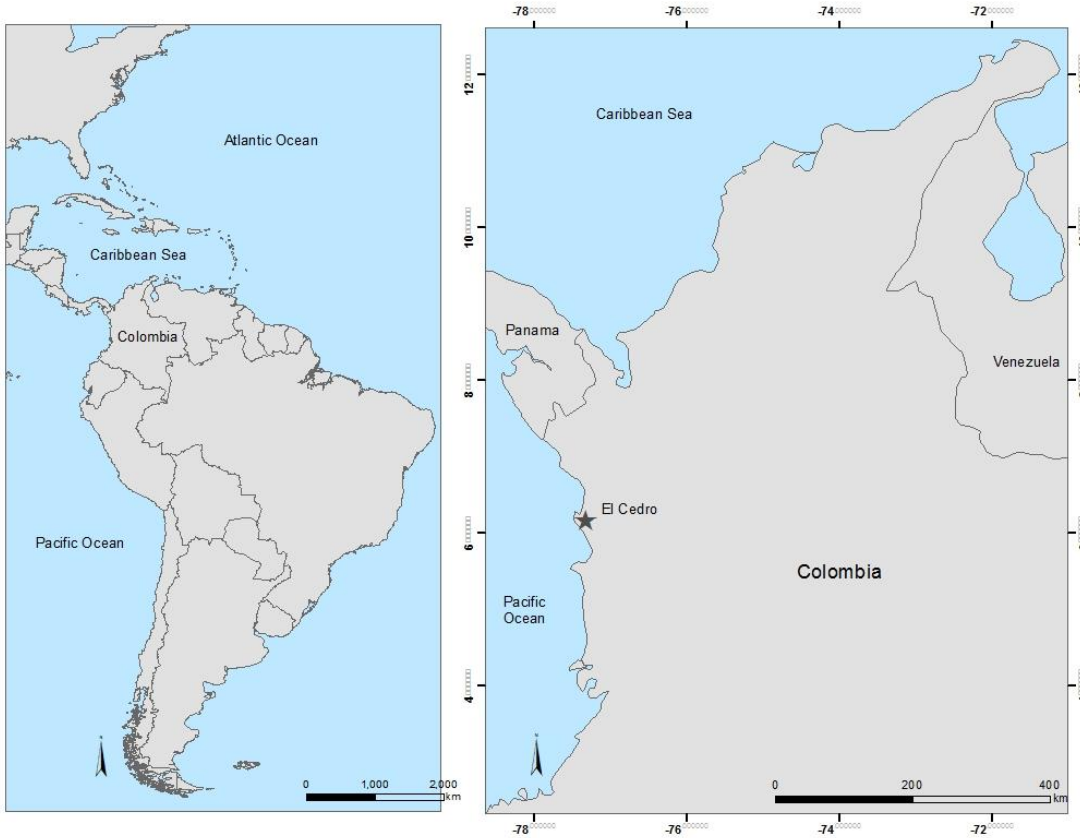

Figure 3: Study Area.

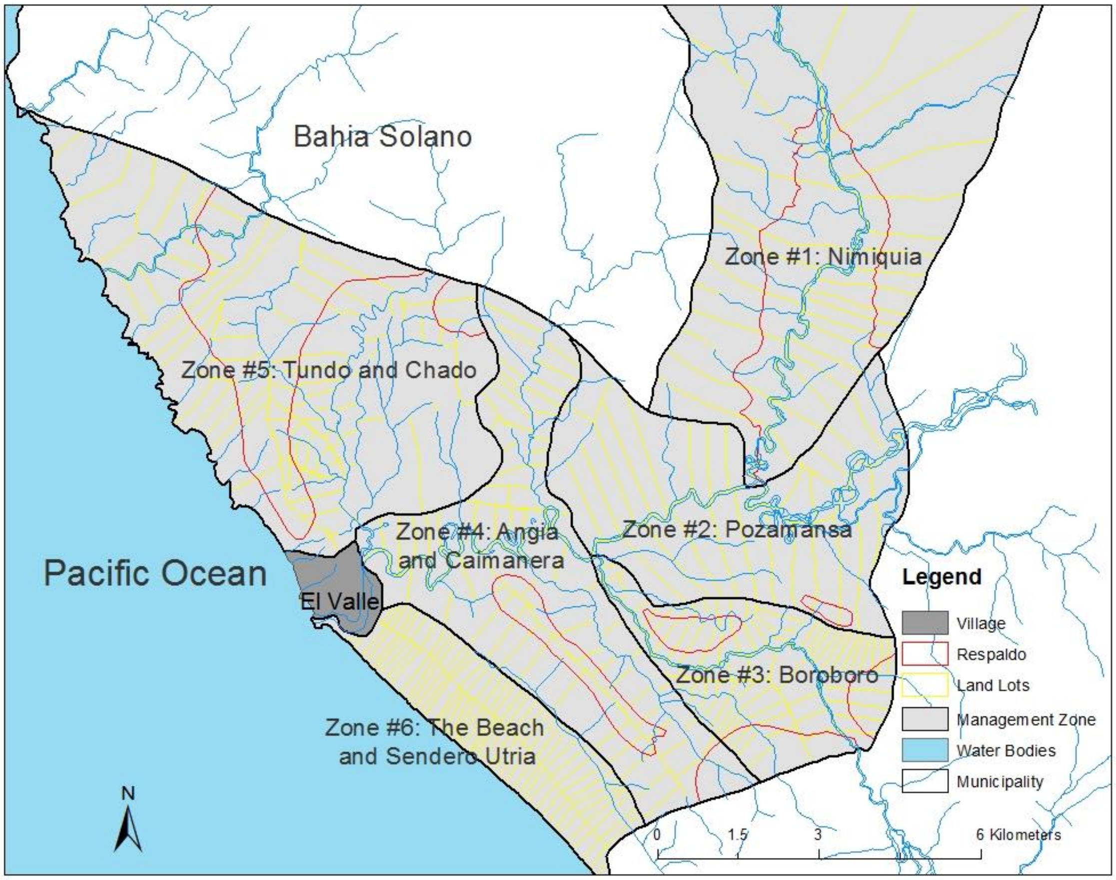

Figure 4: El Cedro's MZs and hypothetical distribution of farms

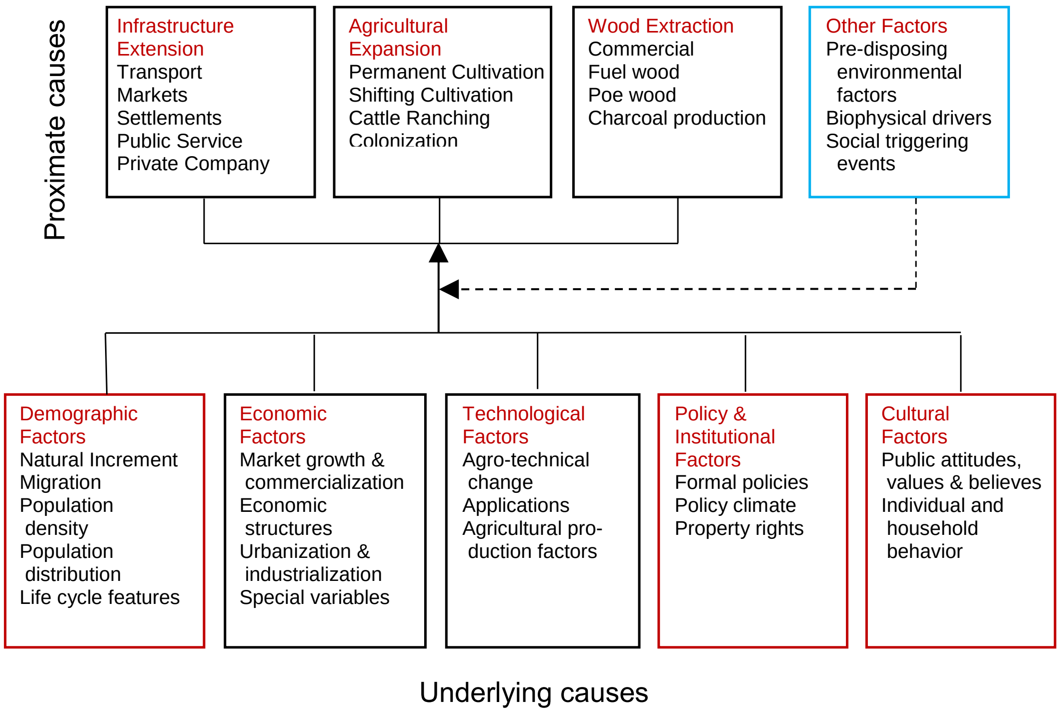

Figure 5: Causes of forest decline (after Geist and Lambin 2002 p. 144)

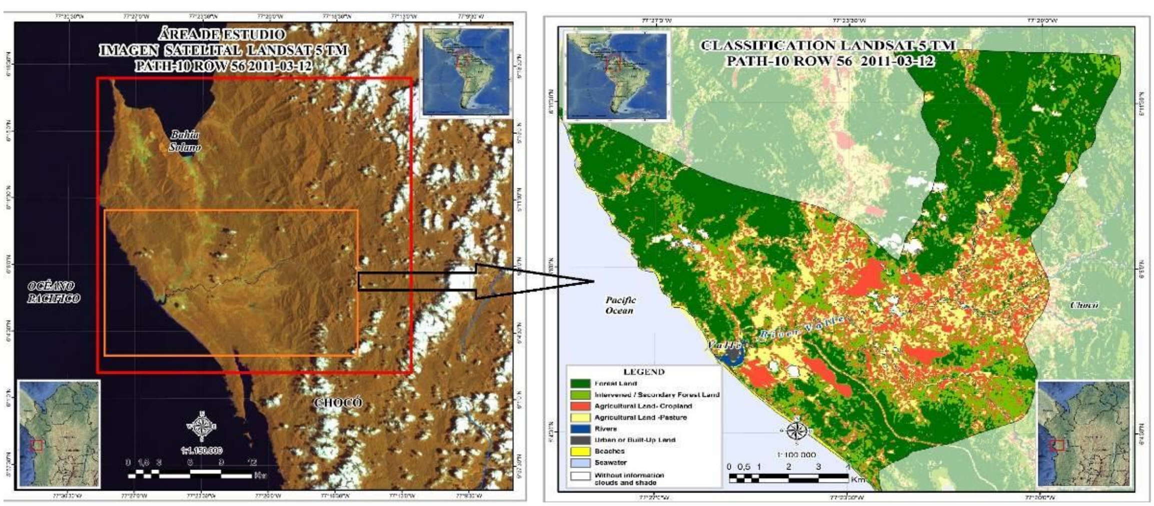

Figure 6: Broad Area of 862 km^2 (left); El Cedro (right)

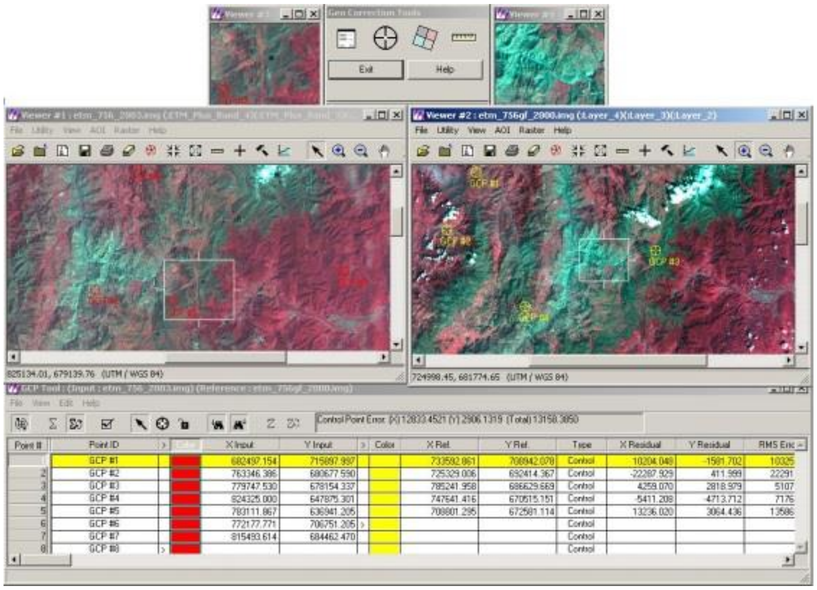

Figure 7: ERDAS Geometric Correction Tool

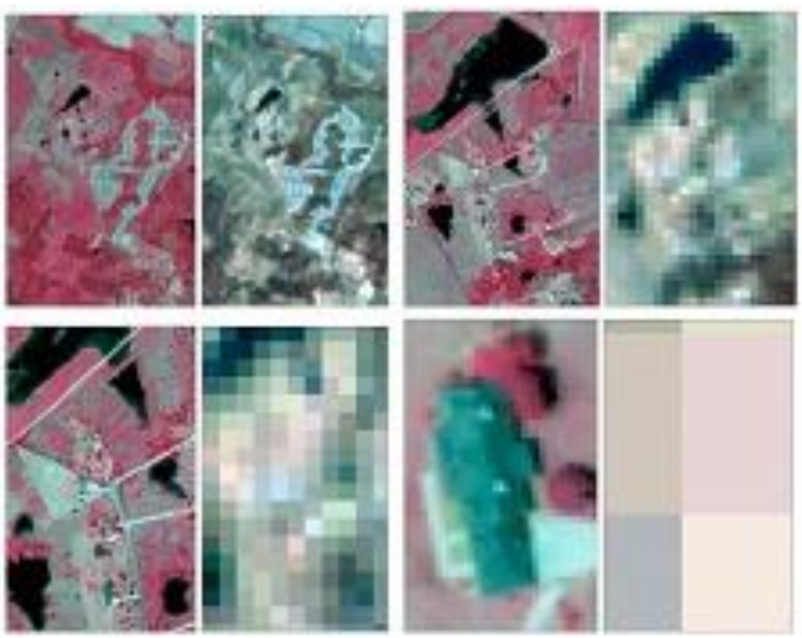

Figure 8: Zooming of typical data used for Classification

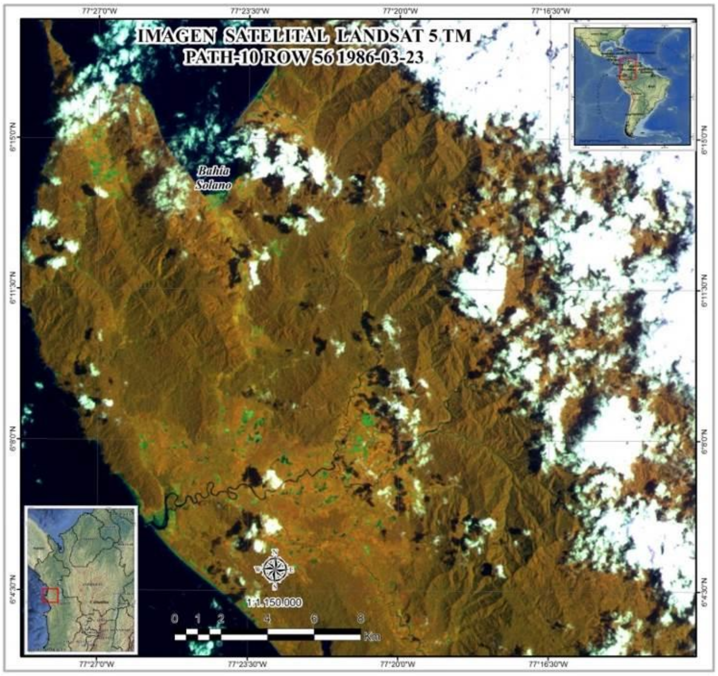

Figure 9: Landsat 5 TM year 1986

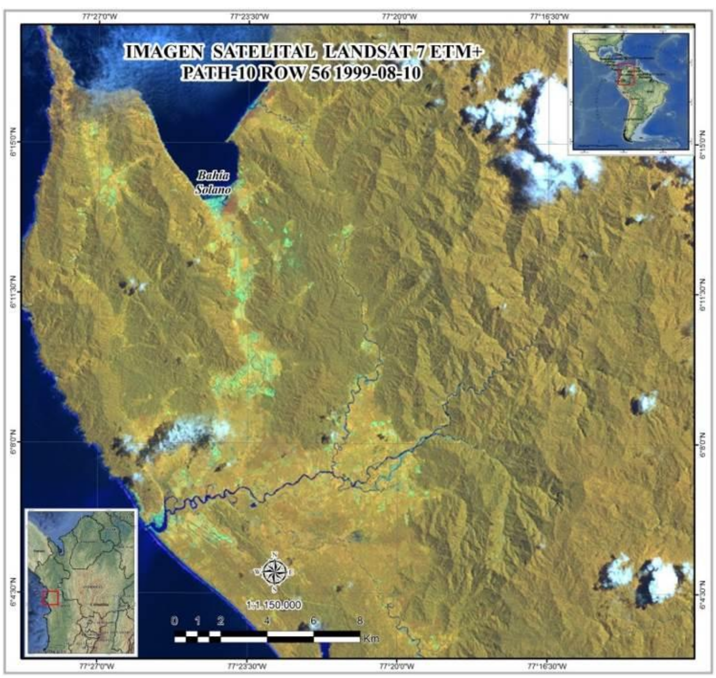

Figure 10: Landsat 7 ETM+ year 1999

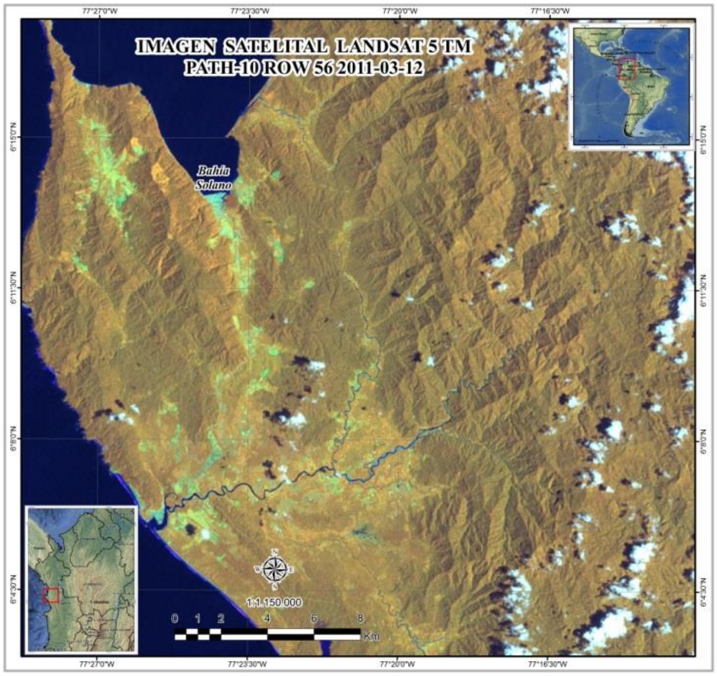

Figure 11: Landsat 5 TM year 2011

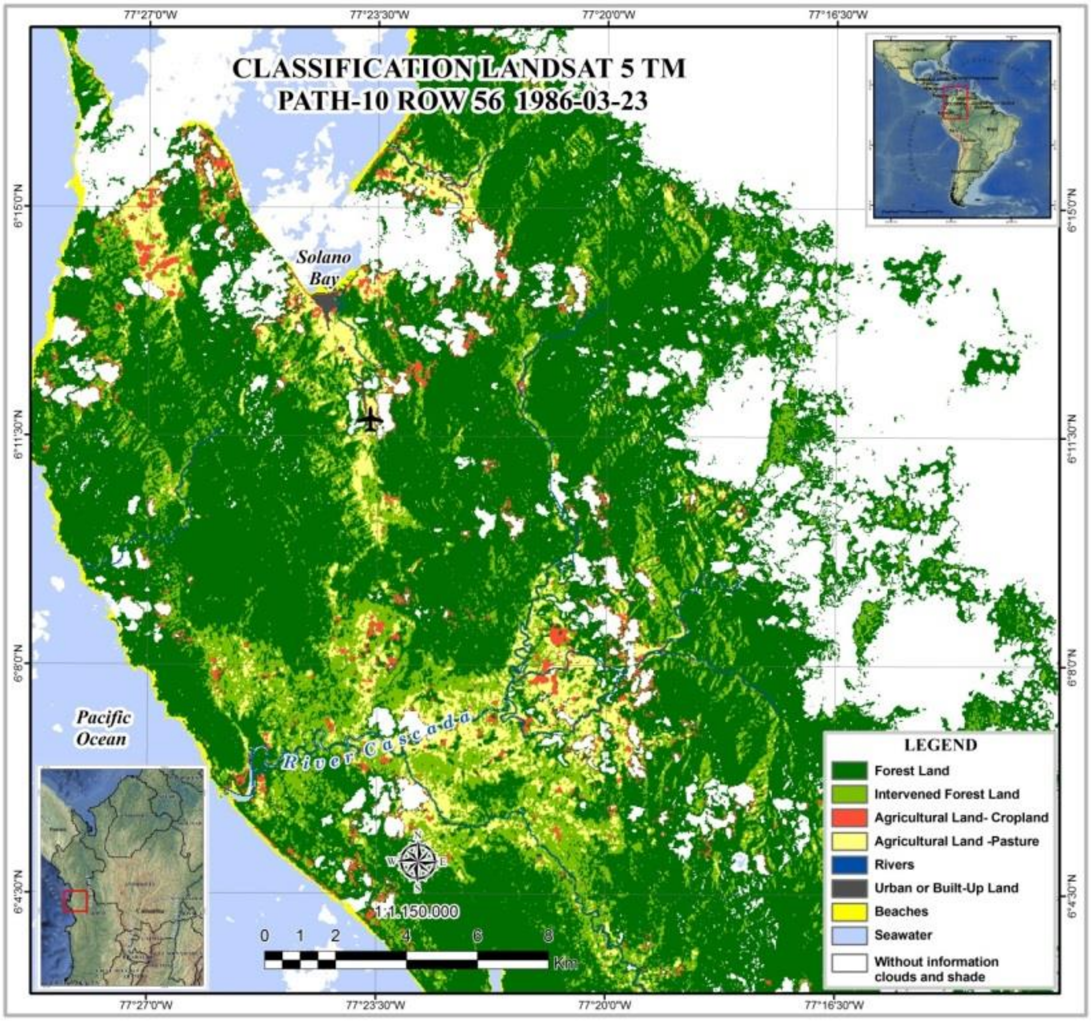

Figure 12: Supervised classification of Land Cover (1986, Broad Area)

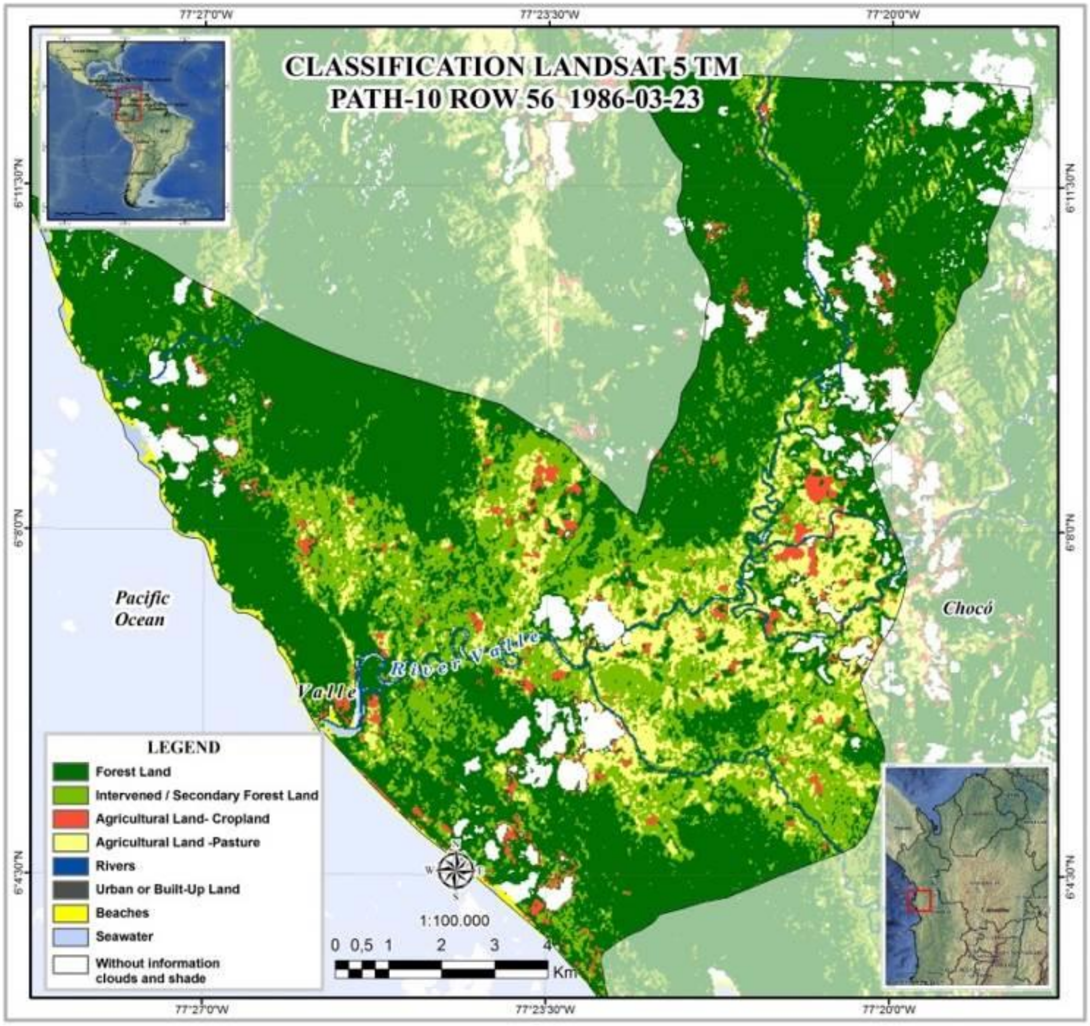

Figure 13: Supervised classification of Land Cover (1986, El Cedro)

Figure 14: Supervised classification of Land Cover (1999, Broad Area)

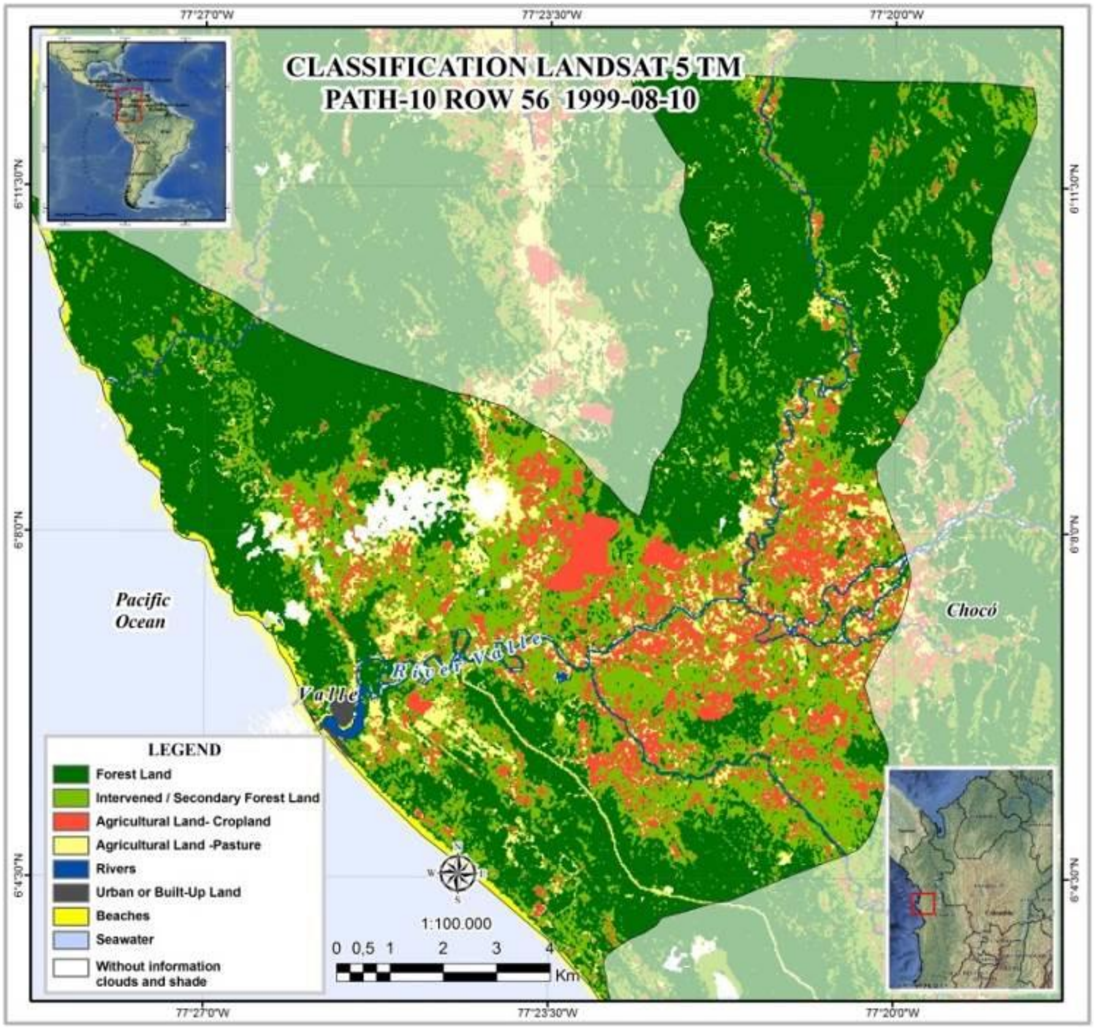

Figure 15: Supervised classification of Land Cover (1999, El Cedro)

Figure 16: Supervised classification of Land Cover (2011, Broad Area)

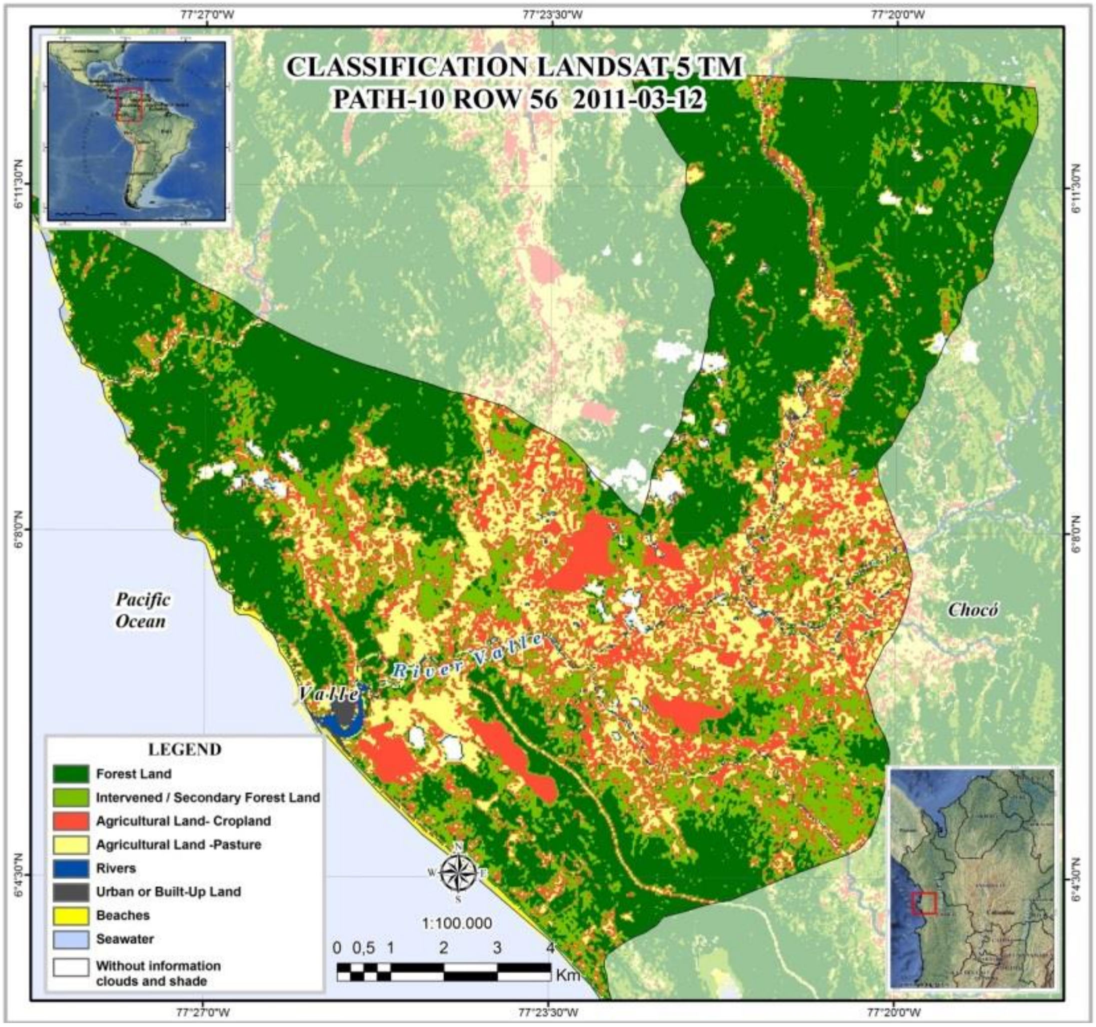

Figure 17: Supervised classification of Land Cover (2011, El Cedro)

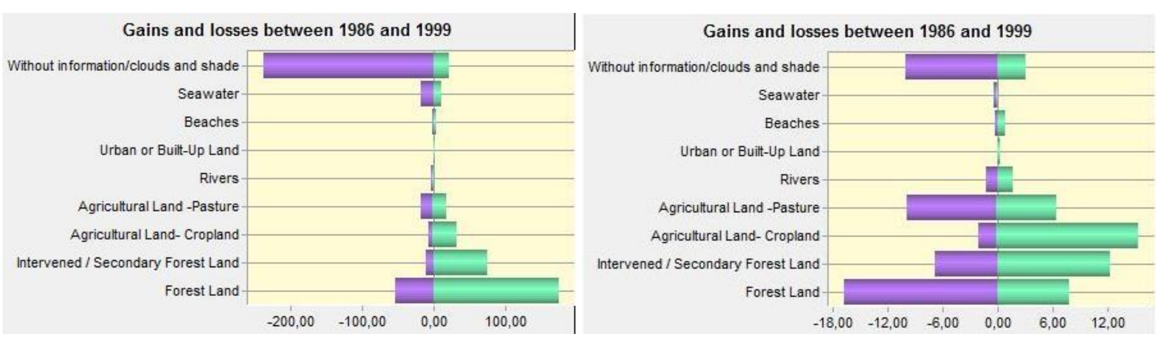

Figure 18: Gain and loss (km^2) 1986-1999. Left: Broad Area; Right: El Cedro

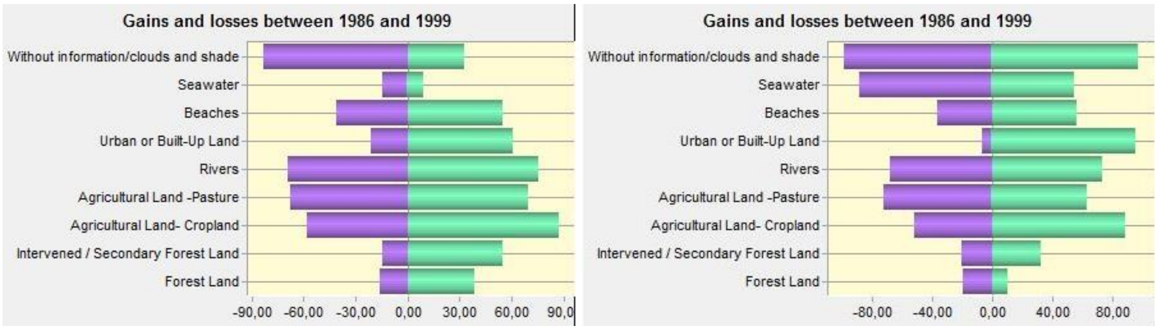

Figure 19: Gain and loss (%) 1986-1999. Left: Broad Area; Right: El Cedro

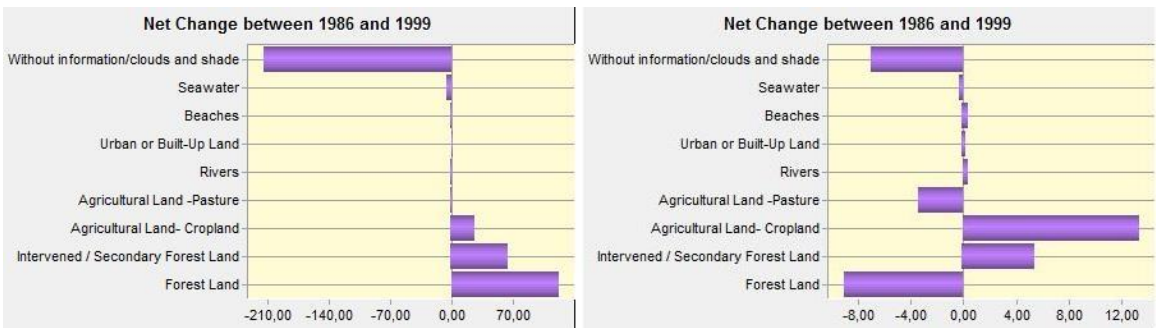

Figure 20: Net change (km^2)1986-1999. Left: Broad Area; Right: El Cedro.

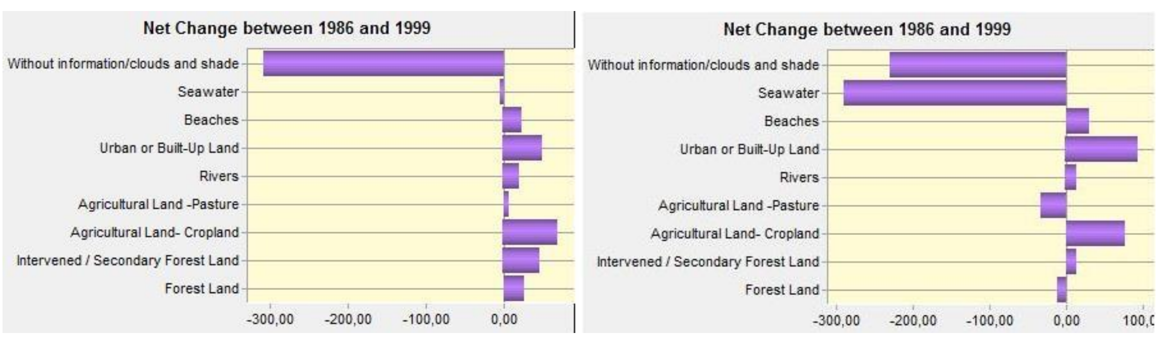

Figure 21: Net change (%) 1986-1999. Left: Broad Area; Right: El Cedro.

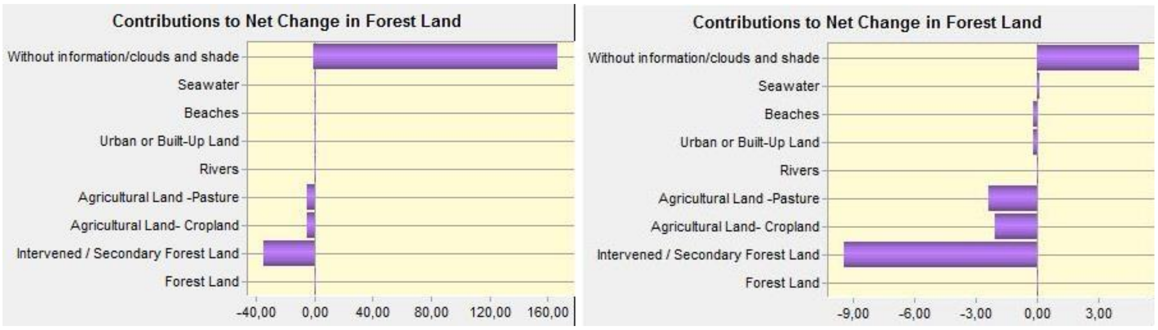

Figure 22: Contributors to Net Change of Forest (km^2) 1986-1999. Left: Broad Area; Right: El Cedro

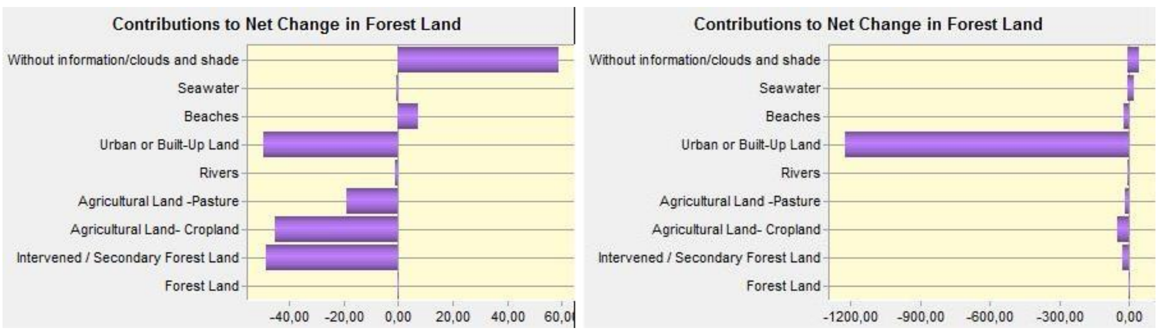

Figure 23: Contributors to Net change of Forest (%) 1986-1999. Left: Broad Area; Right: El Cedro

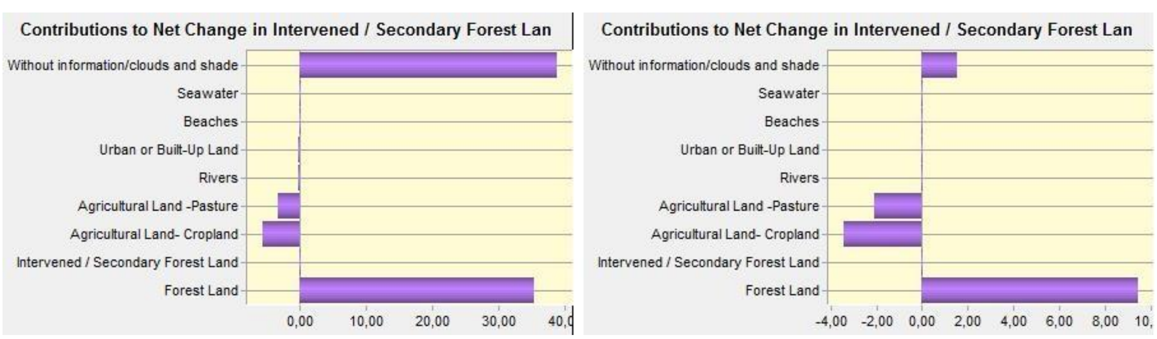

Figure 24: Contributors to Net change of Secondary Forest (km^2) 1986-1999. Left: Broad Area; Right: El Cedro

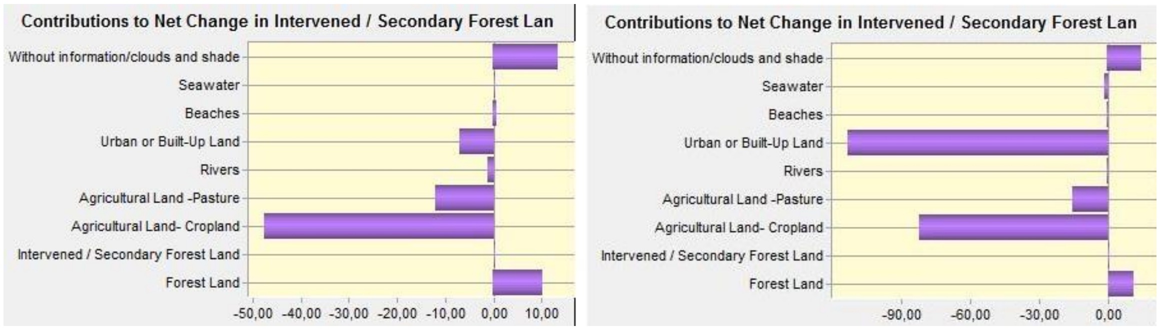

Figure 25: Contributors to Net change of Secondary Forest (%) 1986-1999. Left: Broad Area; Right: El Cedro

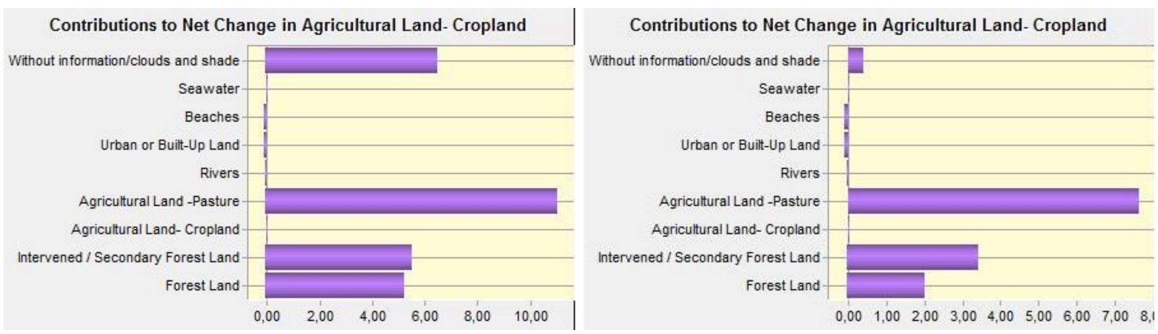

Figure 26: Contributors to Net change of Croplands (km^2) 1986-1999. Left: Broad Area; Right: El Cedro

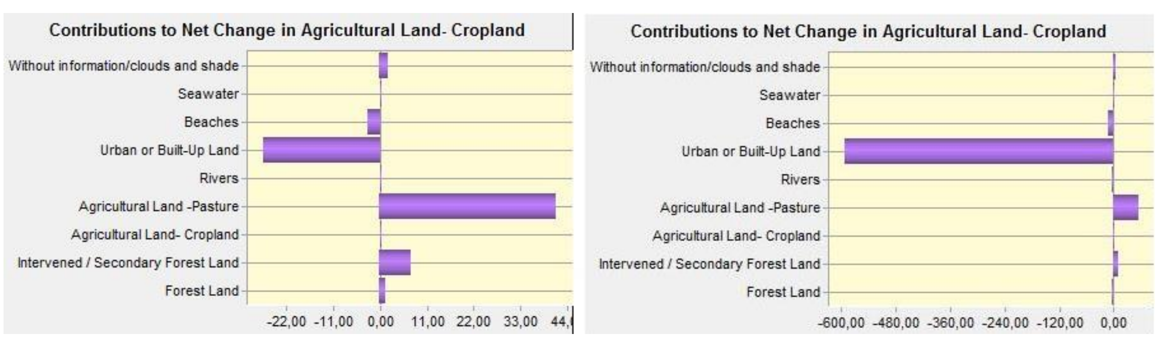

Figure 27: Contributors to Net change of Croplands (%) 1986-1999. Left: Broad Area; Right: El Cedro

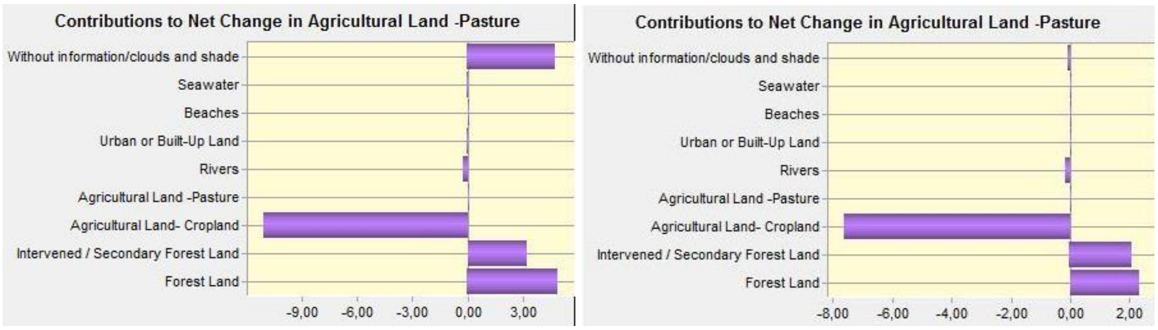

Figure 28: Contributors to Net change of Pastures (km^2) 1986-1999. Left: Broad Area; Right: El Cedro.

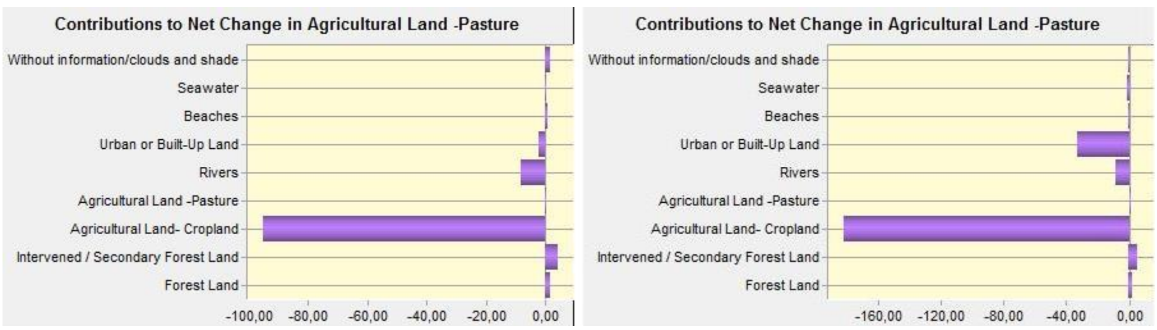

Figure 29: Contributors to Net change of Pastures (%) 1986-1999. Left: Broad Area; Right: El Cedro.

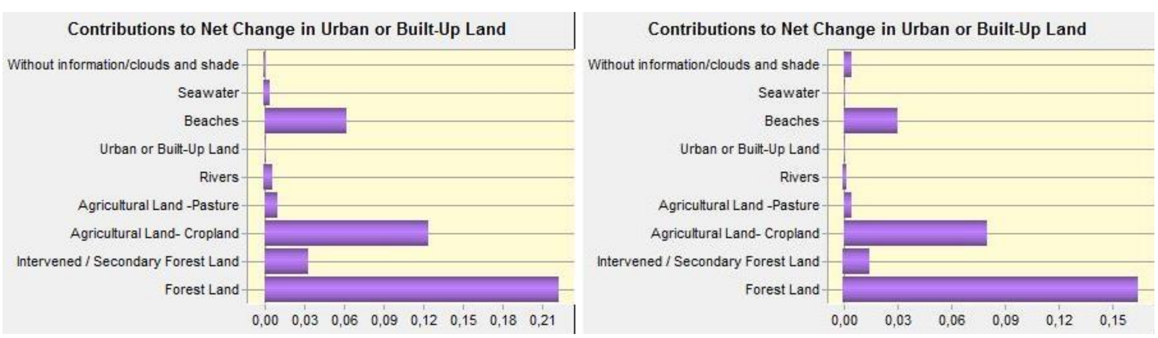

Figure 30: Contributors to Net change of Urban or Built-up areas (km^2) 1986-1999. Left: Broad Area; Right: El Cedro

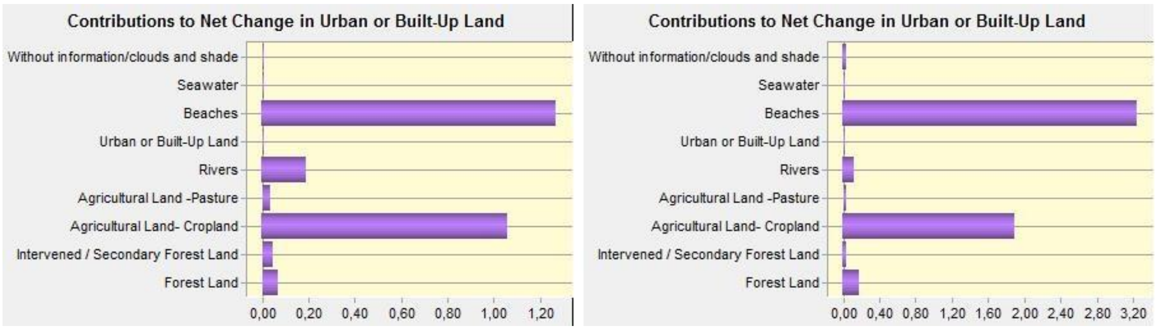

Figure 31: Contributors to Net change of Urban or Built-up areas (%) 1986-1999. Left: Broad Area; Right: El Cedro

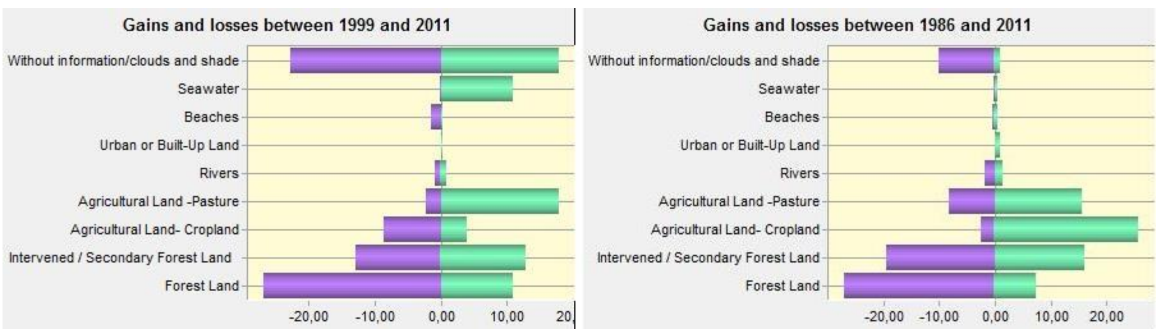

Figure 32: Gain and loss (km_2) 1999-2011. Left: Broad Area; Right: El Cedro

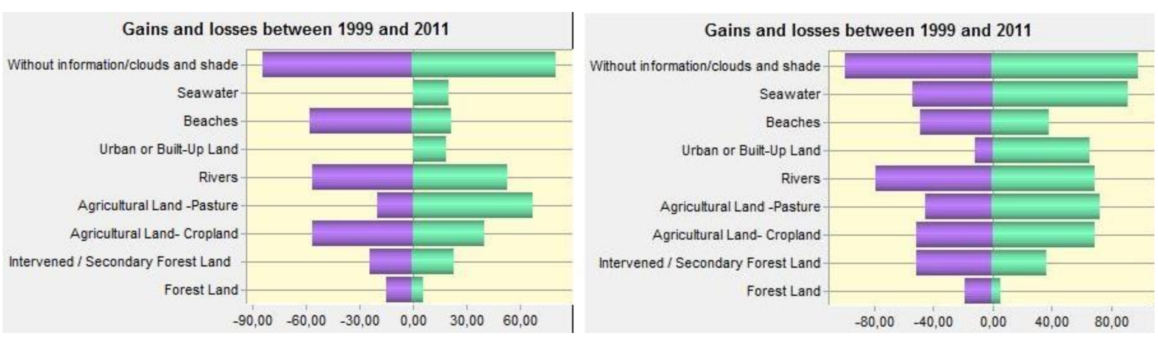

Figure 33: Gain and loss (%) 1999-2011. Left: Broad Area; Right: El Cedro

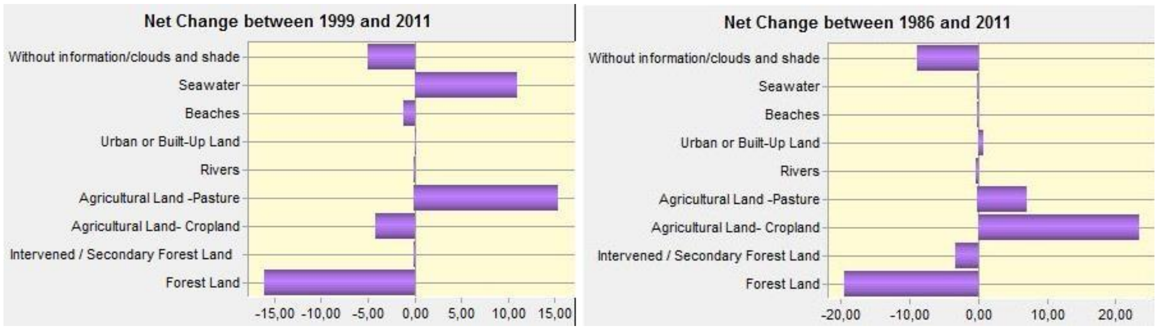

Figure 34: Net change (km^2) 1999-2011. Left: Broad Area; Right: El Cedro

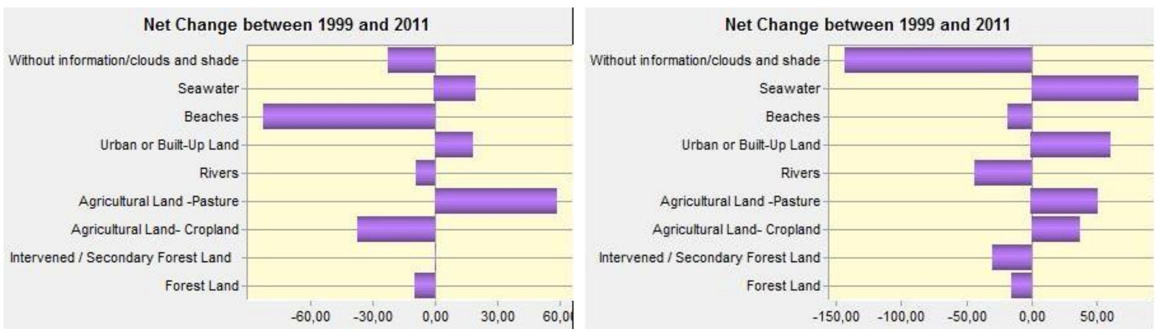

Figure 35: Net change (%) 1999-2011. Left: Broad Area; Right: El Cedro

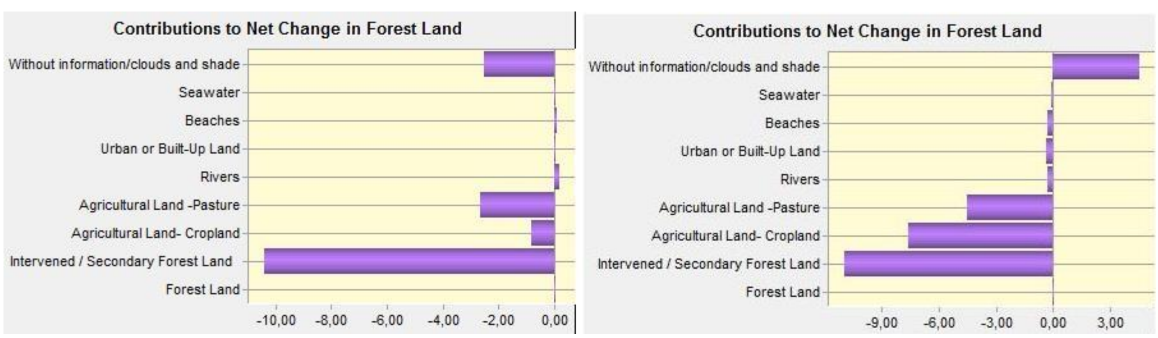

Figure 36: Contributors to Net change of Forest (km^2) 1999-2011. Left: Broad Area; Right: El Cedro

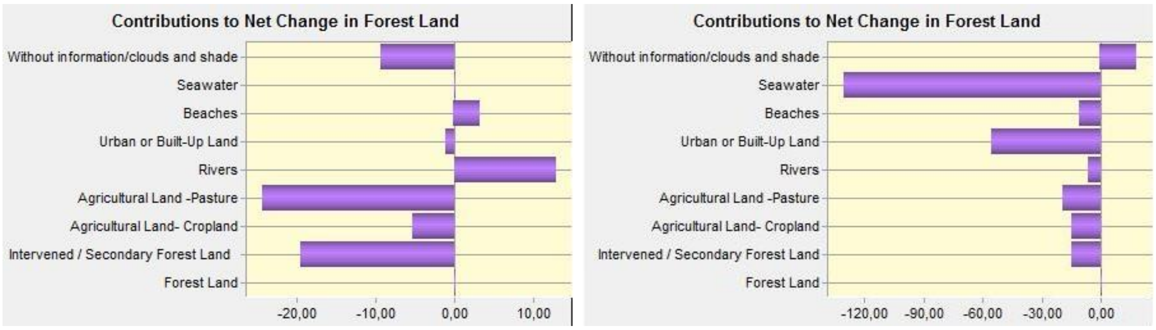

Figure 37: Contributors to Net change of Forest (%) 1999-2011. Left: Broad Area; Right: El Cedro

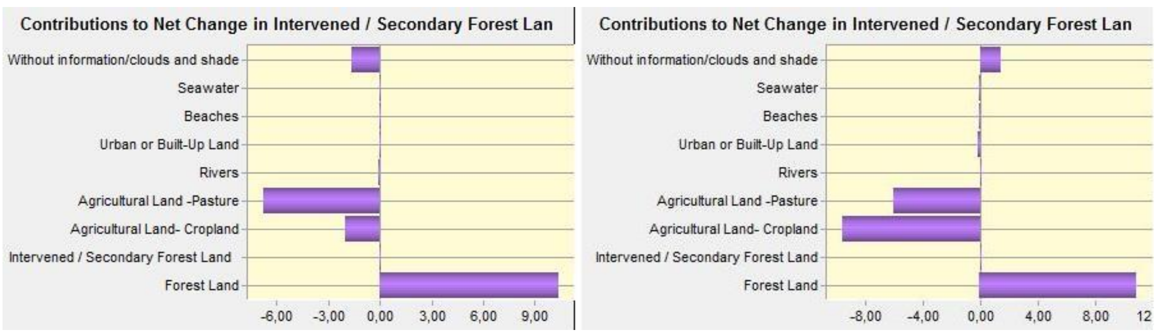

Figure 38: Contributors to Net change of Secondary Forest (km^2) 1999-2011. Left: Broad Area; Right: El Cedro

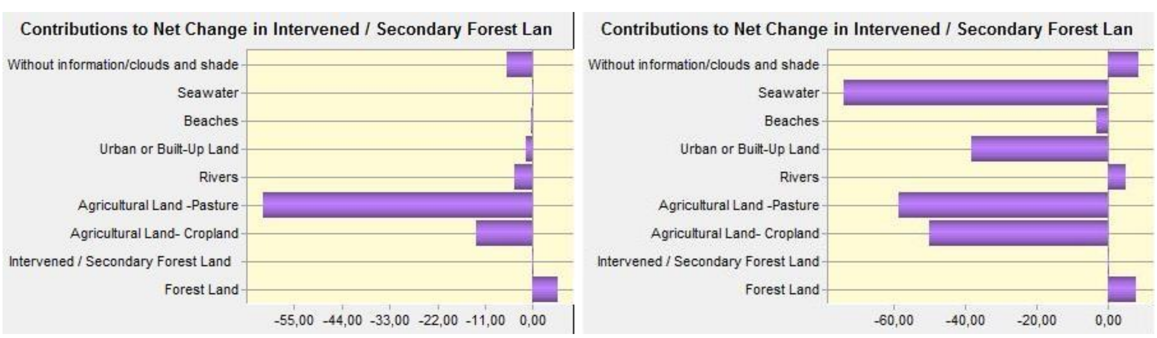

Figure 39: Contributors to Net change of Secondary Forest (%) 1999-2011. Left: Broad Area; Right: El Cedro

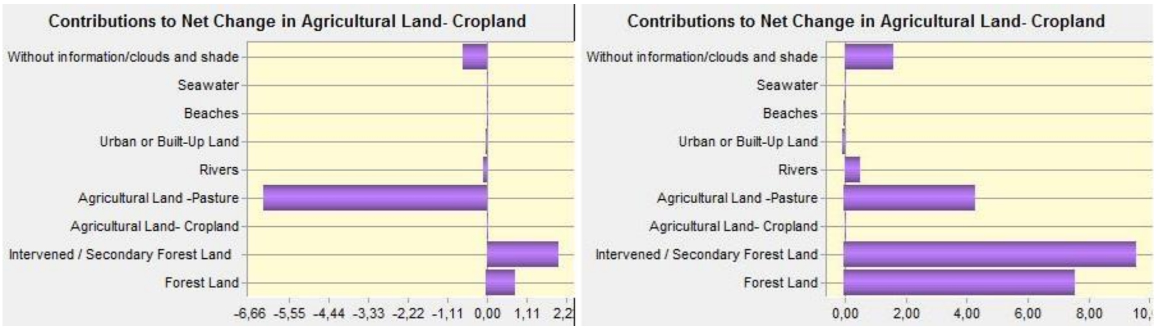

Figure 40: Contributors to Net change of Croplands (km^2) 1999-2011. Left: Broad Area; Right: El Cedro

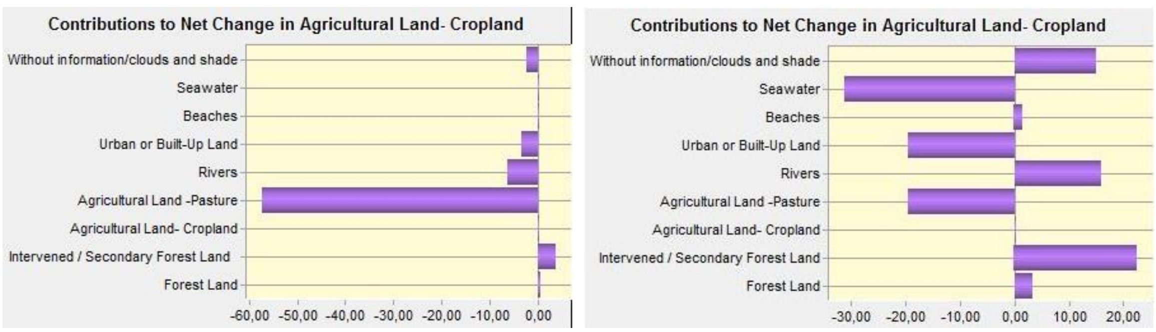

Figure 41: Contributors to Net change of Croplands (%) 1999-2011. Left: Broad Area; Right: El Cedro

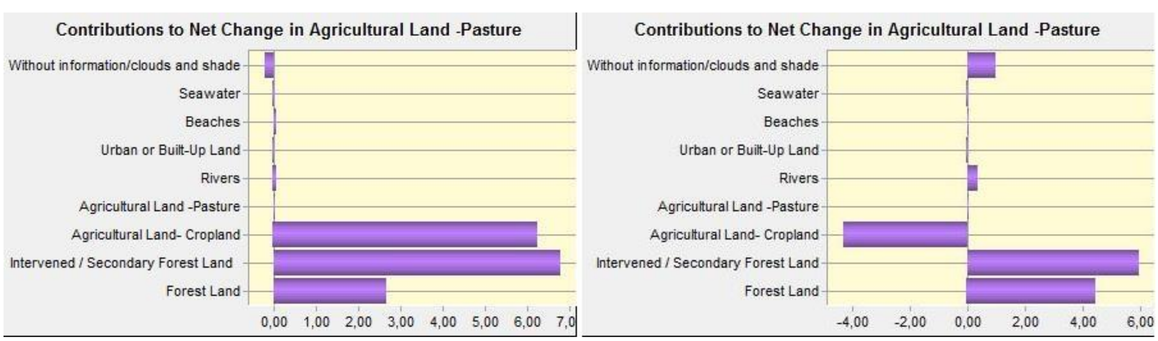

Figure 42: Contributors to Net change of Pastures (km^2) 1999-2011. Left: Broad Area; Right: El Cedro.

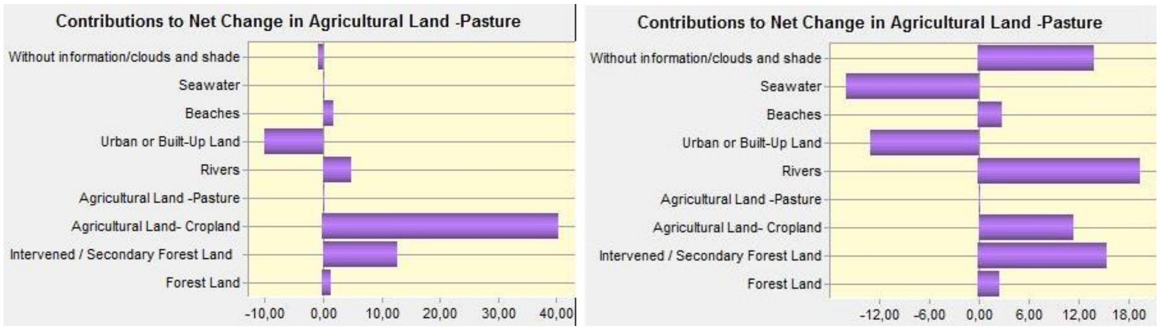

Figure 43: Contributors to Net change of Pastures (%) 1999-2011. Left: Broad Area; Right: El Cedro.

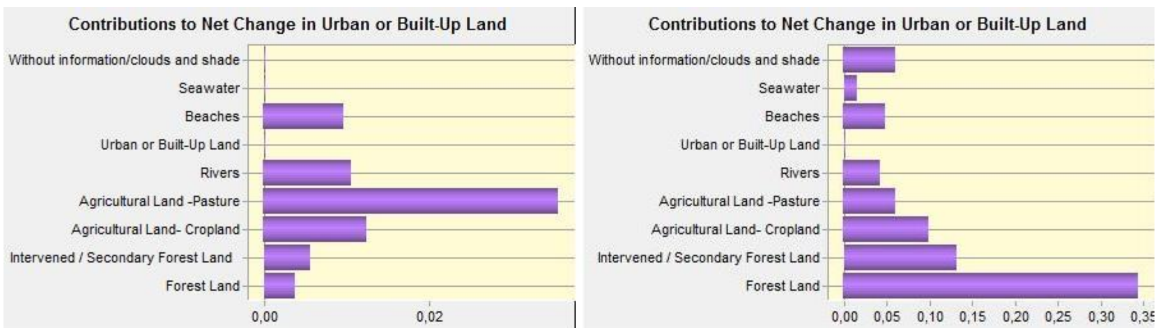

Figure 44: Contributors to Net change of Urban or Built-up areas (km^2) 1999-2011. Left: Broad Area; Right: El Cedro

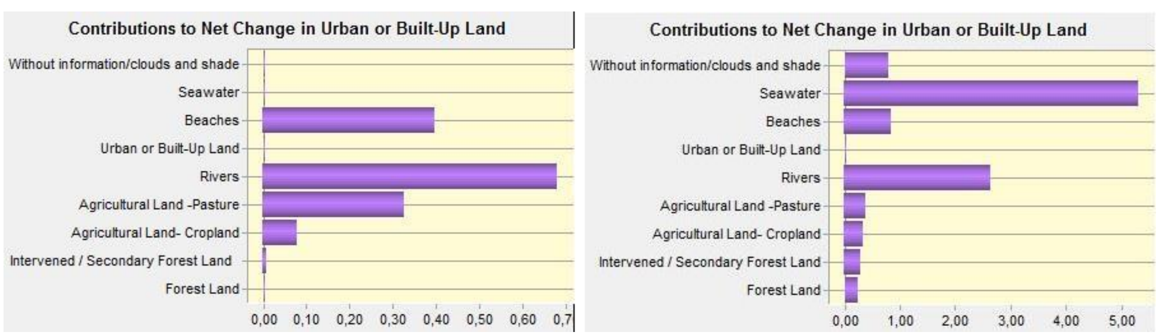

Figure 45: Contributors to Net change of Urban or Built-up areas (%) 1999-2011. Left: Broad Area; Right: El Cedro

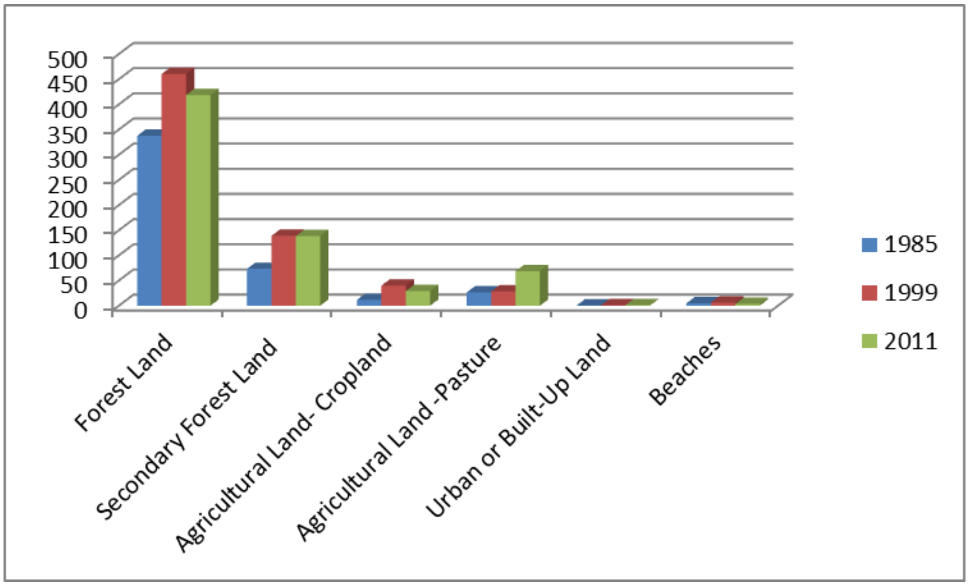

Figure 46: Broad Area Extension of Land Cover (km^2): 1986, 1999, 2011

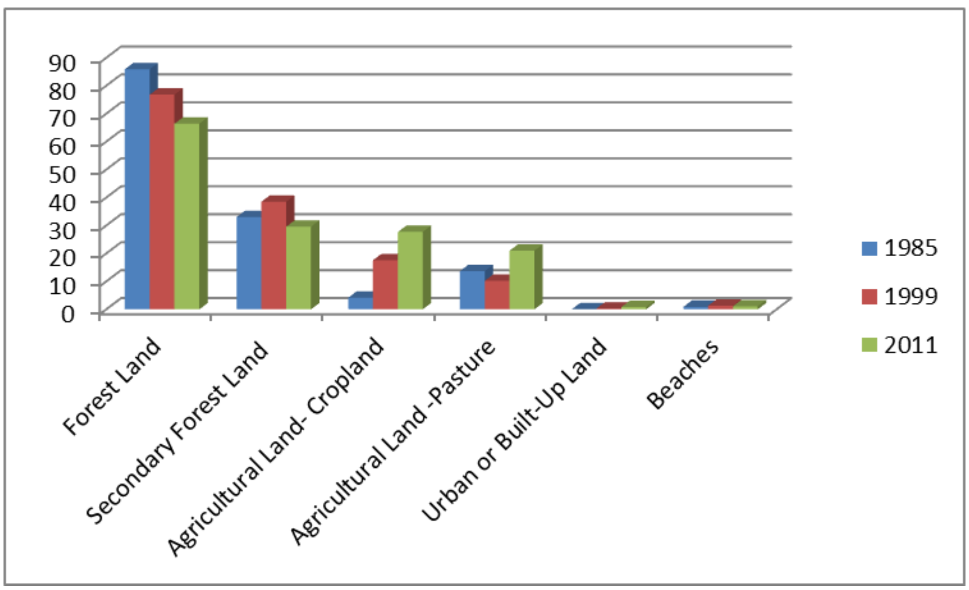

Figure 47: El Cedro Extension of Land Cover (km^2): 1986, 1999, 2011

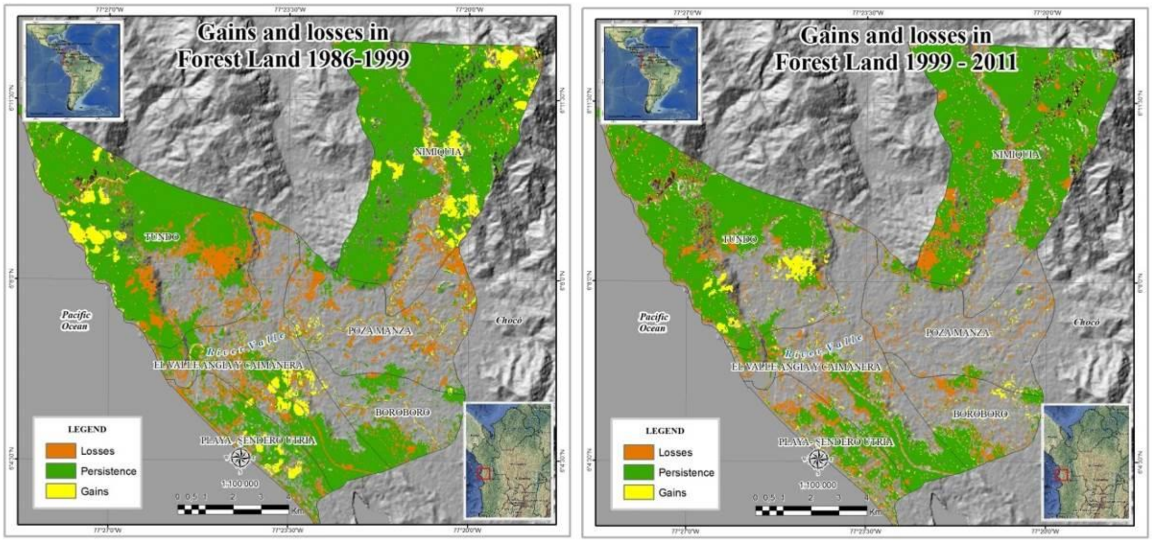

Figure 48: Gain, Persistence and Loss of Forest in El Cedro

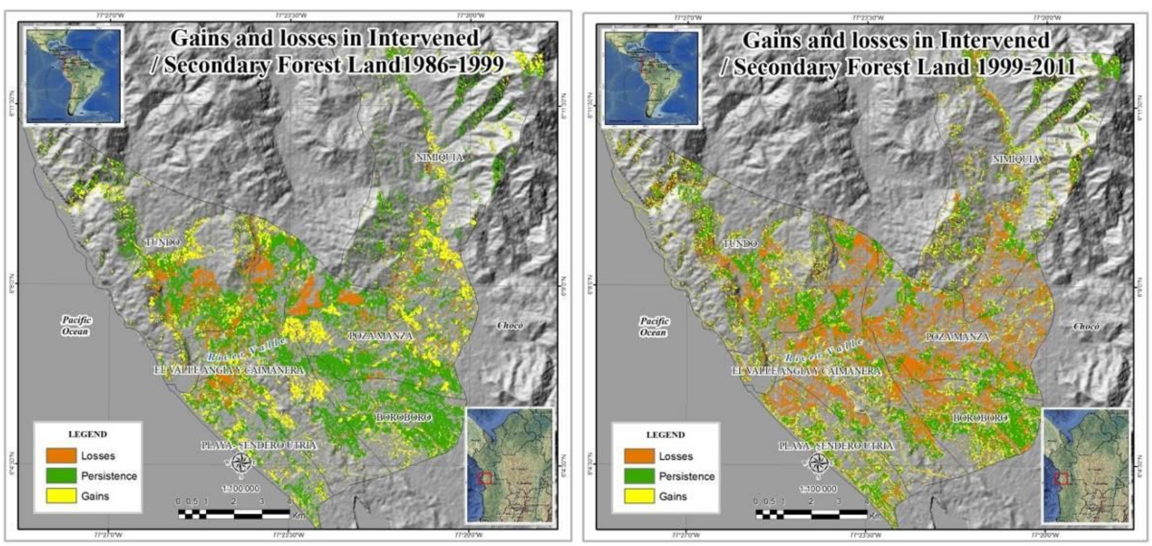

Figure 49: Gain, Persistence and Loss of Secondary Forest in El Cedro

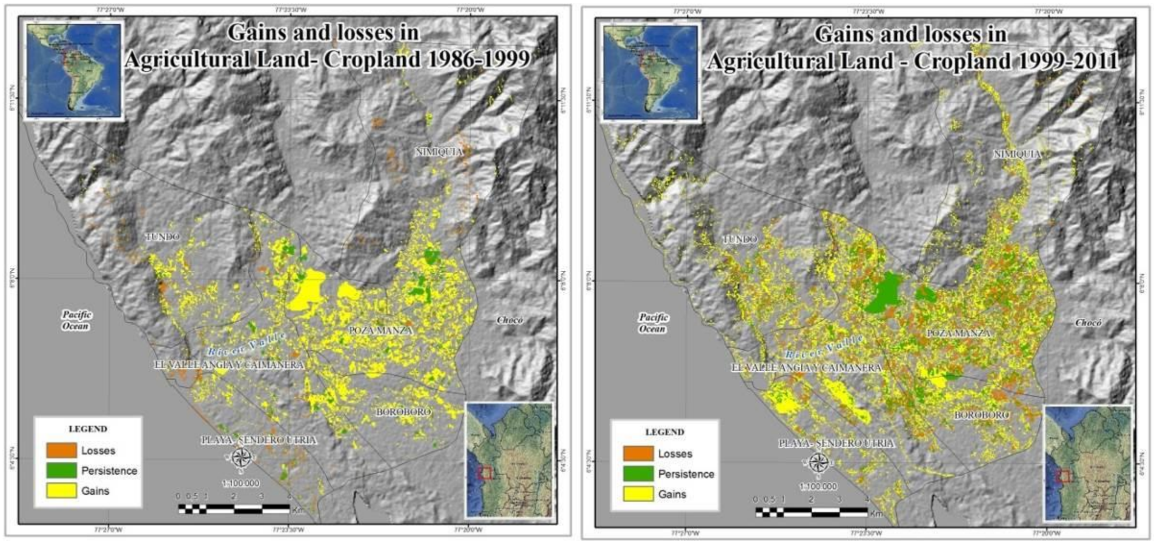

Figure 50: Gain, Persistence and Loss of Cropland in El Cedro

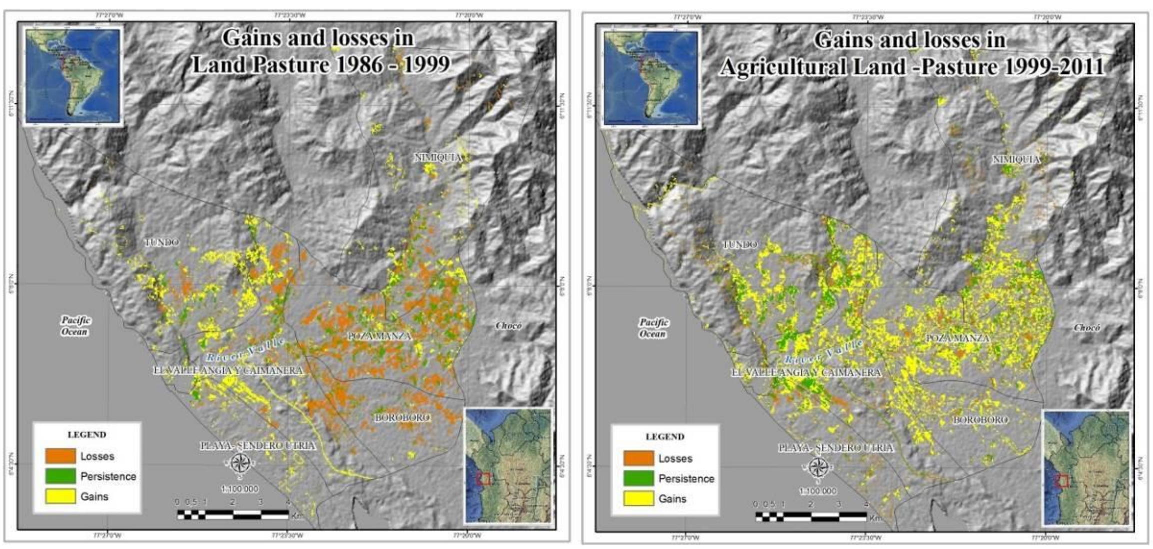

Figure 51: Gain, Persistence and Loss of Pasture in El Cedro

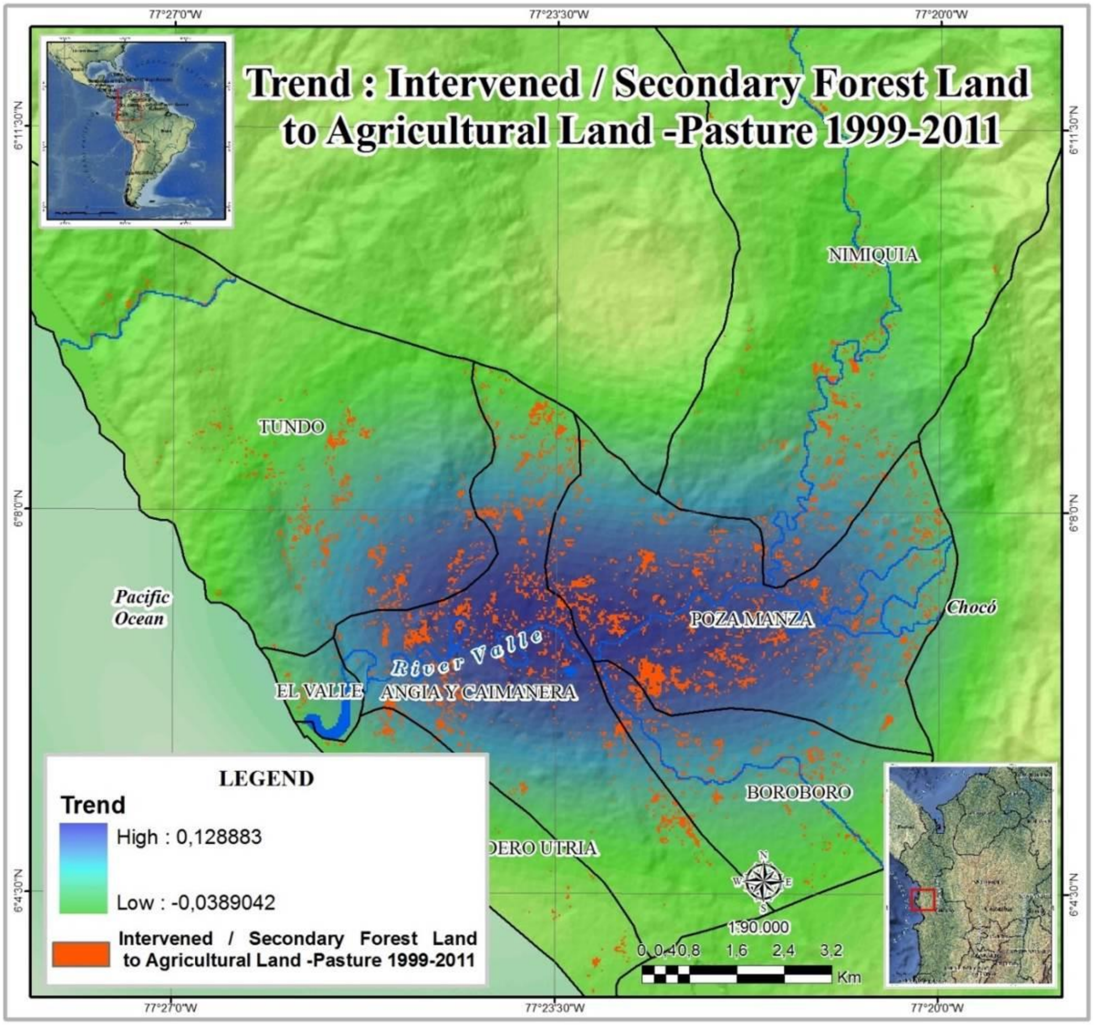

Figure 52: Trend Model: Secondary forest to Pasture (1999 and 2011)

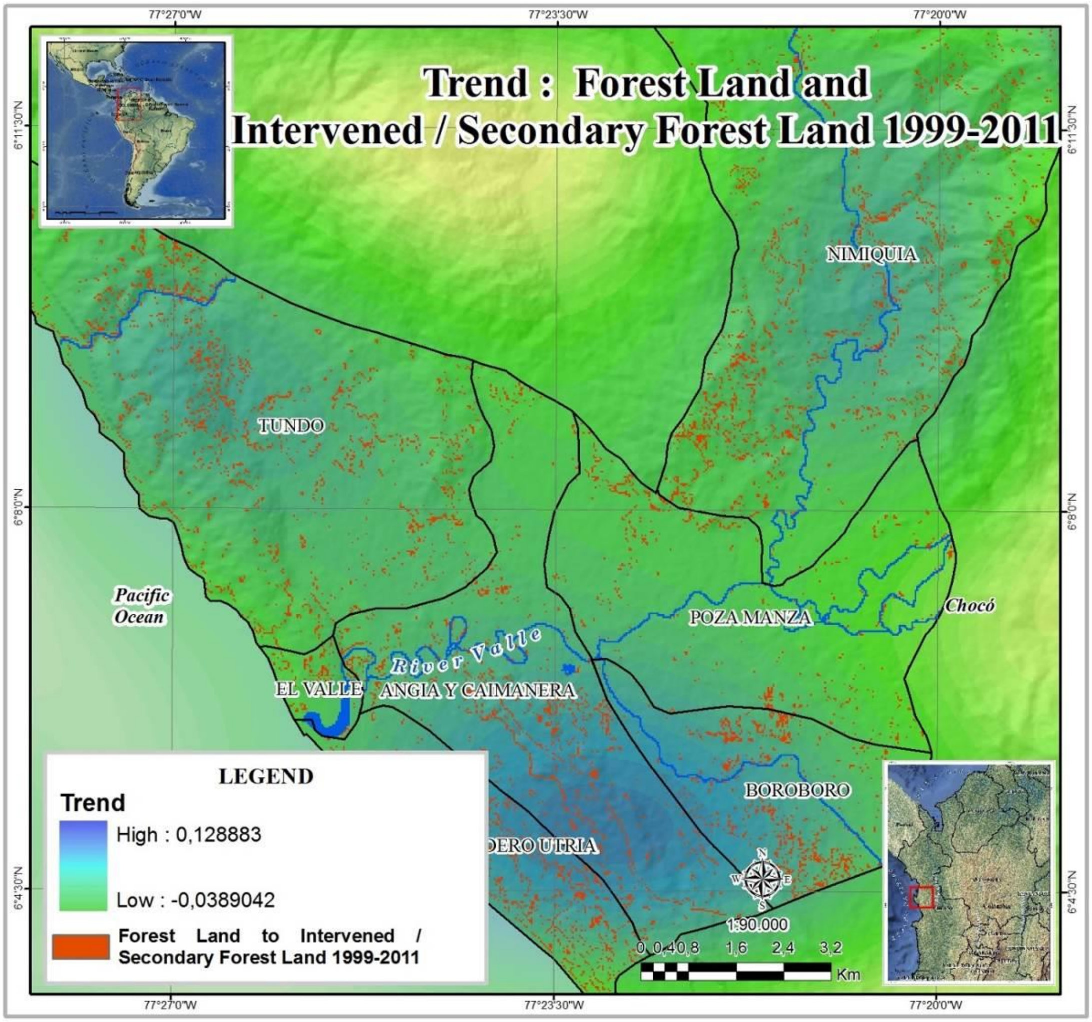

Figure 53: Trend Model: Forest to Secondary Forest (1999 and 2011)

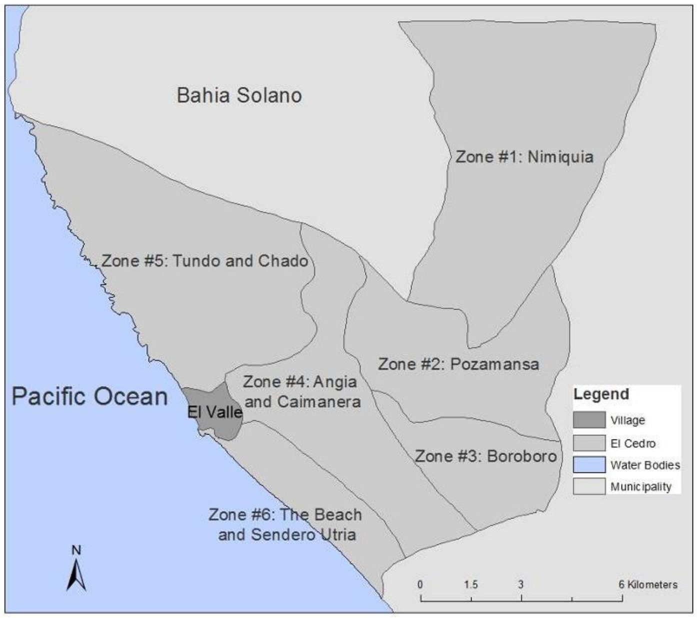

Figure 54: Management Zones in the El Cedro

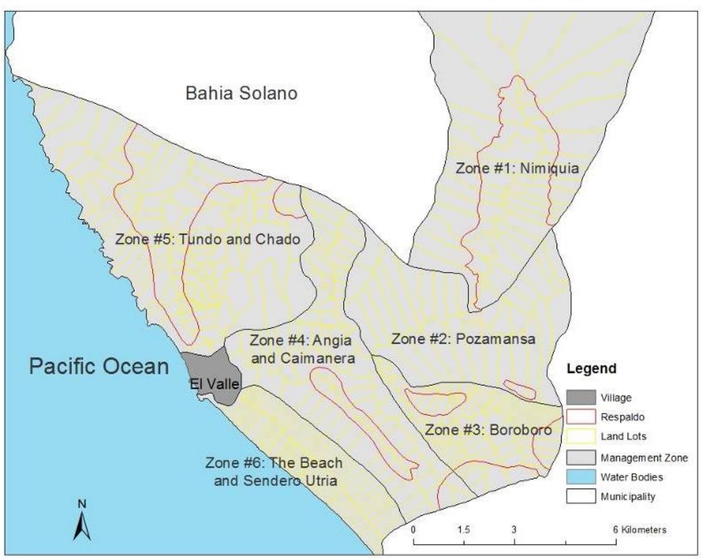

Figure 55: El Cedro's Hypothetical distribution of Farms per MZs

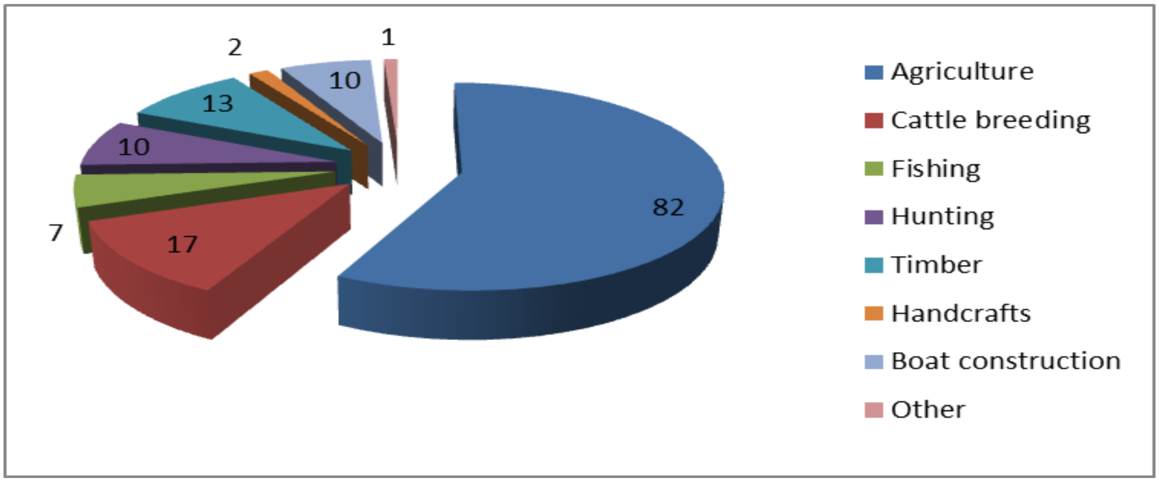

Figure 56: Land use/ livelihoods per Farms (%) in El Cedro

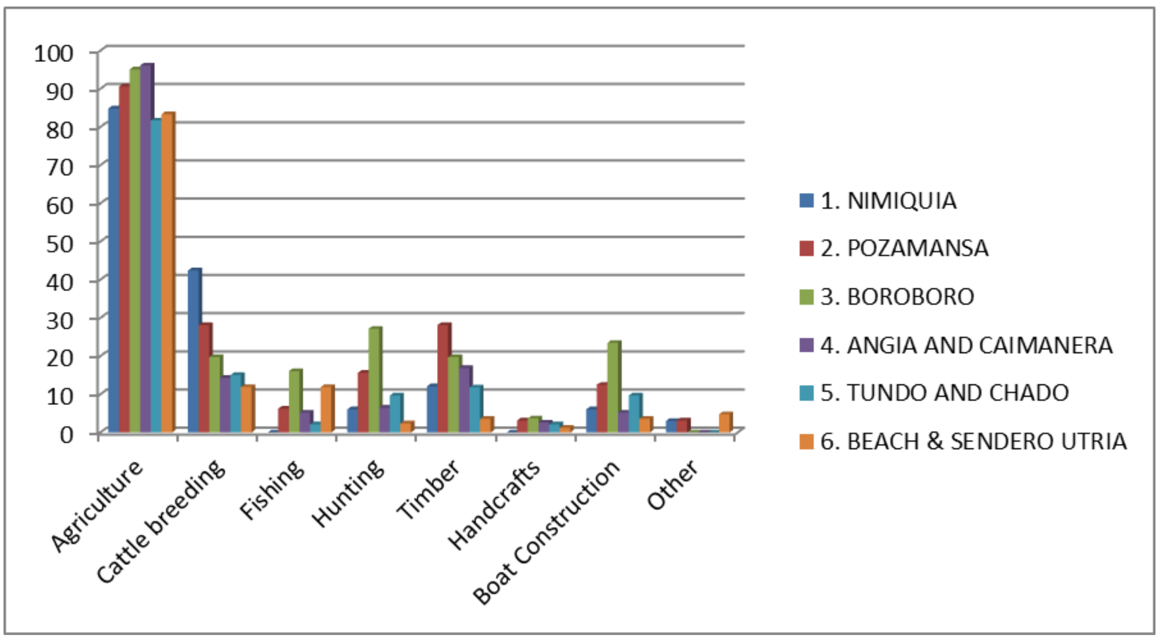

Figure 57: Land use/ livelihoods per Management Zone (%)

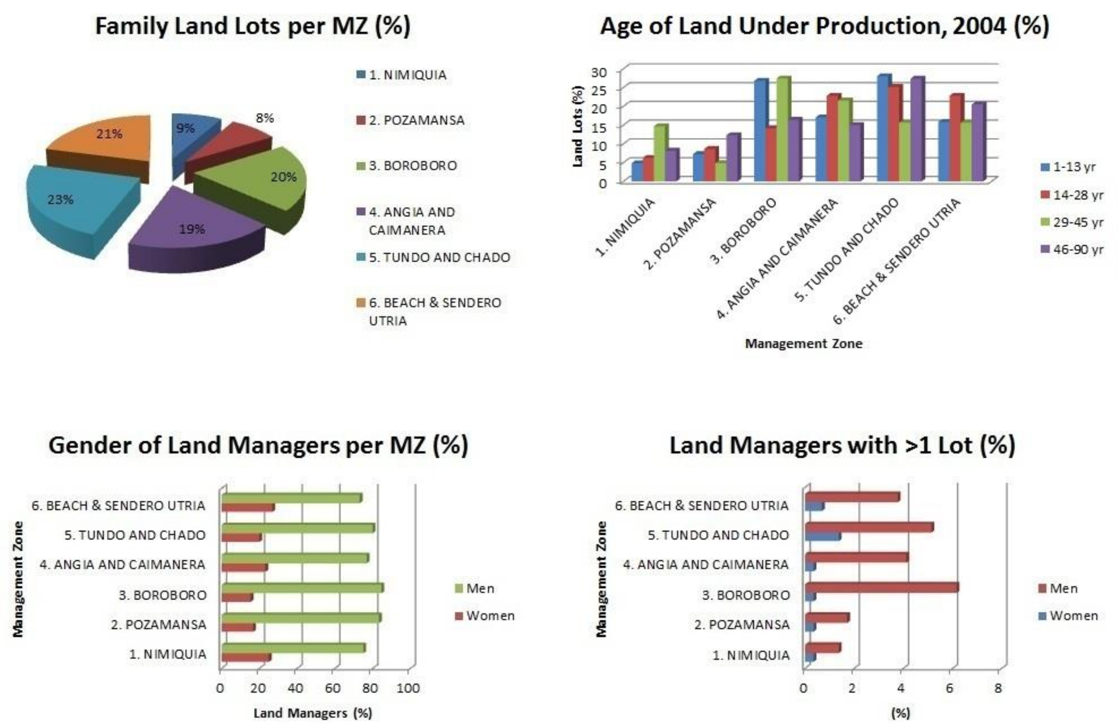

Figure 58: Land Tenure by Gender per MZ (%)

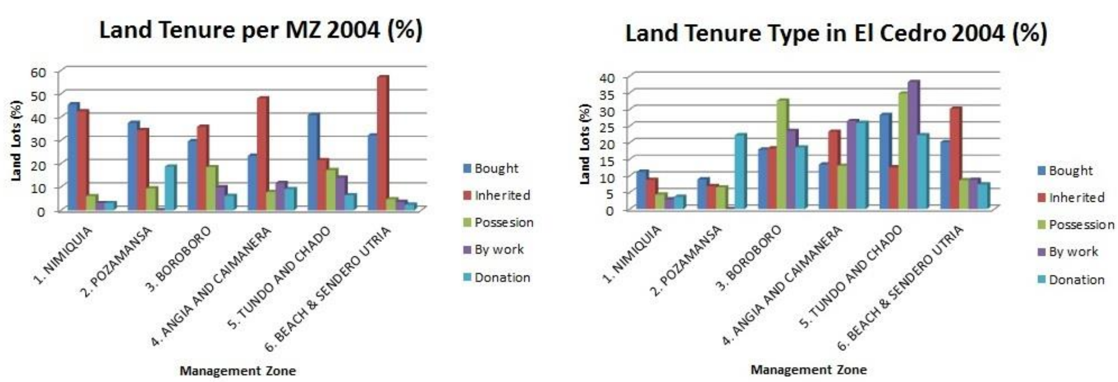

Figure 59: Land Tenure Type (%) per MZ (right); In *El Cedro* (left)

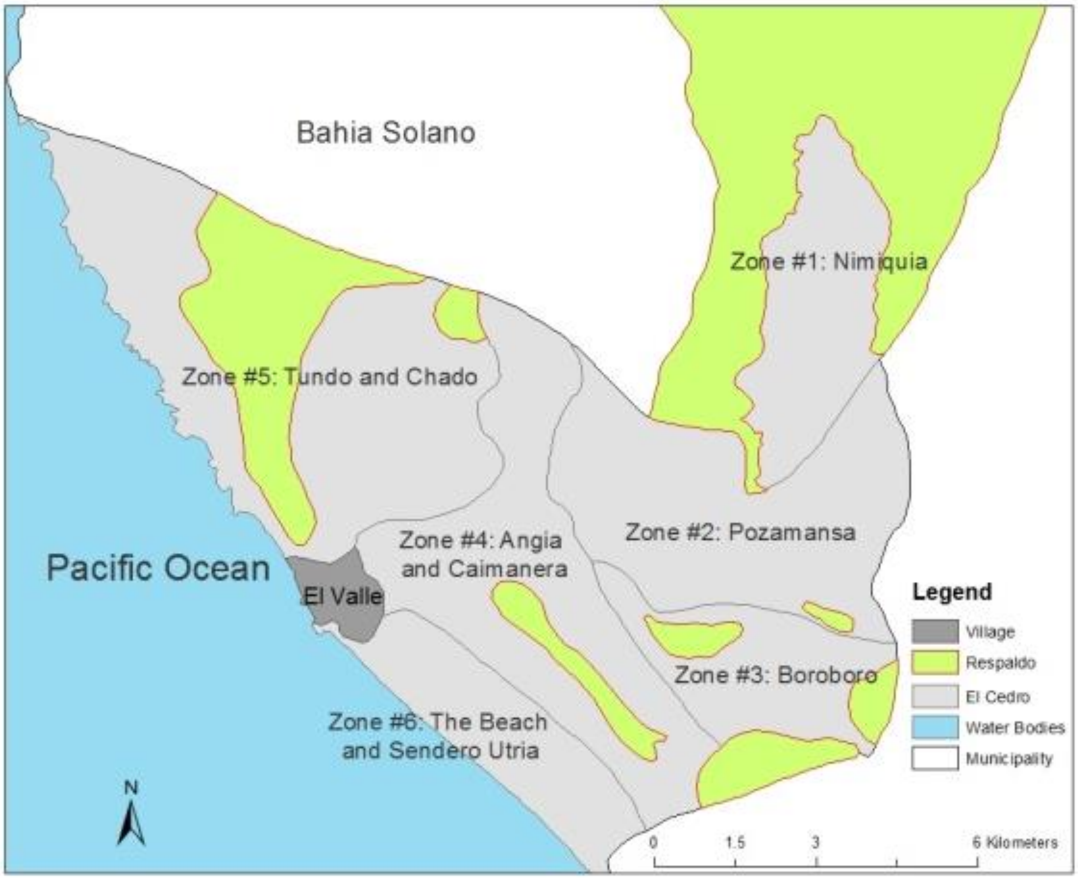

Figure 60: Distribution of *Respaldo* in the El Cedro

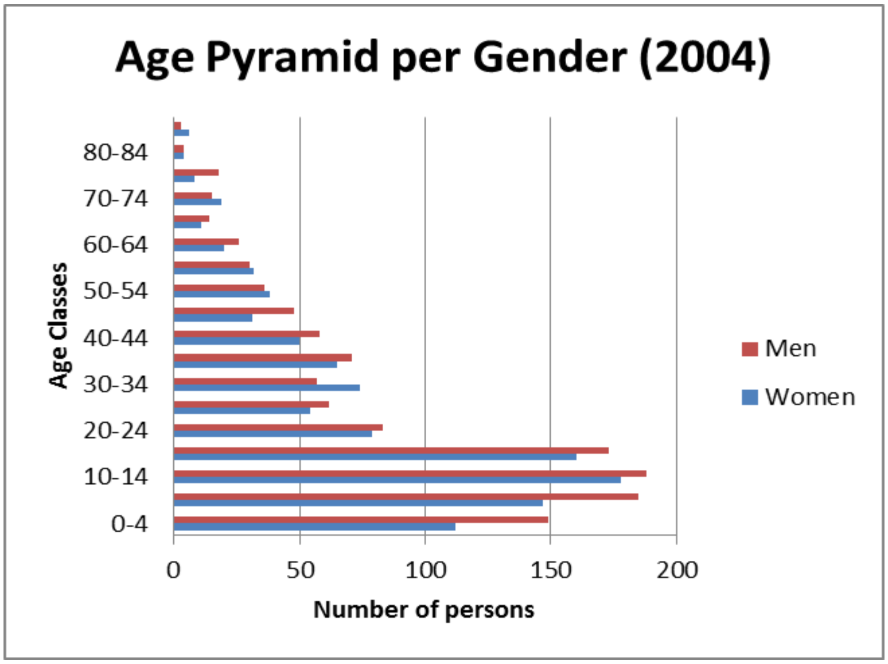

Figure 61: Age Pyramid of El Cedro (Unified, Year 2004)

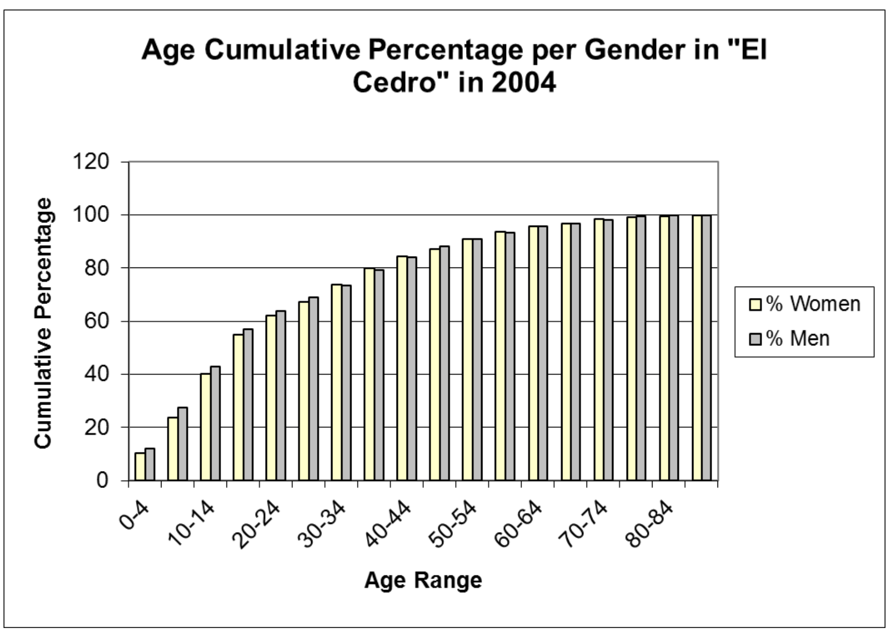

Figure 62: Population Cumulative % in El Cedro (Year 2004)

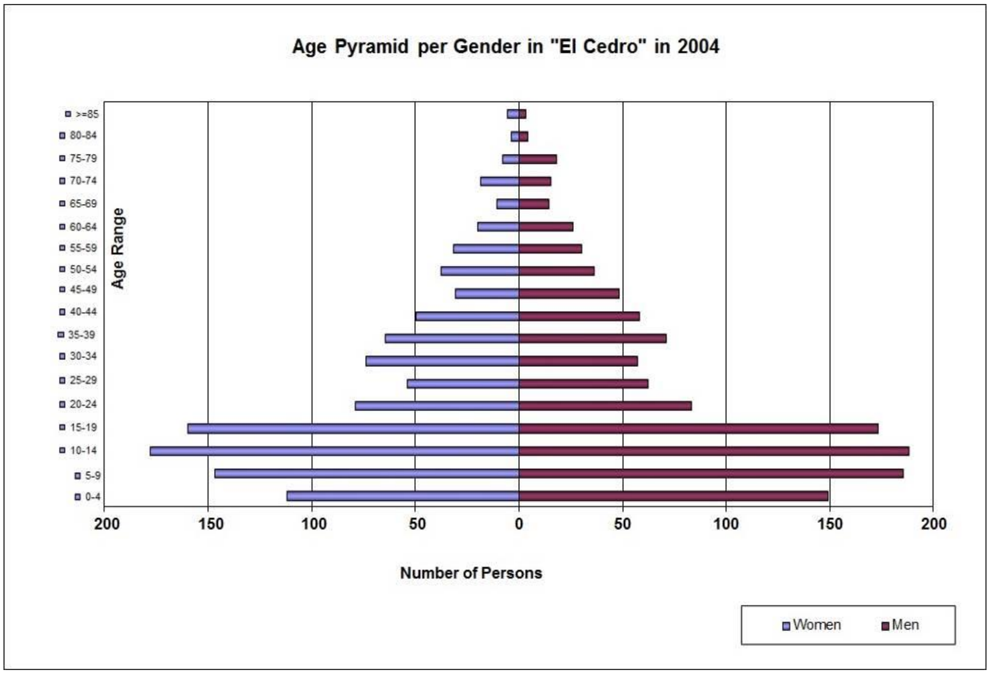

Figure 63: Age pyramid El Cedro (unjointed year 2004).

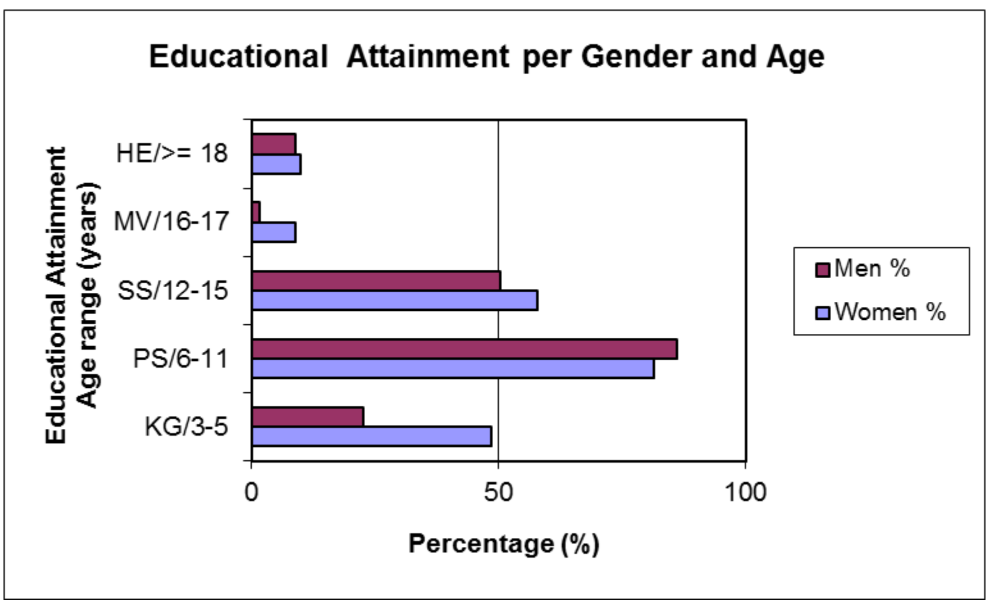

Figure 64: Education attainment (%) in El Cedro (2014).

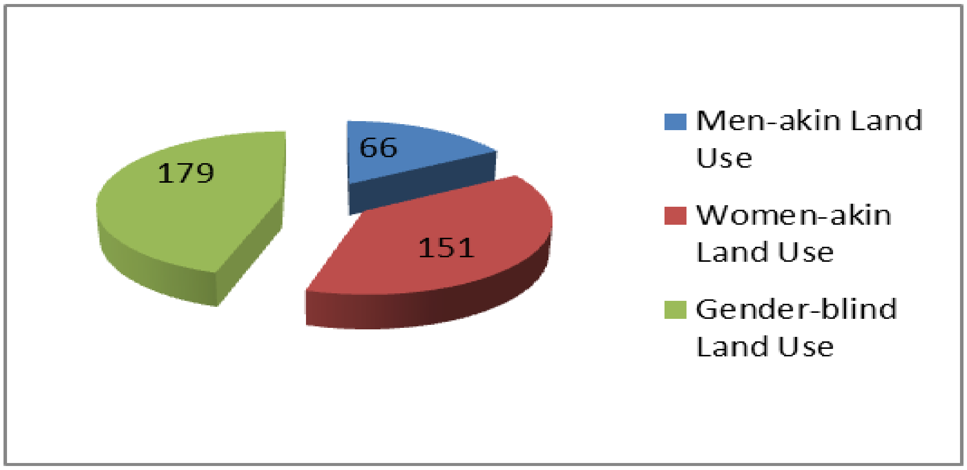

Figure 65: Persons per gendered land use groups

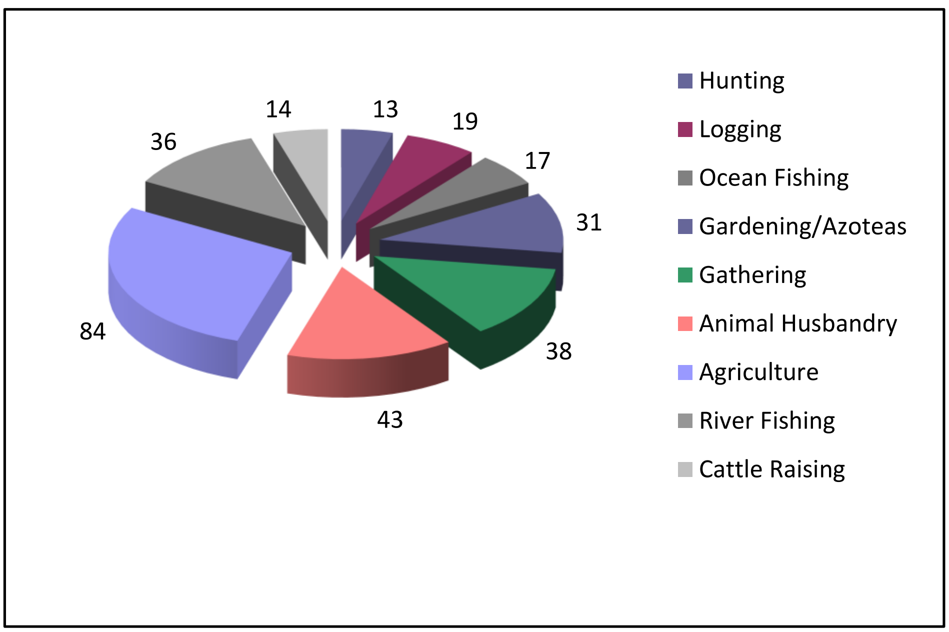

Figure 66: Persons per land use type (%) in El Cedro (*n*=134)

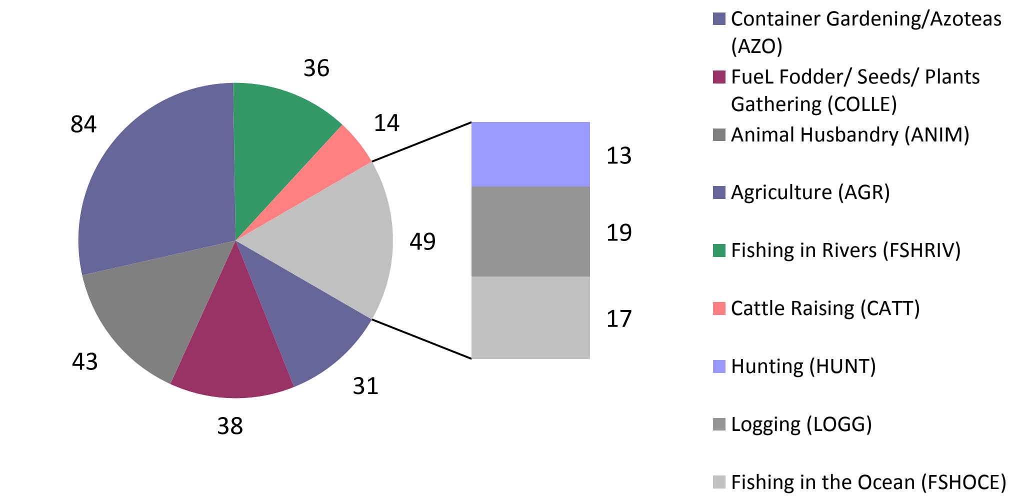

Figure 67: Persons per Men-akin land use types (%)

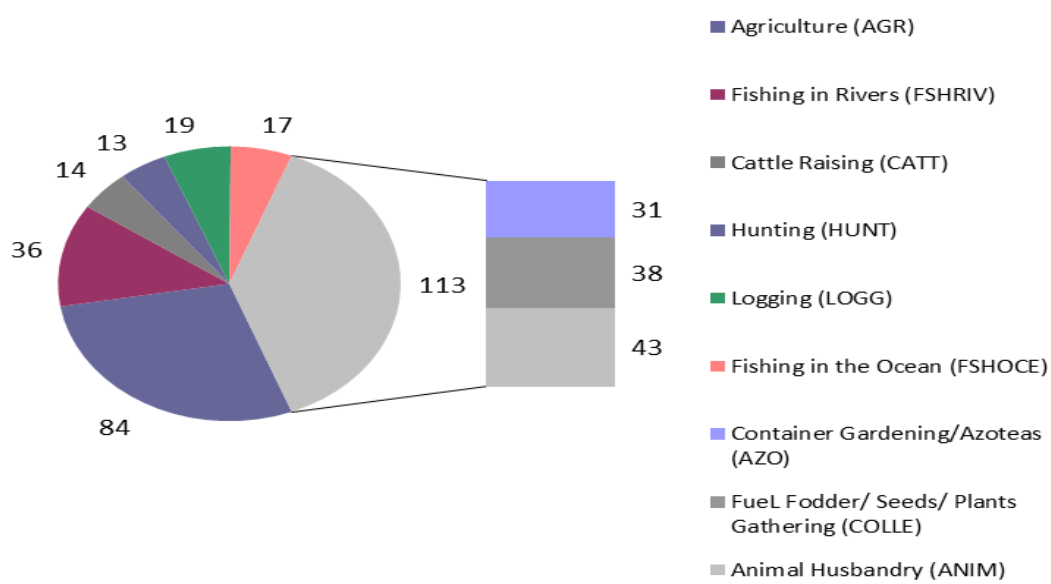

Figure 68: Persons per Women-akin land use types (%)

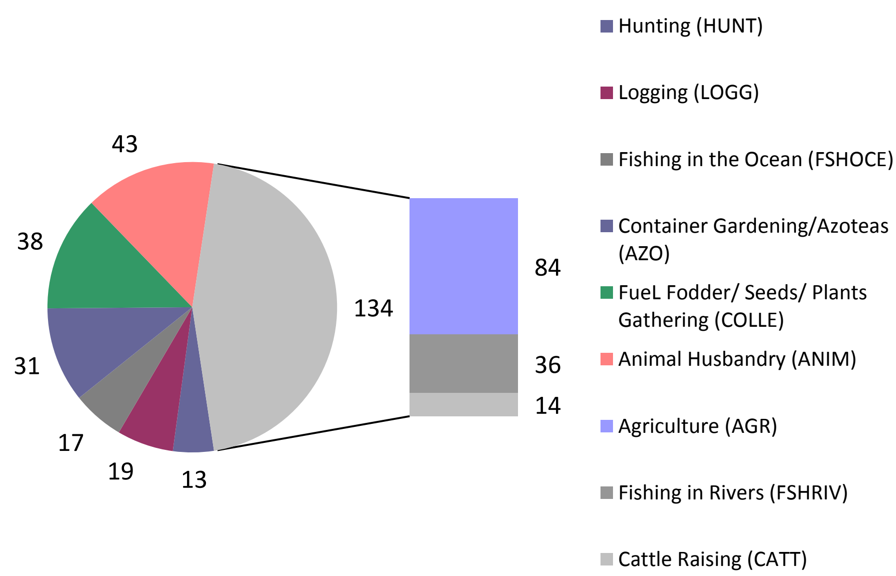

Figure 69: Persons per Gendered-neutral land use types (%)

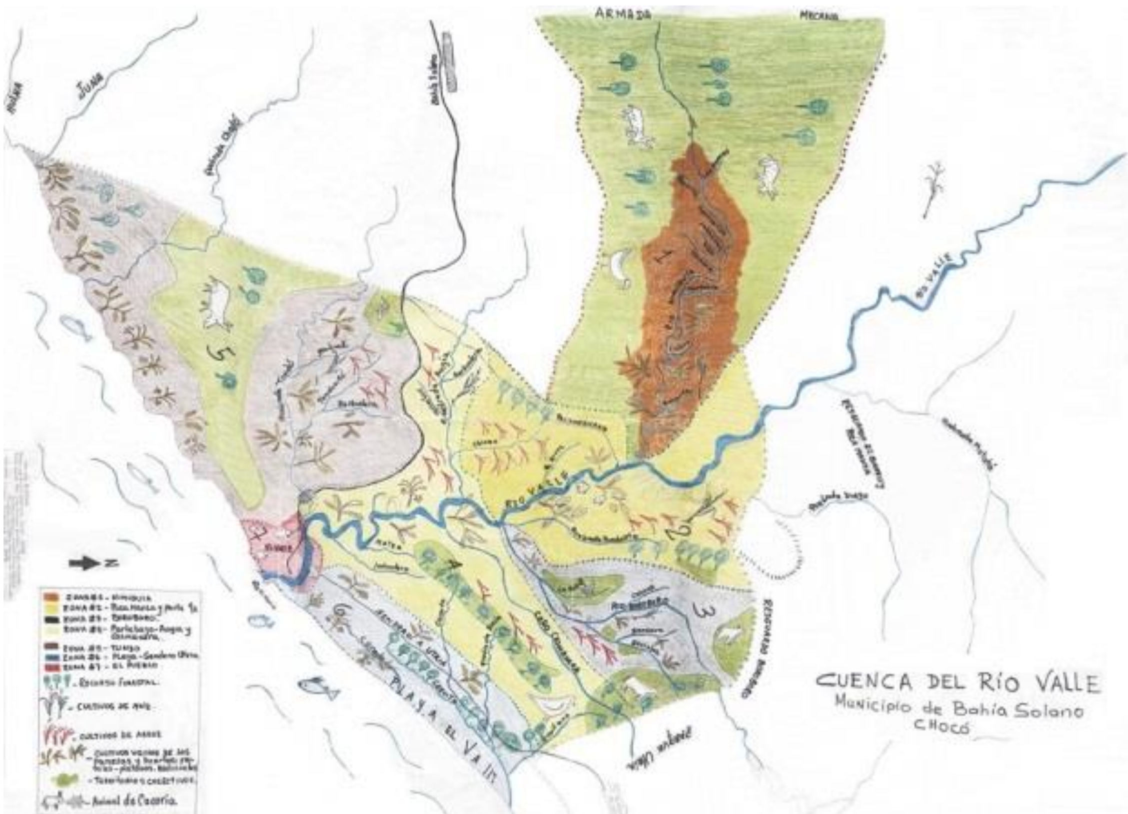

Figure 70: Map of El Cedro Produced by Locals

Figure 71: *Monte bravo* (right); *Monte Viche* (left): Southern beach ridges

Figure 72: *Monte viche* in fallow

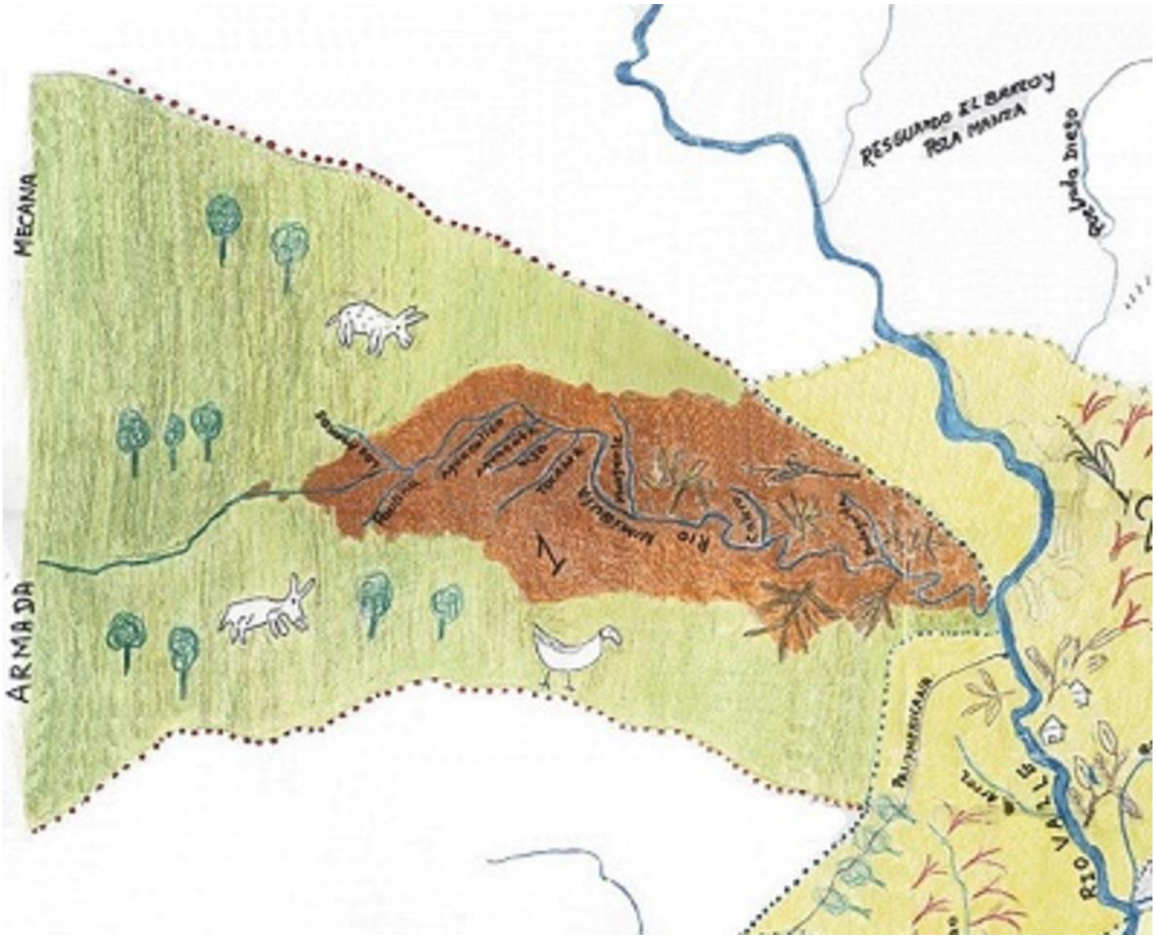

Figure 73: Nimiquia Zone drawn by locals (top and bottom in green)

Figure 74: *Rastrojo* inside alluvial plains of the El Valle River

Figure 75: *Rastrojo* in the El Valle River natural levees

Figure 76: *Rastrojo* in southern beach ridges

Figure 77: Leisure and *Rastrojo* in northern beach ridges

Figure 78: Village houses: Pig corrals (front), *Azoteas* (middle part).

Figure 79: *Azoteas* of an older women in the village

Figure 80: *Potrero* in El Sendero via Utria

Figure 81: *Potrero* on southern beach ridges

Figure 82: *Potrero* in Nimiquia River / Zone

Figure 83: Urban and Built-Up land of El Valle village

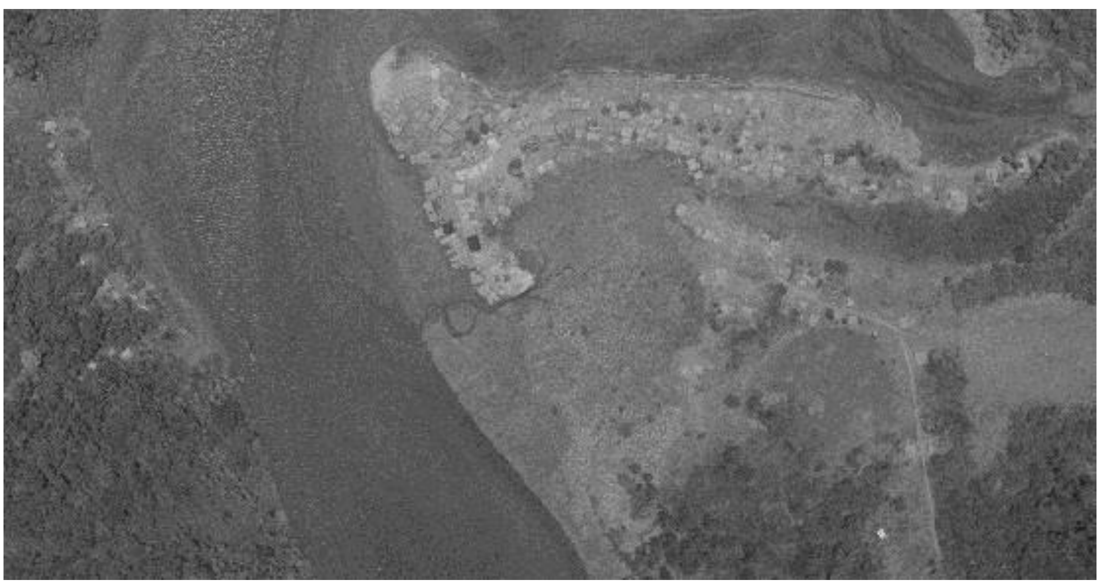

Figure 84: Aerial photograph of the El Valle village (1953)

Figure 85: Aerial photograph of the El Valle village (1962)

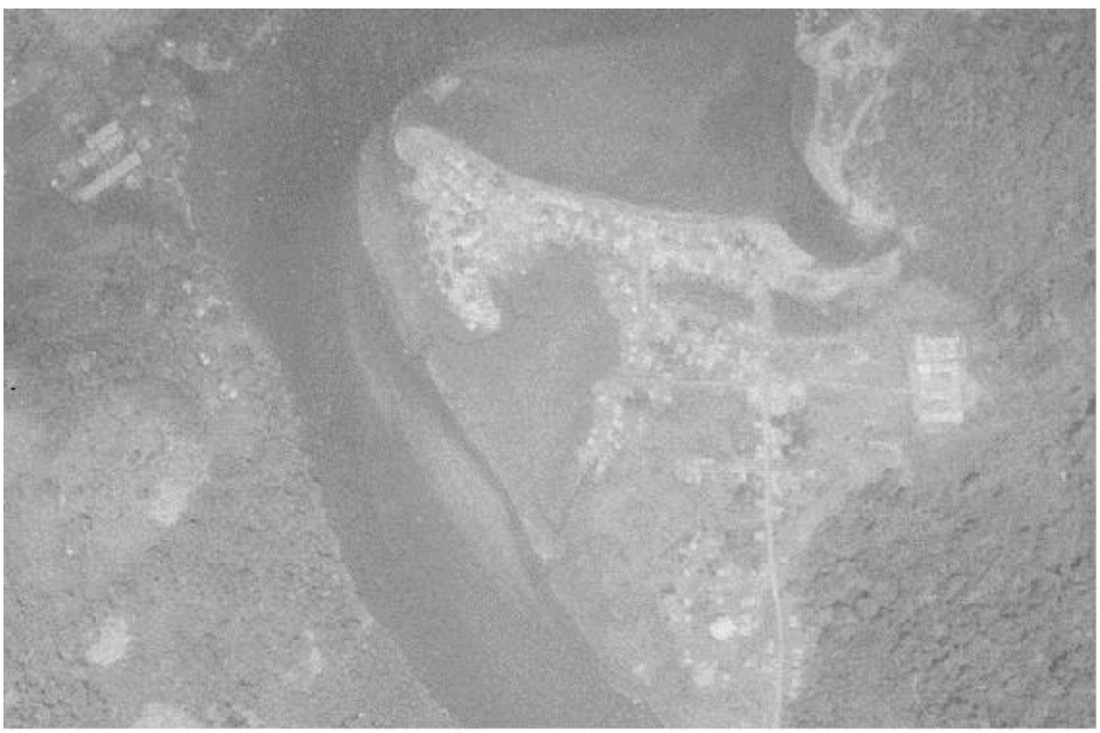

Figure 86: Aerial photograph of the El Valle village (1970)

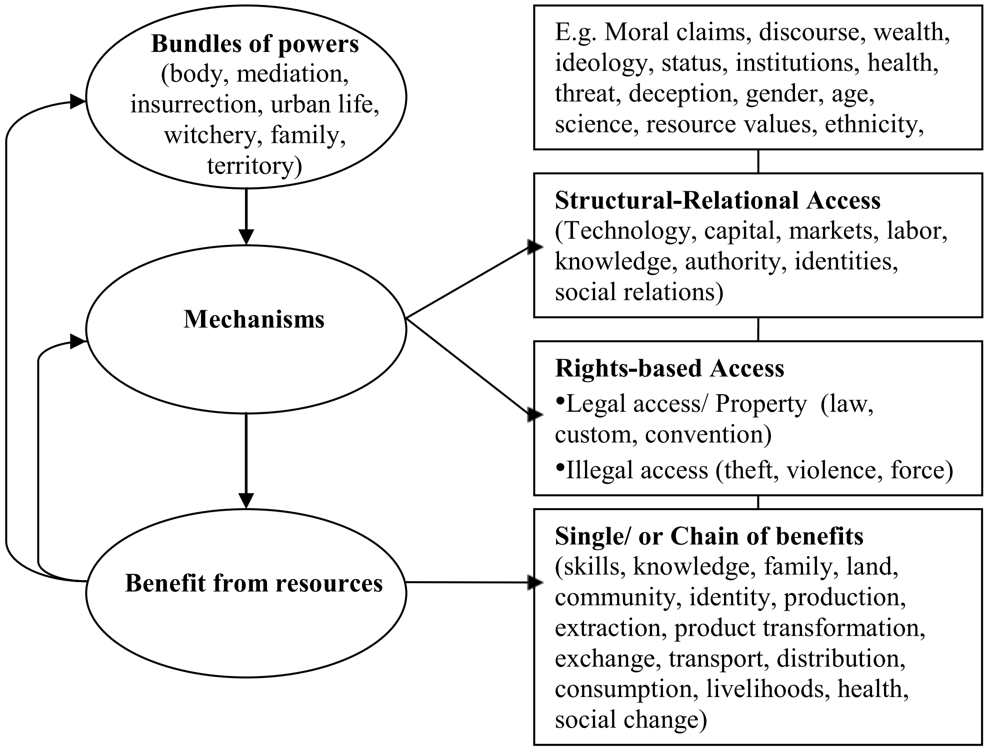

Figure 87: Access Framework for Afro-Colombian women since 1830 by Nancy Aguirre (based on Ribot and Peluso 2003, and Camacho 2004)

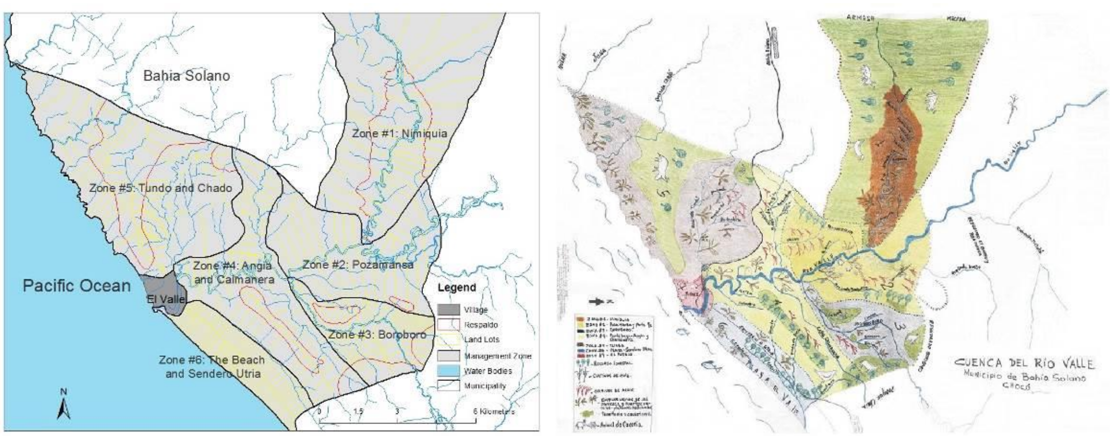

Figure 88: El Cedro's MZs. Right: By Locals; Left: With GIS.

Appendices

APPENDIX A. LAND USE AND LAND COVER CLASSIFICATION SYSTEMS

IGBP Land Cover Classification (by Belward 1996) (source: Global Land Cover Characteristics Database, http://edcdaac.usgs.gov/glcc/globdoc2_0.asp, original source: Belward, A.S.(ed.), 1996, The IGBP-DIS global 1 km land cover data set (DISCover)-proposal and implementation plans: IGBP-DIS Working Paper No. 13, Toulouse, France, 61 p.)

Value	Description
1	Evergreen Needle leaf Forest
2	Evergreen Broadleaf Forest
3	Deciduous Needle leaf Forest
4	Deciduous Broadleaf Forest
5	Mixed Forest
6	Closed Shrub lands
7	Open Shrub lands
8	Woody Savannas
9	Savannas
10	Grasslands
11	Permanent Wetlands
12	Croplands
13	Urban and Built-Up
14	Cropland/Natural Vegetation Mosaic
15	Snow and Ice
16	Barren or Sparsely Vegetated

17	Water Bodies
99	Interrupted Areas (Goodes Homolosine Projection)
100	Missing Data

USGS Land Use/Land Cover System Legend (Anderson et al. 1976) (Modified Level 2). (Source: Global Land Cover Characteristics Database, http://edcdaac.usgs.gov/glcc/globdoc2_0.asp, original source: Anderson, J.R., Hardy, E.E., Roach J.T., and Witmer R.E. (1976), A land use and land cover classification system for use with remote sensor data: U.S. Geological Survey Professional Paper 964, 28 p.)

Value	Code	Description
1	100	Urban and Built-Up Land
2	211	Dryland Cropland and Pasture
3	212	Irrigated Cropland and Pasture
4	213	Mixed Dryland/Irrigated Cropland and Pasture
5	280	Cropland/Grassland Mosaic
6	290	Cropland/Woodland Mosaic
7	311	Grassland
8	321	Shrubland
9	330	Mixed Shrubland/Grassland
10	332	Savanna
11	411	Deciduous Broadleaf Forest
12	412	Deciduous Needleleaf Forest
13	421	Evergreen Broadleaf Forest

14	422	Evergreen Needleleaf Forest
15	430	Mixed Forest
16	500	Water Bodies
17	620	Herbaceous Wetland
18	610	Wooded Wetland
19	770	Barren or Sparsely Vegetated
20	820	Herbaceous Tundra
21	810	Wooded Tundra
22	850	Mixed Tundra
23	830	Bare Ground Tundra
24	900	Snow or Ice
99		Interrupted Areas (Goodes Homolosine Projection)
100		Missing Data

APPENDIX B: SECONDARY AND PRIMARY DATA ORIGINAL CODE DESCRIPTION

Names of Aggregated Data

N_PLOTS = Total Number of Land Plots in each Management Zone

N_PLOTP = Percentage of Land Plots per Management Zone out of the Total Number of lots in all Management Zones

L_TENA = Number of Land Tenants in each Management Zone

L_TENAP = Percentage of Land Tenants in each Management Zone out of the Total Number of land tenants in all Management Zones

More_PL = Persons with more than one land lot in each Management Zone

More_PLP = Percentage of Persons with more than one land lot in each Management Zone out of the Total Number of land tenants in all Management Zones

LTWOM = Number of Women who are Land Tenants in each Management Zone

LTWOMP = Percentage of Women who are Land Tenants in each Management Zone out of the Total number of Land Tenants in all Management Zones

More_PLW = Number of Women with more than one land lot in each Management Zone

Mor_PLWP = Percentage of Women with more than one land lot in each Management Zone out of the Total number of Land Tenants in all Management Zones

LTMEN = Number of Men who are Land Tenants in each Management Zone

LTMENP = Percentage of Men who are Land Tenants in each Management Zone out of the Total number of Land Tenants in all Management Zones

More_PLM = Number of Men with more than one land lot in each Management Zone

Mor_PLMP = Percentage of Men with more than one land lot in each Management Zone out of the Total number of Land Tenants in all Management Zones

AGR = Number of Land Lots that are used in Agriculture in each Management Zone

AGRP = Percentage of Land Lots that are used in Agriculture in each Management Zone out of the Total Number of Lots per Management Zone

LSTK = Number of Land Lots that are used in Livestock breeding/Cattle Raising in each Management Zone

LSTKP = Percentage of Land Lots that are used in Livestock breeding/Cattle Raising in each Management Zone out of the Total Number of Lots per Management Zone

FISH = Number of Land Lots that are used in Fishing in each Management Zone

FISHP = Percentage of Land Lots that are used in Fishing in each Management Zone out of the Total Number of Lots per Management Zone

HUNT = Number of Land Lots that are used in Hunting in each Management Zone

HUNTP = Percentage of Land Lots that are used in Hunting in each Management Zone out of the Total Number of Lots per Management Zone

WOOD = Number of Land Lots that are used in logging in each Management Zone

WOODP = Percentage of Land Lots that are used in logging in each Management Zone out of the Total Number of Lots per Management Zone

HCRFT = Number of Land Lots that are used for collection of Handcraft materials in each Management Zone

HCRFTP = Percentage of Land Lots that are used for collection of Handcraft materials in each Management Zone out of the Total Number of Lots per Management Zone

BOATS = Number of Land Lots that are used in Logging for Boat Construction (whether or not in situ) in each Management Zone

BOATSP = Percentage of Land Lots that are used in Logging trees for Construction of Boats (whether or not in situ) in each Management Zone out of the Total Number of Lots per Management Zone

PIGS = Number of Land Lots that are used in Hog Breeding in each Management Zone

PIGSP = Percentage of Land Lots that are used in Hog Breeding in each Management Zone out of the Total Number of Lots per Management Zone

OTHER = Number of Land Lots that are used other productive activities in each Management Zone (not defined which are those)

OTHERP = Percentage of Land Lots that are used in other productive activities in each Management Zone (not defined which are those) out of the Total Number of Lots per Management Zone

AGE_M50 = Number of Land Lots older than 50 years in each Management Zone

AG_M50P = Percentage of Land Lots with more than 50 years of use in each Management Zone out of the Total Number of Lots per Management Zone

AGE30_50 = Number of Land Lots between 30 and 50 years of use in each Management Zone

AG30_50P = Percentage of Land Lots between 30 and 50 years of use in each Management Zone out of the Total Number of Lots per Management Zone

AGE_L30 = Number of Land Lots of less than 30 years of use in each Management Zone

AG_L30P = Percentage of Land Lots of less than 30 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr1_17 = Number of Land Lots of less than 17 years of use in each Management Zone

Yr1_17P = Percentage of Land Lots of less than 17 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr18_38 = Number of Land Lots between 18 and 38 years of use in each Management Zone

Yr18_38P = Percentage of Land Lots between 18 and 38 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr39_90 = Number of Land Lots between 39 and 90 years of use in each Management Zone

Yr39_90P = Percentage of Land Lots between 39 and 90 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr1_13 = Number of Land Lots of 13 years or less of use in each Management Zone

Yr1_13P = Percentage of Land Lots of 13 years or less of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr14_28 = Number of Land Lots between 14 and 28 years of use in each Management Zone

Yr14_28P = Percentage of Land Lots between 14 and 28 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr29_45 = Number of Land Lots between 29 and 45 years of use in each Management Zone

Yr29_45P = Percentage of Land Lots between 29 and 45 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr46_90 = Number of Land Lots between 46 and 90 years of use in each Management Zone

Yr46_90P = Percentage of Land Lots between 46 and 90 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr1_11 = Number of Land Lots of 11 years or less of use in each Management Zone

Yr1_11P = Percentage of Land Lots of 11 years or less of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr12_22 = Number of Land Lots between 12 and 22 years of use in each Management Zone

Yr12_22P = Percentage of Land Lots between 12 and 22 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr23_35 = Number of Land Lots between 23 and 35 years of use in each Management Zone

Yr23_35P = Percentage of Land Lots between 23 and 35 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr36_55 = Number of Land Lots between 35 and 55 years of use in each Management Zone

Yr36_55P = Percentage of Land Lots between 35 and 55 years of use in each Management Zone out of the Total Number of Lots per Management Zone

Yr56_90 = Number of Land Lots between 56 and 90 years of use in each Management Zone

Yr56_90P = Percentage of Land Lots between 56 and 90 years of use in each Management Zone out of the Total Number of Lots per Management Zone

BOUGHT = Number of Land Lots acquired by way of Purchasing/Buying them in each Management Zone

BOUGHP = Percentage of Land Lots acquired by way of Purchasing/Buying them in each Management Zone out of the Total Number of Lots per Management Zone

INHERI = Number of Land Lots acquired by Inheritance in each Management Zone

INHERP = = Percentage of Land Lots acquired by Inheritance in each Management Zone out of the Total Number of Lots per Management Zone

POSES = Number of Land Lots acquired by Possession/Custody in each Management Zone

POSESP = Percentage of Land Lots acquired by Possession/Custody in each Management Zone out of the Total Number of Lots per Management Zone

WORK = Number of Land Lots acquired by way of Working (Laboring) them in each Management Zone

WORKP = Percentage of Land Lots acquired by way of Working (Laboring) them in each Management Zone out of the Total Number of Lots per Management Zone

DONAT = Number of Land Lots acquired by (a third part) Donation in each Management Zone

DONATP = Percentage of Land Lots acquired by (a third part) Donation in each Management Zone out of the Total Number of Lots per Management Zone

RHUNT = Number of Land Lots which *Respaldo* is used on Hunting in each Management Zone

RHUNTP = Percentage of Land Lots which *Respaldo* is used on Hunting in each Management Zone out of the Total Number of Lots per Management Zone

RCRAFT = Number of Land Lots which *Respaldo* is used on Gathering/Collecting materials for Handcrafts in each Management Zone

RCRAFTP = Percentage of Land Lots which *Respaldo* is used on Gathering/Collecting materials for Handcrafts in each Management Zone out of the Total Number of Lots per Management Zone

RLOG = Number of Land Lots which *Respaldo* is used on Logging in each Management Zone

RLOGP = Percentage of Land Lots which *Respaldo* is used on Logging in each Management Zone out of the Total Number of Lots per Management Zone

RFAMILY = Number of Land Lots which *Respaldo* is used by Family members in each Management Zone

RFAMIP = Percentage of Land Lots which *Respaldo* is used by Family members in each Management Zone out of the Total Number of Lots per Management Zone

RNEIGH = Number of Land Lots which *Respaldo* is used by Neighbors in each Management Zone

RNEIGP = Percentage of Land Lots which *Respaldo* is used by Neighbors in each Management Zone out of the Total Number of Lots per Management Zone

RNONE = Number of Land Lots which *Respaldo* is used by Nobody or has No-Use in each Management Zone

RNONEP = Percentage of Land Lots which *Respaldo* is used by Nobody or has No-Use in each Management Zone out of the Total Number of Lots per Management Zone

Original Codes of Individual records (secondary data)

Codes of variables corresponding to secondary data (400) individual records as the same as those of the aggregated dataset above, with exception to the following variables:

MOR_PLGE = Gender of persons who have more than one Land Lot per record (1=woman; 2=man)

ZONE = Number of the Management Zone of the study area per record (from 1 to 6)

NUMUSE = Total number of individual land uses (or productive activities) per record

LOT_AGE = Years of use of a land lot per record

APPENDIX C: DESCRIPTION OF VARIABLES OR INTERVIEW QUESTIONS

Place where the Subject's land is located

Management Zone Code

Living at the farm (yes/no)

Village Neighborhood Name

Neighborhood Code

Number of homes owned

Household Head (yes/no)

Gender of research subject

Gender code (female =1 male=0)

Age of research subject

Age code

Civil status of research subject (single /married / divorced / widow)

Civil status code

Number of children

Education attainment

Education attainment Acronym

Education attainment Code

Place where born

Place where born code

Number of Years living in El Cedro

Have ever lived at other place? (yes=1)

Number of years living in other places

Key goods: Number of televisions

Key goods: Number of refrigerators

Total number of key goods

Livelihoods/Land Use: Hunting (yes=1)

Livelihoods/Land Use: Cattle raising (yes=1)

Livelihoods/Land Use: Fishing (yes=1)

Livelihoods/Land Use: Agriculture (yes=1)

Livelihoods/Land Use: Azoteas (container gardening) (yes=1)

Livelihoods/Land Use: Handcrafts (yes=1)

Livelihoods/Land Use: Teaching (yes=1)

Livelihoods/Land Use: Cooking/cleaning (yes=1)

Livelihoods/Land Use: Collecting/gathering (yes=1)

Livelihoods/Land Use: Other (yes=1)

Total number of Livelihood/Land Use activities

Hunting (detailed) (yes=1)

Hunting species names

Hunting number of species

Cattle raising (detailed) (yes=1)

Cattle raising: number of heads

Cattle raising: land area under use

Cattle raising: grass type name

Cattle raising: what is invested in this activity (description)

Cattle raising: number of heads sold per year

Fishing in rivers (detailed): (yes=1)

Fishing in rivers: river name

Fishing in rivers: species name

Fishing in ocean: (yes=1)

Fishing in ocean: place name in the ocean

Fishing in ocean: species name

Fishing in ocean: name of fishing method

Logging (detailed): (yes=1)

Logging: number of timber blocks logged per month

Logging: name of tree species logged

Animal husbandry (detailed): number of pigs

Animal husbandry: number of chicken

Animal husbandry: number of ducks/turkeys

Animal husbandry: for consumption (cs) or for sale (vt)

Land Tenure and use (detailed): Number of land parcels owned

Land Tenure and use: Age of land plots

Land Tenure and use: Tenure type (inherited / bough / possession)

Land Tenure and use: Tenure code

Land Tenure and use: Number of hectares per land plot

Land Tenure and use: Traveling distance from home to land plot by boat (hours)

Land Tenure and use: Is the land plot abandoned to fallow? (yes=1)

Land Tenure and use: Production costs per year (Colombian pesos)

Land Tenure and use: Production needs (description)

Land Tenure and use: Production practices (description)

Land Tenure and use: Land products (names)

Land use change (today): Description (product names)

Land use change (10 years ago): description (product names)

Land use change (20 years ago): description (product names)

Land use change (30 years ago): description (product names)

Individuals' Income / Expenses: Sales per month (description)

Individuals' Income / Expenses: Is income fixed? (Yes=1)

Individuals' Income / Expenses: Income per month (Colombian pesos)

Individuals' Income / Expenses: Expenses per month (Colombian pesos)

Knowledge transfer: Father (yes=1)

Knowledge transfer: Mother (yes=1)

Knowledge transfer: Learned by themselves (yes=1)

Knowledge transfer: Other person taught them (yes=1)

Comments (descriptive)

APPENDIX D: PROC LOGISTIC OUTPUTS FOR GENDERED LANDHOLDING

Output 6.1 PROC LOGISTIC Output for LOTW (BML in 151-Record Dataset)

```
                         The LOGISTIC Procedure
                           Model Information
               Data Set                      WORK.INTERVIEWS
               Response Variable             LOTW                LOTW
               Number of Response Levels     2
               Model                         binary logit
               Optimization Technique        Fisher's scoring
                       Number of Observations Read         152
                       Number of Observations Used         151
                            Response Profile
                          Ordered                      Total
                            Value     LOTW         Frequency
                                1     1                   66
                                2     0                   85

                          Probability modeled is LOTW='1'.
NOTE: 1 observation was deleted due to missing values for the response or explanatory
      variables.
                         Class Level Information
                     Class     Value         Design Variables
                     EDU       0           1      0      0      0
                               1           0      1      0      0
                               2           0      0      1      0
                               3           0      0      0      1
                               4          -1     -1     -1     -1
                     AZO       0           1
                               1          -1
                     LOGG      0           1
                               1          -1
                     ANIM      0           1
                               1          -1
                     KMOTH     0           1
                               1          -1
                     KTHEM     0           1
                               1          -1

                        Model Convergence Status
                 Convergence criterion (GCONV=1E-8) satisfied.

                          Model Fit Statistics
                                                 Intercept
                                   Intercept           and
                       Criterion        Only     Covariates
                       AIC           208.933       120.309
                       SC            211.951       150.482
                       -2 Log L      206.933       100.309

                       Testing Global Null Hypothesis: BETA=0
```

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	106.6243	9	<.0001
Score	79.1777	9	<.0001
Wald	36.8618	9	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
EDU	4	11.9657	0.0176
AZO	1	15.7283	<.0001
LOGG	1	5.9168	0.0150
ANIM	1	7.5588	0.0060
KMOTH	1	4.3715	0.0365
KTHEM	1	5.9617	0.0146

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-0.8018	0.7322	1.1991	0.2735
EDU	0	1	-1.4024	0.7948	3.1131	0.0777
EDU	1	1	-1.4188	0.5221	7.3845	0.0066
EDU	2	1	0.1018	0.5217	0.0380	0.8454
EDU	3	1	0.3657	0.6553	0.3114	0.5768
AZO	0	1	-1.6449	0.4148	15.7283	<.0001
LOGG	0	1	1.5094	0.6205	5.9168	0.0150
ANIM	0	1	-0.8735	0.3177	7.5588	0.0060
KMOTH	0	1	-0.9505	0.4546	4.3715	0.0365
KTHEM	0	1	0.7367	0.3017	5.9617	0.0146

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
EDU 0 vs 4	0.023	0.002	0.353
EDU 1 vs 4	0.023	0.003	0.210
EDU 2 vs 4	0.105	0.013	0.881
EDU 3 vs 4	0.137	0.013	1.438
AZO 0 vs 1	0.037	0.007	0.189
LOGG 0 vs 1	20.466	1.797	233.023
ANIM 0 vs 1	0.174	0.050	0.606
KMOTH 0 vs 1	0.149	0.025	0.888
KTHEM 0 vs 1	4.364	1.337	14.243

Association of Predicted Probabilities and Observed Responses

Percent Concordant	92.3	Somers' D	0.861
Percent Discordant	6.2	Gamma	0.874
Percent Tied	1.5	Tau-a	0.427
Pairs	5610	c	0.931

Output 6.2 PROC LOGISTIC Output for LOTW (BML in 134-Record Dataset)

```
                    The LOGISTIC Procedure
                       Model Information
Data Set                      WORK.INTERVIEWS
Response Variable             LOTW                    LOTW
Number of Response Levels     2
Model                         binary logit
Optimization Technique        Fisher's scoring

        Number of Observations Read          137
        Number of Observations Used          134

                    Response Profile
           Ordered                      Total
             Value      LOTW        Frequency
                 1      1                  65
                 2      0                  69

           Probability modeled is LOTW='1'.

NOTE: 3 observations were deleted due to missing values for the response or explanatory
      variables.

                    Class Level Information
          Class     Value          Design Variables
          EDU       0          1       0       0       0
                    1          0       1       0       0
                    2          0       0       1       0
                    3          0       0       0       1
                    4         -1      -1      -1      -1
          AZO       0          1
                    1         -1
          LOGG      0          1
                    1         -1
          ANIM      0          1
                    1         -1
          KMOTH     0          1
                    1         -1
          KTHEM     0          1
                    1         -1

                  Model Convergence Status
        Quasi-complete separation of data points detected.

WARNING: The maximum likelihood estimate may not exist.
WARNING: The LOGISTIC procedure continues in spite of the above warning. Results shown
are based on the last maximum likelihood iteration. Validity of the model fit is
         questionable.
```

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	187.644	78.505
SC	190.542	107.484
-2 Log L	185.644	58.505

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	127.1386	9	<.0001
Score	83.3269	9	<.0001
Wald	21.8344	9	0.0094

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
EDU	4	9.1201	0.0582
AZO	1	0.0060	0.9382
LOGG	1	0.0051	0.9433
ANIM	1	3.7364	0.0532
KMOTH	1	3.3542	0.0670
KTHEM	1	9.6860	0.0019

WARNING: The validity of the model fit is questionable.

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-2.8632	43.1857	0.0044	0.9471
EDU	0	1	-11.4052	172.7	0.0044	0.9473
EDU	1	1	0.6543	43.1787	0.0002	0.9879
EDU	2	1	2.7519	43.1792	0.0041	0.9492
EDU	3	1	2.6850	43.1815	0.0039	0.9504
AZO	0	1	-8.3642	107.9	0.0060	0.9382
LOGG	0	1	7.6720	107.9	0.0051	0.9433
ANIM	0	1	-0.8317	0.4302	3.7364	0.0532
KMOTH	0	1	-1.5167	0.8281	3.3542	0.0670
KTHEM	0	1	1.2215	0.3925	9.6860	0.0019

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
EDU 0 vs 4	<0.001	<0.001	>999.999
EDU 1 vs 4	0.009	<0.001	0.297
EDU 2 vs 4	0.077	0.003	2.201
EDU 3 vs 4	0.072	0.002	2.735
AZO 0 vs 1	<0.001	<0.001	>999.999
LOGG 0 vs 1	>999.999	<0.001	>999.999
ANIM 0 vs 1	0.190	0.035	1.023
KMOTH 0 vs 1	0.048	0.002	1.237
KTHEM 0 vs 1	11.508	2.471	53.602

```
Association of Predicted Probabilities and Observed Responses
     Percent Concordant     96.3    Somers' D    0.937
     Percent Discordant      2.7    Gamma        0.946
     Percent Tied            1.0    Tau-a        0.471
     Pairs                  4485    c            0.968
```

Output 6.3 PROC LOGISTIC Output for LOTW (BML in 134-Record Dataset)

```
                    The LOGISTIC Procedure
                      Model Information

   Data Set                     WORK.INTERVIEWS
   Response Variable            LOTW                 LOTW
   Number of Response Levels    2
   Model                        binary logit
   Optimization Technique       Fisher's scoring

           Number of Observations Read         137

           Number of Observations Used         134

                       Response Profile
              Ordered                      Total
                Value     LOTW         Frequency
                    1     1                   65
                    2     0                   69

              Probability modeled is LOTW='1'.

NOTE: 3 observations were deleted due to missing values for the response or explanatory
      variables.

                    Class Level Information
                                      Design
                Class     Value     Variables
                AZO       0                 1
                          1                -1
                LOGG      0                 1
                          1                -1
                ANIM      0                 1
                          1                -1
                KMOTH     0                 1
                          1                -1
                INFIX     0                 1
                          1                -1
                KTHEM     0                 1
                          1                -1

                   Model Convergence Status
         Convergence criterion (GCONV=1E-8) satisfied.
```

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	187.644	82.192
SC	190.542	102.477
-2 Log L	185.644	68.192

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	117.4521	6	<.0001
Score	79.3862	6	<.0001
Wald	27.1901	6	0.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AZO	1	14.7517	0.0001
LOGG	1	8.3684	0.0038
ANIM	1	5.9524	0.0147
KMOTH	1	5.0159	0.0251
INFIX	1	7.5289	0.0061
KTHEM	1	15.2472	<.0001

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	0.00919	0.8319	0.0001	0.9912
AZO	0	1	-2.2448	0.5845	14.7517	0.0001
LOGG	0	1	2.3054	0.7969	8.3684	0.0038
ANIM	0	1	-0.9803	0.4018	5.9524	0.0147
KMOTH	0	1	-1.1208	0.5004	5.0159	0.0251
INFIX	0	1	-1.3556	0.4940	7.5289	0.0061
KTHEM	0	1	1.5881	0.4067	15.2472	<.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AZO 0 vs 1	0.011	0.001	0.111
LOGG 0 vs 1	100.570	4.423	>999.999
ANIM 0 vs 1	0.141	0.029	0.680
KMOTH 0 vs 1	0.106	0.015	0.756
INFIX 0 vs 1	0.066	0.010	0.461
KTHEM 0 vs 1	23.956	4.864	117.977

Association of Predicted Probabilities and Observed Responses

Percent Concordant	95.0	Somers' D	0.920
Percent Discordant	3.1	Gamma	0.938
Percent Tied	1.9	Tau-a	0.463
Pairs	4485	c	0.960

Output 6.4 PROC LOGISTIC Output for LOTW (BML in 151-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOTW	LOTW
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	152
Number of Observations Used	151

Response Profile

Ordered Value	LOTW	Total Frequency
1	1	66
2	0	85

Probability modeled is LOTW='1'.

NOTE: 1 observation was deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
LOGG	0	1
	1	-1
AZO	0	1
	1	-1
ANIM	0	1
	1	-1
INFIX	0	1
	1	-1
KMOTH	0	1
	1	-1
KTHEM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	208.933	118.951
SC	211.951	140.072
-2 Log L	206.933	104.951

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	101.9826	6	<.0001
Score	76.0916	6	<.0001
Wald	35.5733	6	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
LOGG	1	6.5826	0.0103
AZO	1	14.6375	0.0001
ANIM	1	10.4488	0.0012
INFIX	1	9.2122	0.0024
KMOTH	1	6.1500	0.0131
KTHEM	1	11.9802	0.0005

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-0.3758	0.6661	0.3183	0.5726
LOGG	0	1	1.4720	0.5737	6.5826	0.0103
AZO	0	1	-1.2068	0.3154	14.6375	0.0001
ANIM	0	1	-0.9768	0.3022	10.4488	0.0012
INFIX	0	1	-1.2093	0.3984	9.2122	0.0024
KMOTH	0	1	-0.9380	0.3782	6.1500	0.0131
KTHEM	0	1	1.0470	0.3025	11.9802	0.0005

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
LOGG 0 vs 1	18.991	2.004	179.996
AZO 0 vs 1	0.089	0.026	0.308
ANIM 0 vs 1	0.142	0.043	0.463
INFIX 0 vs 1	0.089	0.019	0.425
KMOTH 0 vs 1	0.153	0.035	0.675
KTHEM 0 vs 1	8.117	2.480	26.569

Association of Predicted Probabilities and Observed Responses

Percent Concordant	91.1	Somers' D	0.851
Percent Discordant	6.0	Gamma	0.876
Percent Tied	2.9	Tau-a	0.422
Pairs	5610	c	0.925

Output 6.5 PROC LOGISTIC Output for LOTM (BML in 151-Record Dataset)

The LOGISTIC Procedure
Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOTM	LOTM
Number of Response Levels	2	

Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	152
Number of Observations Used	151

Response Profile

Ordered Value	LOTM	Total Frequency
1	1	72
2	0	79

Probability modeled is LOTM='1'.

NOTE: 1 observation was deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
AZO	0	1
	1	-1
LOGG	0	1
	1	-1
ANIM	0	1
	1	-1
INFIX	0	1
	1	-1
KMOTH	0	1
	1	-1
KTHEM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	211.006	108.808
SC	214.023	129.929
-2 Log L	209.006	94.808

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	114.1982	6	<.0001
Score	80.6571	6	<.0001
Wald	32.6992	6	<.0001

Type 3 Analysis of Effects

Wald

Effect	DF	Chi-Square	Pr > ChiSq
AZO	1	15.2002	<.0001
LOGG	1	9.4158	0.0022
ANIM	1	2.7045	0.1001
INFIX	1	5.2564	0.0219
KMOTH	1	0.6733	0.4119
KTHEM	1	16.8195	<.0001

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-0.3574	0.7709	0.2150	0.6429
AZO	0	1	2.1748	0.5578	15.2002	<.0001
LOGG	0	1	-2.3154	0.7546	9.4158	0.0022
ANIM	0	1	0.5206	0.3165	2.7045	0.1001
INFIX	0	1	0.8699	0.3794	5.2564	0.0219
KMOTH	0	1	0.2779	0.3386	0.6733	0.4119
KTHEM	0	1	-1.1565	0.2820	16.8195	<.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AZO 0 vs 1	77.454	8.697	689.761
LOGG 0 vs 1	0.010	<0.001	0.188
ANIM 0 vs 1	2.832	0.819	9.796
INFIX 0 vs 1	5.696	1.287	25.202
KMOTH 0 vs 1	1.743	0.462	6.575
KTHEM 0 vs 1	0.099	0.033	0.299

Association of Predicted Probabilities and Observed Responses

Percent Concordant	92.2	Somers' D	0.871
Percent Discordant	5.1	Gamma	0.895
Percent Tied	2.6	Tau-a	0.438
Pairs	5688	c	0.936

Output 6.6 PROC LOGISTIC Output for LOTM (BML in 134-Record Dataset)

The LOGISTIC Procedure
Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOTM	LOTM
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	134

Response Profile

Ordered		Total

Value	LOTM	Frequency
1	1	69
2	0	65

Probability modeled is LOTM='1'.

NOTE: 1 observation was deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
AZO	0	1
	1	-1
LOGG	0	1
	1	-1
ANIM	0	1
	1	-1
INFIX	0	1
	1	-1
KMOTH	0	1
	1	-1
KTHEM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	187.644	82.192
SC	190.542	102.477
-2 Log L	185.644	68.192

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	117.4521	6	<.0001
Score	79.3862	6	<.0001
Wald	27.1901	6	0.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AZO	1	14.7517	0.0001
LOGG	1	8.3684	0.0038
ANIM	1	5.9524	0.0147
INFIX	1	7.5289	0.0061
KMOTH	1	5.0159	0.0251
KTHEM	1	15.2472	<.0001

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-0.00919	0.8319	0.0001	0.9912
AZO	0	1	2.2448	0.5845	14.7517	0.0001
LOGG	0	1	-2.3054	0.7969	8.3684	0.0038
ANIM	0	1	0.9803	0.4018	5.9524	0.0147
INFIX	0	1	1.3556	0.4940	7.5289	0.0061
KMOTH	0	1	1.1208	0.5004	5.0159	0.0251
KTHEM	0	1	-1.5881	0.4067	15.2472	<.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AZO 0 vs 1	89.086	9.012	880.649
LOGG 0 vs 1	0.010	<0.001	0.226
ANIM 0 vs 1	7.103	1.470	34.312
INFIX 0 vs 1	15.047	2.170	104.358
KMOTH 0 vs 1	9.408	1.323	66.906
KTHEM 0 vs 1	0.042	0.008	0.206

Association of Predicted Probabilities and Observed Responses

Percent Concordant	95.0	Somers' D	0.920
Percent Discordant	3.1	Gamma	0.938
Percent Tied	1.9	Tau-a	0.463
Pairs	4485	c	0.960

Output 6.7 PROC LOGISTIC Output for LOTM (BML in 151-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOTM	LOTM
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	152
Number of Observations Used	144

Response Profile

Ordered Value	LOTM	Total Frequency
1	1	69
2	0	75

Probability modeled is LOTM='1'.

NOTE: 8 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Design

Class	Value	Variables	
LOGG	0	1	
	1	-1	
FSHOCE	0	1	
	1	-1	
INCOMCO1	1	1	0
	2	0	1
	3	-1	-1
KTHEM	0	1	
	1	-1	

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	201.376	92.397
SC	204.346	116.156
-2 Log L	199.376	76.397

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	122.9793	7	<.0001
Score	88.3028	7	<.0001
Wald	38.0952	7	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	5.0816	0.0242
LOGG	1	18.1275	<.0001
TACTI	1	31.3778	<.0001
FSHOCE	1	8.7442	0.0031
INCOMCO1	2	3.6365	0.1623
KTHEM	1	7.8083	0.0052

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	5.9313	1.3521	19.2428	<.0001
AGE		1	0.0445	0.0198	5.0816	0.0242
LOGG	0	1	-3.0890	0.7255	18.1275	<.0001
TACTI		1	-1.3097	0.2338	31.3778	<.0001
FSHOCE	0	1	-1.2363	0.4181	8.7442	0.0031
INCOMCO1	1	1	-0.0137	0.4541	0.0009	0.9760
INCOMCO1	2	1	-0.9425	0.5000	3.5539	0.0594
KTHEM	0	1	-0.9885	0.3538	7.8083	0.0052

Odds Ratio Estimates

Effect		Point Estimate	95% Wald Confidence Limits	
AGE		1.046	1.006	1.087
LOGG	0 vs 1	0.002	<0.001	0.036
TACTI		0.270	0.171	0.427
FSHOCE	0 vs 1	0.084	0.016	0.434
INCOMCO1	1 vs 3	0.379	0.056	2.567
INCOMCO1	2 vs 3	0.150	0.019	1.152
KTHEM	0 vs 1	0.138	0.035	0.554

Association of Predicted Probabilities and Observed Responses

Percent Concordant	95.6	Somers' D	0.913
Percent Discordant	4.3	Gamma	0.914
Percent Tied	0.1	Tau-a	0.459
Pairs	5175	c	0.956

Output 6.8 PROC LOGISTIC Output for LOTM (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOTM	LOTM
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	137
Number of Observations Used	129

Response Profile

Ordered Value	LOTM	Total Frequency
1	1	66
2	0	63

Probability modeled is LOTM='1'.

NOTE: 8 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables	
LOGG	0	1	
	1	-1	
FSHOCE	0	1	
	1	-1	
INCOMCO1	1	1	0
	2	0	1
	3	-1	-1
KTHEM	0	1	
	1	-1	

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	180.762	63.185
SC	183.622	86.063
-2 Log L	178.762	47.185

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	131.5775	7	<.0001
Score	88.6559	7	<.0001
Wald	26.6613	7	0.0004

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	3.4679	0.0626
LOGG	1	13.7146	0.0002
TACTI	1	24.3769	<.0001
FSHOCE	1	8.1400	0.0043
INCOMCO1	2	2.9851	0.2248
KTHEM	1	5.5820	0.0181

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	9.7212	2.3069	17.7574	<.0001
AGE		1	0.0500	0.0268	3.4679	0.0626
LOGG	0	1	-3.6777	0.9931	13.7146	0.0002
TACTI		1	-1.8993	0.3847	24.3769	<.0001
FSHOCE	0	1	-2.0426	0.7159	8.1400	0.0043
INCOMCO1	1	1	-0.5669	0.7275	0.6072	0.4358
INCOMCO1	2	1	-1.3046	0.7633	2.9212	0.0874
KTHEM	0	1	-1.0769	0.4558	5.5820	0.0181

Odds Ratio Estimates

Effect		Point Estimate	95% Wald Confidence Limits	
AGE		1.051	0.997	1.108
LOGG	0 vs 1	<0.001	<0.001	0.031
TACTI		0.150	0.070	0.318

FSHOCE	0 vs 1	0.017	0.001	0.278
INCOMCO1	1 vs 3	0.087	0.002	3.241
INCOMCO1	2 vs 3	0.042	0.001	1.686
KTHEM	0 vs 1	0.116	0.019	0.693

Association of Predicted Probabilities and Observed Responses

Percent Concordant	97.8	Somers' D	0.957
Percent Discordant	2.1	Gamma	0.958
Percent Tied	0.1	Tau-a	0.482
Pairs	4158	c	0.979

Output 6.9 PROC LOGISTIC Output for LOTM (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOTM	LOTM
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	137
Number of Observations Used	134

Response Profile

Ordered Value	LOTM	Total Frequency
1	1	69
2	0	65

Probability modeled is LOTM='1'.

NOTE: 3 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
LOGG	0	1
	1	-1
FSHOCE	0	1
	1	-1
KTHEM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	187.644	69.638
SC	190.542	87.025

-2 Log L	185.644	57.638

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	128.0065	5	<.0001
Score	87.3909	5	<.0001
Wald	29.3689	5	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	5.6051	0.0179
LOGG	1	15.8221	<.0001
TACTI	1	26.3079	<.0001
FSHOCE	1	9.7852	0.0018
KTHEM	1	4.6671	0.0307

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	8.7151	2.0649	17.8134	<.0001
AGE		1	0.0571	0.0241	5.6051	0.0179
LOGG	0	1	-3.6407	0.9153	15.8221	<.0001
TACTI		1	-1.8038	0.3517	26.3079	<.0001
FSHOCE	0	1	-2.1893	0.6999	9.7852	0.0018
KTHEM	0	1	-0.8729	0.4041	4.6671	0.0307

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	1.059	1.010	1.110
LOGG 0 vs 1	<0.001	<0.001	0.025
TACTI	0.165	0.083	0.328
FSHOCE 0 vs 1	0.013	<0.001	0.195
KTHEM 0 vs 1	0.174	0.036	0.851

Association of Predicted Probabilities and Observed Responses

Percent Concordant	97.1	Somers' D	0.941
Percent Discordant	2.9	Gamma	0.942
Percent Tied	0.0	Tau-a	0.474
Pairs	4485	c	0.971

Output 6.10 PROC LOGISTIC Output for LOTM (BML in 151-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOTM	LOTM
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	152
Number of Observations Used	151

Response Profile

Ordered Value	LOTM	Total Frequency
1	1	72
2	0	79

Probability modeled is LOTM='1'.

NOTE: 1 observation was deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
LOGG	0	1
	1	-1
FSHOCE	0	1
	1	-1
KTHEM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	211.006	102.316
SC	214.023	120.420
-2 Log L	209.006	90.316

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	118.6896	5	<.0001
Score	87.2342	5	<.0001
Wald	40.8862	5	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	4.9915	0.0255
LOGG	1	19.1953	<.0001
TACTI	1	33.5988	<.0001
FSHOCE	1	7.3061	0.0069
KTHEM	1	10.5006	0.0012

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq

Intercept		1	5.1969	1.2104	18.4339	<.0001
AGE		1	0.0379	0.0170	4.9915	0.0255
LOGG	0	1	-2.7897	0.6367	19.1953	<.0001
TACTI		1	-1.1774	0.2031	33.5988	<.0001
FSHOCE	0	1	-1.0794	0.3994	7.3061	0.0069
KTHEM	0	1	-1.0259	0.3166	10.5006	0.0012

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	1.039	1.005	1.074
LOGG 0 vs 1	0.004	<0.001	0.046
TACTI	0.308	0.207	0.459
FSHOCE 0 vs 1	0.115	0.024	0.552
KTHEM 0 vs 1	0.128	0.037	0.444

Association of Predicted Probabilities and Observed Responses

Percent Concordant	94.5	Somers' D	0.891
Percent Discordant	5.4	Gamma	0.892
Percent Tied	0.1	Tau-a	0.448
Pairs	5688	c	0.945

Output 6.11 PROC LOGISTIC Output for LOTW (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOTW	LOTW
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	137
Number of Observations Used	134

Response Profile

Ordered Value	LOTW	Total Frequency
1	1	65
2	0	69

Probability modeled is LOTW='1'.

NOTE: 3 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
LOGG	0	1
	1	-1
FSHOCE	0	1

	1	-1
KTHEM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	187.644	69.638
SC	190.542	87.025
-2 Log L	185.644	57.638

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	128.0065	5	<.0001
Score	87.3909	5	<.0001
Wald	29.3689	5	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	5.6051	0.0179
LOGG	1	15.8221	<.0001
TACTI	1	26.3079	<.0001
FSHOCE	1	9.7852	0.0018
KTHEM	1	4.6671	0.0307

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-8.7151	2.0649	17.8134	<.0001
AGE		1	-0.0571	0.0241	5.6051	0.0179
LOGG	0	1	3.6407	0.9153	15.8221	<.0001
TACTI		1	1.8038	0.3517	26.3079	<.0001
FSHOCE	0	1	2.1893	0.6999	9.7852	0.0018
KTHEM	0	1	0.8729	0.4041	4.6671	0.0307

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	0.944	0.901	0.990
LOGG 0 vs 1	>999.999	40.186	>999.999
TACTI	6.072	3.048	12.098
FSHOCE 0 vs 1	79.719	5.130	>999.999
KTHEM 0 vs 1	5.731	1.176	27.932

Association of Predicted Probabilities and Observed Responses

Percent Concordant	97.1	Somers' D	0.941
Percent Discordant	2.9	Gamma	0.942

Percent Tied	0.0	Tau-a	0.474
Pairs	4485	c	0.971

Output 6.12 PROC LOGISTIC Output for LOTW (BML in 151-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOTW	LOTW
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	152
Number of Observations Used	151

Response Profile

Ordered Value	LOTW	Total Frequency
1	1	66
2	0	85

Probability modeled is LOTW='1'.

NOTE: 1 observation was deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
LOGG	0	1
	1	-1
FSHOCE	0	1
	1	-1
KTHEM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	208.933	107.528
SC	211.951	125.632
-2 Log L	206.933	95.528

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	111.4053	5	<.0001
Score	82.5139	5	<.0001
Wald	39.3816	5	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	1.6384	0.2005
LOGG	1	15.0662	0.0001
TACTI	1	34.5812	<.0001
FSHOCE	1	10.3989	0.0013
KTHEM	1	5.6839	0.0171

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-7.2000	1.4428	24.9016	<.0001
AGE		1	-0.0211	0.0164	1.6384	0.2005
LOGG	0	1	2.5655	0.6609	15.0662	0.0001
TACTI		1	1.2188	0.2073	34.5812	<.0001
FSHOCE	0	1	1.5329	0.4754	10.3989	0.0013
KTHEM	0	1	0.7135	0.2993	5.6839	0.0171

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	0.979	0.948	1.011
LOGG 0 vs 1	169.170	12.680	>999.999
TACTI	3.383	2.254	5.079
FSHOCE 0 vs 1	21.453	3.328	138.280
KTHEM 0 vs 1	4.166	1.289	13.464

Association of Predicted Probabilities and Observed Responses

Percent Concordant	93.5	Somers' D	0.872
Percent Discordant	6.4	Gamma	0.873
Percent Tied	0.1	Tau-a	0.432
Pairs	5610	c	0.936

APPENDIX E: PROC LOGISTIC OUTPUTS FOR MEN-AKIN LAND USE

Output 6.13 PROC LOGISTIC Output for HUNT (BML in 134-Record Dataset)

```
                         The LOGISTIC Procedure
                           Model Information

             Data Set                      WORK.INTERVIEWS
             Response Variable             HUNT                HUNT
             Number of Response Levels     2
             Model                         binary logit
             Optimization Technique        Fisher's scoring

                     Number of Observations Read         137
                     Number of Observations Used         105

                            Response Profile
                        Ordered                      Total
                          Value     HUNT         Frequency
                              1     1                   15
                              2     0                   90

                        Probability modeled is HUNT='1'.
NOTE: 32 observations were deleted due to missing values for the response or explanatory
      variables.

                          Class Level Information
                                                Design
                          Class     Value     Variables
                          FISH      0                 1
                                    1                -1
                          LOGG      0                 1
                                    1                -1
                          KOTHE     0                 1
                                    1                -1

                         Model Convergence Status
                Convergence criterion (GCONV=1E-8) satisfied.

                           Model Fit Statistics
                                                 Intercept
                                   Intercept           and
                     Criterion          Only    Covariates
                     AIC              88.124        60.063
                     SC               90.778        75.987
                     -2 Log L         86.124        48.063

                     Testing Global Null Hypothesis: BETA=0
             Test                 Chi-Square       DF     Pr > ChiSq
             Likelihood Ratio        38.0616        5         <.0001
```

Score	36.2661	5	<.0001
Wald	16.3439	5	0.0059

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
FISH	1	6.3430	0.0118
LOGG	1	12.6281	0.0004
LDISTHR	1	4.4584	0.0347
INCOME	1	0.4590	0.4981
KOTHE	1	4.3951	0.0360

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-4.6322	1.4562	10.1187	0.0015
FISH	0	1	-1.2394	0.4921	6.3430	0.0118
LOGG	0	1	-1.7328	0.4876	12.6281	0.0004
LDISTHR		1	1.2532	0.5935	4.4584	0.0347
INCOME		1	1.418E-7	2.093E-7	0.4590	0.4981
KOTHE	0	1	0.9761	0.4656	4.3951	0.0360

Odds Ratio Estimates

Effect		Point Estimate	95% Wald Confidence Limits	
FISH	0 vs 1	0.084	0.012	0.577
LOGG	0 vs 1	0.031	0.005	0.211
LDISTHR		3.502	1.094	11.207
INCOME		1.000	1.000	1.000
KOTHE	0 vs 1	7.044	1.136	43.693

Association of Predicted Probabilities and Observed Responses

Percent Concordant	93.3	Somers' D	0.872
Percent Discordant	6.1	Gamma	0.878
Percent Tied	0.7	Tau-a	0.216
Pairs	1350	c	0.936

Output 6.14 PROC LOGISTIC Output for HUNT including the GENDERW variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	HUNT	HUNT
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	105

Response Profile

Ordered Value	HUNT	Total Frequency
1	1	15
2	0	90

Probability modeled is HUNT='1'.

NOTE: 30 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
FISH	0	1
	1	-1
LOGG	0	1
	1	-1
KOTHE	0	1
	1	-1
GENDERW	0	1
	1	-1

Model Convergence Status

Quasi-complete separation of data points detected.

WARNING: The maximum likelihood estimate may not exist.

WARNING: The LOGISTIC procedure continues in spite of the above warning. Results shown are based on the last maximum likelihood iteration. Validity of the model fit is questionable.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	88.124	48.017
SC	90.778	66.595
-2 Log L	86.124	34.017

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	52.1070	6	<.0001
Score	38.8947	6	<.0001
Wald	11.0786	6	0.0860

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
FISH	1	6.4052	0.0114
LOGG	1	6.5318	0.0106
LDISTHR	1	4.9986	0.0254
INCOME	1	1.5172	0.2180
KOTHE	1	3.3796	0.0660
GENDERW	1	0.0160	0.8993

WARNING: The validity of the model fit is questionable.

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-18.5749	100.6	0.0341	0.8535
FISH	0	1	-1.6956	0.6700	6.4052	0.0114
LOGG	0	1	-1.7073	0.6680	6.5318	0.0106
LDISTHR		1	1.5815	0.7074	4.9986	0.0254
INCOME		1	2.034E-6	1.651E-6	1.5172	0.2180
KOTHE	0	1	1.2689	0.6902	3.3796	0.0660
GENDERW	0	1	12.7195	100.5	0.0160	0.8993

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
FISH 0 vs 1	0.034	0.002	0.465
LOGG 0 vs 1	0.033	0.002	0.451
LDISTHR	4.862	1.215	19.453
INCOME	1.000	1.000	1.000
KOTHE 0 vs 1	12.652	0.845	189.327
GENDERW 0 vs 1	>999.999	<0.001	>999.999

Association of Predicted Probabilities and Observed Responses

Percent Concordant	96.3	Somers' D	0.930
Percent Discordant	3.3	Gamma	0.933
Percent Tied	0.4	Tau-a	0.230
Pairs	1350	c	0.965

Output 6.15 PROC LOGISTIC Output for HUNT including the GENDERM variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	HUNT	HUNT
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read 135
Number of Observations Used 105

Response Profile

Ordered Value	HUNT	Total Frequency
1	1	15
2	0	90

Probability modeled is HUNT='1'.

NOTE: 30 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
FISH	0	1
	1	-1
LOGG	0	1
	1	-1
KOTHE	0	1
	1	-1
GENDERM	0	1
	1	-1

Model Convergence Status

Quasi-complete separation of data points detected.

WARNING: The maximum likelihood estimate may not exist.

WARNING: The LOGISTIC procedure continues in spite of the above warning. Results shown are based on the last maximum likelihood iteration. Validity of the model fit is questionable.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	88.124	48.017
SC	90.778	66.595
-2 Log L	86.124	34.017

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	52.1070	6	<.0001
Score	38.8947	6	<.0001
Wald	11.0786	6	0.0860

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
FISH	1	6.4052	0.0114
LOGG	1	6.5318	0.0106
LDISTHR	1	4.9986	0.0254
INCOME	1	1.5172	0.2180
KOTHE	1	3.3796	0.0660
GENDERM	1	0.0160	0.8993

The LOGISTIC Procedure

WARNING: The validity of the model fit is questionable.

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-18.5749	100.6	0.0341	0.8535
FISH	0	1	-1.6956	0.6700	6.4052	0.0114
LOGG	0	1	-1.7073	0.6680	6.5318	0.0106

```
LDISTHR          1      1.5815      0.7074        4.9986        0.0254
INCOME           1    2.034E-6    1.651E-6        1.5172        0.2180
KOTHE      0     1      1.2689      0.6902        3.3796        0.0660
GENDERM    0     1    -12.7195       100.5        0.0160        0.8993

                       Odds Ratio Estimates
                             Point          95% Wald
         Effect            Estimate      Confidence Limits
         FISH    0 vs 1       0.034       0.002       0.465
         LOGG    0 vs 1       0.033       0.002       0.451
         LDISTHR              4.862       1.215      19.453
         INCOME               1.000       1.000       1.000
         KOTHE   0 vs 1      12.652       0.845     189.327
         GENDERM 0 vs 1      <0.001      <0.001    >999.999

    Association of Predicted Probabilities and Observed Responses
          Percent Concordant     96.3    Somers' D    0.930
          Percent Discordant      3.3    Gamma        0.933
          Percent Tied            0.4    Tau-a        0.230
          Pairs                  1350    c            0.965
```

Output 6.16 PROC LOGISTIC Output for LOGG (BML in 134-Record Dataset)

```
                      The LOGISTIC Procedure
                         Model Information
       Data Set                     WORK.INTERVIEWS
       Response Variable            LOGG                LOGG
       Number of Response Levels    2
       Model                        binary logit
       Optimization Technique       Fisher's scoring

               Number of Observations Read         135
               Number of Observations Used         129

                          Response Profile
                  Ordered                      Total
                    Value     LOGG         Frequency
                        1     1                   24
                        2     0                  105

                  Probability modeled is LOGG='1'.
NOTE: 6 observations were deleted due to missing values for the response or explanatory
      variables.

                     Class Level Information
                                         Design
                  Class        Value     Variables
                  HUNT         0          1
                               1         -1
                  INCOMCO1     1          1      0
                               2          0      1
```

3	-1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	125.953	95.821
SC	128.813	110.120
-2 Log L	123.953	85.821

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	38.1328	4	<.0001
Score	39.9132	4	<.0001
Wald	21.0742	4	0.0003

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
TLOTS	1	5.0650	0.0244
HUNT	1	12.4533	0.0004
INCOMCO1	2	10.5716	0.0051

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-1.5274	0.5386	8.0419	0.0046
TLOTS		1	0.4932	0.2191	5.0650	0.0244
HUNT	0	1	-1.3012	0.3687	12.4533	0.0004
INCOMCO1	1	1	-1.3891	0.4689	8.7770	0.0031
INCOMCO1	2	1	0.7895	0.4018	3.8617	0.0494

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
TLOTS	1.637	1.066	2.516
HUNT 0 vs 1	0.074	0.017	0.314
INCOMCO1 1 vs 3	0.137	0.022	0.855
INCOMCO1 2 vs 3	1.209	0.235	6.216

Association of Predicted Probabilities and Observed Responses

Percent Concordant	83.7	Somers' D	0.732
Percent Discordant	10.4	Gamma	0.778
Percent Tied	5.9	Tau-a	0.223
Pairs	2520	c	0.866

Output 6.17 PROC LOGISTIC Output for LOGG including the GENDERW variable (BML in 134-Record Dataset)

```
                          The LOGISTIC Procedure
                             Model Information
                 Data Set                      WORK.INTERVIEWS
                 Response Variable             LOGG                 LOGG
                 Number of Response Levels     2
                 Model                         binary logit
                 Optimization Technique        Fisher's scoring

                         Number of Observations Read         135
                         Number of Observations Used         129

                              Response Profile
                            Ordered                      Total
                              Value     LOGG         Frequency
                                  1     1                   24
                                  2     0                  105

                            Probability modeled is LOGG='1'.
NOTE: 6 observations were deleted due to missing values for the response or explanatory
      variables.
                         Class Level Information
                                                   Design
                            Class        Value     Variables
                            GENDERW      0          1
                                         1         -1
                            HUNT         0          1
                                         1         -1
                            INCOMCO1     1          1      0
                                         2          0      1
                                         3         -1     -1

                         Model Convergence Status
                  Convergence criterion (GCONV=1E-8) satisfied.
                           Model Fit Statistics
                                                  Intercept
                                  Intercept             and
                         Criterion          Only     Covariates
                         AIC             125.953         82.554
                         SC              128.813         99.713
                         -2 Log L        123.953         70.554


                         Testing Global Null Hypothesis: BETA=0
                 Test                 Chi-Square       DF     Pr > ChiSq
                 Likelihood Ratio        53.3992        5         <.0001
                 Score                   48.1995        5         <.0001
                 Wald                    21.3398        5         0.0007
                              Type 3 Analysis of Effects
```

Effect	DF	Wald Chi-Square	Pr > ChiSq
GENDERW	1	7.8491	0.0051
TLOTS	1	5.8582	0.0155
HUNT	1	4.9732	0.0257
INCOMCO1	2	6.7099	0.0349

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.2595	0.9480	11.8230	0.0006
GENDERW	0	1	1.6917	0.6038	7.8491	0.0051
TLOTS		1	0.7496	0.3097	5.8582	0.0155
HUNT	0	1	-0.8252	0.3700	4.9732	0.0257
INCOMCO1	1	1	-1.0226	0.4805	4.5293	0.0333
INCOMCO1	2	1	0.8505	0.4204	4.0934	0.0431

Odds Ratio Estimates

Effect		Point Estimate	95% Wald Confidence Limits	
GENDERW	0 vs 1	29.469	2.763	314.269
TLOTS		2.116	1.153	3.883
HUNT	0 vs 1	0.192	0.045	0.819
INCOMCO1	1 vs 3	0.303	0.049	1.883
INCOMCO1	2 vs 3	1.971	0.379	10.241

Association of Predicted Probabilities and Observed Responses

Percent Concordant	90.4	Somers' D	0.835
Percent Discordant	6.9	Gamma	0.858
Percent Tied	2.7	Tau-a	0.255
Pairs	2520	c	0.918

Output 6.18 PROC LOGISTIC Output for LOGG including the GENDERM variable (BML in 134-Record Dataset)

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	LOGG	LOGG
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	129

Response Profile

Ordered Value	LOGG	Total Frequency
1	1	24
2	0	105

Probability modeled is LOGG='1'.

NOTE: 6 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables	
HUNT	0	1	
	1	-1	
INCOMCO1	1	1	0
	2	0	1
	3	-1	-1
GENDERM	0	1	
	1	-1	

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	125.953	82.554
SC	128.813	99.713
-2 Log L	123.953	70.554

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	53.3992	5	<.0001
Score	48.1995	5	<.0001
Wald	21.3398	5	0.0007

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
TLOTS	1	5.8582	0.0155
HUNT	1	4.9732	0.0257
INCOMCO1	2	6.7099	0.0349
GENDERM	1	7.8491	0.0051

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.2595	0.9480	11.8230	0.0006
TLOTS		1	0.7496	0.3097	5.8582	0.0155
HUNT	0	1	-0.8252	0.3700	4.9732	0.0257
INCOMCO1	1	1	-1.0226	0.4805	4.5293	0.0333
INCOMCO1	2	1	0.8505	0.4204	4.0934	0.0431
GENDERM	0	1	-1.6917	0.6038	7.8491	0.0051

Odds Ratio Estimates

Effect		Point Estimate	95% Wald Confidence Limits	
TLOTS		2.116	1.153	3.883
HUNT	0 vs 1	0.192	0.045	0.819
INCOMCO1	1 vs 3	0.303	0.049	1.883
INCOMCO1	2 vs 3	1.971	0.379	10.241
GENDERM	0 vs 1	0.034	0.003	0.362

Association of Predicted Probabilities and Observed Responses

Percent Concordant	90.4	Somers' D	0.835
Percent Discordant	6.9	Gamma	0.858
Percent Tied	2.7	Tau-a	0.255
Pairs	2520	c	0.918

Output 6.19 PROC LOGISTIC Output for FSHOCE (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	FSHOCE	FSHOCE
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	129

Response Profile

Ordered Value	FSHOCE	Total Frequency
1	1	22
2	0	107

Probability modeled is FSHOCE='1'.

NOTE: 6 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
FSHRIV	0	1
	1	-1
KTHEM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	119.840	87.160
SC	122.700	101.459
-2 Log L	117.840	77.160

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	40.6802	4	<.0001
Score	33.6982	4	<.0001
Wald	18.3595	4	0.0010

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
TLOTS	1	4.3548	0.0369
FSHRIV	1	12.6505	0.0004
EXPENSE	1	4.8661	0.0274
KTHEM	1	5.3147	0.0211

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-1.2012	0.9027	1.7707	0.1833
TLOTS		1	-1.2181	0.5837	4.3548	0.0369
FSHRIV	0	1	-1.1879	0.3340	12.6505	0.0004
EXPENSE		1	1.383E-6	6.272E-7	4.8661	0.0274
KTHEM	0	1	-1.2179	0.5283	5.3147	0.0211

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
TLOTS	0.296	0.094	0.929
FSHRIV 0 vs 1	0.093	0.025	0.344
EXPENSE	1.000	1.000	1.000
KTHEM 0 vs 1	0.088	0.011	0.694

Association of Predicted Probabilities and Observed Responses

Percent Concordant	88.3	Somers' D	0.775
Percent Discordant	10.8	Gamma	0.782
Percent Tied	0.9	Tau-a	0.221
Pairs	2354	c	0.887

Output 6.20 PROC LOGISTIC Output for FSHOCE including the GENDERW variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	FSHOCE	FSHOCE
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	129

Response Profile

Ordered Value	FSHOCE	Total Frequency
1	1	22
2	0	107

Probability modeled is FSHOCE='1'.

NOTE: 6 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
FSHRIV	0	1
	1	-1
KTHEM	0	1
	1	-1
GENDERW	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	119.840	81.329
SC	122.700	98.488
-2 Log L	117.840	69.329

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	48.5113	5	<.0001
Score	38.8062	5	<.0001
Wald	20.1323	5	0.0012

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
TLOTS	1	3.9457	0.0470
FSHRIV	1	14.2974	0.0002
EXPENSE	1	6.1098	0.0134

KTHEM	1	4.2824	0.0385
GENDERW	1	6.4002	0.0114

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-1.5329	0.9563	2.5695	0.1089
TLOTS		1	-1.2134	0.6109	3.9457	0.0470
FSHRIV	0	1	-1.3784	0.3645	14.2974	0.0002
EXPENSE		1	1.398E-6	5.657E-7	6.1098	0.0134
KTHEM	0	1	-1.1240	0.5432	4.2824	0.0385
GENDERW	0	1	0.9457	0.3738	6.4002	0.0114

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
TLOTS	0.297	0.090	0.984
FSHRIV 0 vs 1	0.063	0.015	0.265
EXPENSE	1.000	1.000	1.000
KTHEM 0 vs 1	0.106	0.013	0.888
GENDERW 0 vs 1	6.628	1.531	28.693

Association of Predicted Probabilities and Observed Responses

Percent Concordant	91.6	Somers' D	0.835
Percent Discordant	8.1	Gamma	0.838
Percent Tied	0.3	Tau-a	0.238
Pairs	2354	c	0.918

Output 6.21 PROC LOGISTIC Output for FSHOCE including the GENDERM variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	FSHOCE	FSHOCE
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	129

Response Profile

Ordered Value	FSHOCE	Total Frequency
1	1	22
2	0	107

Probability modeled is FSHOCE='1'.

NOTE: 6 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
FSHRIV	0	1
	1	-1
KTHEM	0	1
	1	-1
GENDERM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	119.840	81.329
SC	122.700	98.488
-2 Log L	117.840	69.329

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	48.5113	5	<.0001
Score	38.8062	5	<.0001
Wald	20.1323	5	0.0012

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
TLOTS	1	3.9457	0.0470
FSHRIV	1	14.2974	0.0002
EXPENSE	1	6.1098	0.0134
KTHEM	1	4.2824	0.0385
GENDERM	1	6.4002	0.0114

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-1.5329	0.9563	2.5695	0.1089
TLOTS		1	-1.2134	0.6109	3.9457	0.0470
FSHRIV	0	1	-1.3784	0.3645	14.2974	0.0002
EXPENSE		1	1.398E-6	5.657E-7	6.1098	0.0134
KTHEM	0	1	-1.1240	0.5432	4.2824	0.0385
GENDERM	0	1	-0.9457	0.3738	6.4002	0.0114

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
TLOTS	0.297	0.090	0.984
FSHRIV 0 vs 1	0.063	0.015	0.265

```
EXPENSE              1.000       1.000       1.000
KTHEM   0 vs 1       0.106       0.013       0.888
GENDERM 0 vs 1       0.151       0.035       0.653

Association of Predicted Probabilities and Observed Responses
      Percent Concordant     91.6    Somers' D    0.835
      Percent Discordant      8.1    Gamma        0.838
      Percent Tied            0.3    Tau-a        0.238
      Pairs                  2354    c            0.918
```

APPENDIX F: PROC LOGISTIC OUTPUTS FOR WOMEN-AKIN LAND USE

Output 6.22 PROC LOGISTIC Output for AZO (BML in 134-Record Dataset)

```
                         The LOGISTIC Procedure
                           Model Information
          Data Set                      WORK.INTERVIEWS
          Response Variable             AZO                 AZO
          Number of Response Levels     2
          Model                         binary logit
          Optimization Technique        Fisher's scoring

                  Number of Observations Read         135
                  Number of Observations Used         134

                             Response Profile
                     Ordered                    Total
                       Value     AZO        Frequency
                           1     1                 42
                           2     0                 92

                       Probability modeled is AZO='1'.
NOTE: 1 observation was deleted due to missing values for the response or explanatory
      variables.

                         Class Level Information
                                              Design
                        Class     Value     Variables
                        KMOTH     0                 1
                                  1                -1

                        Model Convergence Status
              Convergence criterion (GCONV=1E-8) satisfied.

                          Model Fit Statistics
                                               Intercept
                                  Intercept          and
                  Criterion            Only   Covariates
                  AIC               168.648       82.338
                  SC                171.546       93.929
                  -2 Log L          166.648       74.338

                  Testing Global Null Hypothesis: BETA=0
          Test                 Chi-Square       DF     Pr > ChiSq
          Likelihood Ratio        92.3098        3         <.0001
          Score                   72.2743        3         <.0001
          Wald                    34.2961        3         <.0001

                       Type 3 Analysis of Effects
                                    Wald
```

Effect	DF	Chi-Square	Pr > ChiSq
CHILDT	1	2.2440	0.1341
TACTI	1	31.4899	<.0001
KMOTH	1	5.1970	0.0226

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-8.9905	1.5381	34.1680	<.0001
CHILDT		1	0.1583	0.1057	2.2440	0.1341
TACTI		1	1.3814	0.2462	31.4899	<.0001
KMOTH	0	1	-1.3174	0.5779	5.1970	0.0226

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
CHILDT	1.172	0.952	1.441
TACTI	3.981	2.457	6.449
KMOTH 0 vs 1	0.072	0.007	0.691

Association of Predicted Probabilities and Observed Responses

Percent Concordant	94.2	Somers' D	0.888
Percent Discordant	5.4	Gamma	0.892
Percent Tied	0.5	Tau-a	0.385
Pairs	3864	c	0.944

Output 6.23 PROC LOGISTIC Output for AZO including the GENDERW variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	AZO	AZO
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	134

Response Profile

Ordered Value	AZO	Total Frequency
1	1	42
2	0	92

Probability modeled is AZO='1'.

NOTE: 1 observation was deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
KMOTH	0	1
	1	-1
GENDERW	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	168.648	60.861
SC	171.546	75.350
-2 Log L	166.648	50.861

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	115.7867	4	<.0001
Score	84.8411	4	<.0001
Wald	28.7510	4	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
CHILDT	1	6.5576	0.0104
TACTI	1	15.5362	<.0001
KMOTH	1	0.3372	0.5615
GENDERW	1	14.8129	0.0001

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-8.9813	1.7750	25.6035	<.0001
CHILDT		1	0.4379	0.1710	6.5576	0.0104
TACTI		1	1.0445	0.2650	15.5362	<.0001
KMOTH	0	1	-0.3884	0.6690	0.3372	0.5615
GENDERW	0	1	-2.2385	0.5816	14.8129	0.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
CHILDT	1.549	1.108	2.166
TACTI	2.842	1.691	4.777
KMOTH 0 vs 1	0.460	0.033	6.331
GENDERW 0 vs 1	0.011	0.001	0.111

Association of Predicted Probabilities and Observed Responses

Percent Concordant	96.1	Somers' D	0.930
Percent Discordant	3.1	Gamma	0.938
Percent Tied	0.9	Tau-a	0.403
Pairs	3864	c	0.965

Output 6.24 PROC LOGISTIC Output for AZO including the GENDERM variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	AZO	AZO
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	134

Response Profile

Ordered Value	AZO	Total Frequency
1	1	42
2	0	92

Probability modeled is AZO='1'.

NOTE: 1 observation was deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
KMOTH	0	1
	1	-1
GENDERM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	168.648	60.861
SC	171.546	75.350
-2 Log L	166.648	50.861

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	115.7867	4	<.0001

Score	84.8411	4	<.0001
Wald	28.7510	4	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
CHILDT	1	6.5576	0.0104
TACTI	1	15.5362	<.0001
KMOTH	1	0.3372	0.5615
GENDERM	1	14.8129	0.0001

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-8.9813	1.7750	25.6035	<.0001
CHILDT		1	0.4379	0.1710	6.5576	0.0104
TACTI		1	1.0445	0.2650	15.5362	<.0001
KMOTH	0	1	-0.3884	0.6690	0.3372	0.5615
GENDERM	0	1	2.2385	0.5816	14.8129	0.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
CHILDT	1.549	1.108	2.166
TACTI	2.842	1.691	4.777
KMOTH 0 vs 1	0.460	0.033	6.331
GENDERM 0 vs 1	87.966	8.999	859.909

Association of Predicted Probabilities and Observed Responses

Percent Concordant	96.1	Somers' D	0.930
Percent Discordant	3.1	Gamma	0.938
Percent Tied	0.9	Tau-a	0.403
Pairs	3864	c	0.965

Output 6.25 PROC LOGISTIC Output for COLLE (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	COLLE	COLLE
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	111

Response Profile

Ordered Value	COLLE	Total Frequency
1	1	42
2	0	69

Probability modeled is COLLE='1'.

NOTE: 24 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables			
EDU	0	1	0	0	0
	1	0	1	0	0
	2	0	0	1	0
	3	0	0	0	1
	4	-1	-1	-1	-1
TTYPE1	0	1			
	1	-1			

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	149.245	109.239
SC	151.954	130.915
-2 Log L	147.245	93.239

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	54.0060	7	<.0001
Score	46.4399	7	<.0001
Wald	29.7756	7	0.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
EDU	4	5.1858	0.2688
CHILDT	1	0.4121	0.5209
TACTI	1	22.2670	<.0001
TTYPE1	1	3.1141	0.0776

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-4.2497	0.9621	19.5098	<.0001
EDU	0	1	1.5020	0.6704	5.0194	0.0251
EDU	1	1	-0.1407	0.4622	0.0927	0.7608
EDU	2	1	-0.4668	0.5486	0.7242	0.3948
EDU	3	1	-0.3676	0.7150	0.2642	0.6072
CHILDT		1	0.0767	0.1195	0.4121	0.5209
TACTI		1	0.8158	0.1729	22.2670	<.0001
TTYPE1	0	1	-0.5589	0.3167	3.1141	0.0776

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
EDU 0 vs 4	7.605	0.697	82.935
EDU 1 vs 4	1.471	0.193	11.232
EDU 2 vs 4	1.062	0.135	8.356
EDU 3 vs 4	1.173	0.106	12.949
CHILDT	1.080	0.854	1.365
TACTI	2.261	1.611	3.173
TTYPE1 0 vs 1	0.327	0.094	1.132

Association of Predicted Probabilities and Observed Responses

Percent Concordant	87.4	Somers' D	0.752
Percent Discordant	12.2	Gamma	0.754
Percent Tied	0.3	Tau-a	0.357
Pairs	2898	c	0.876

Output 6.26 PROC LOGISTIC Output for COLLE including the GENDERW variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	COLLE	COLLE
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	111

Response Profile

Ordered Value	COLLE	Total Frequency
1	1	42
2	0	69

Probability modeled is COLLE='1'.

NOTE: 24 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables			
EDU	0	1	0	0	0
	1	0	1	0	0
	2	0	0	1	0
	3	0	0	0	1
	4	-1	-1	-1	-1
TTYPE1	0	1			
	1	-1			
GENDERW	0	1			

1 -1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	149.245	108.135
SC	151.954	132.521
-2 Log L	147.245	90.135

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	57.1100	8	<.0001
Score	48.4263	8	<.0001
Wald	29.2882	8	0.0003

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
EDU	4	6.0229	0.1974
CHILDT	1	0.3345	0.5630
TACTI	1	11.2336	0.0008
TTYPE1	1	4.2466	0.0393
GENDERW	1	3.0394	0.0813

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.4992	1.0251	11.6509	0.0006
EDU	0	1	1.7507	0.7161	5.9774	0.0145
EDU	1	1	-0.0140	0.4788	0.0009	0.9766
EDU	2	1	-0.4322	0.5480	0.6219	0.4303
EDU	3	1	-0.5866	0.7387	0.6304	0.4272
CHILDT		1	0.0706	0.1222	0.3345	0.5630
TACTI		1	0.6540	0.1951	11.2336	0.0008
TTYPE1	0	1	-0.6706	0.3254	4.2466	0.0393
GENDERW	0	1	-0.5586	0.3204	3.0394	0.0813

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
EDU 0 vs 4	11.806	0.991	140.680
EDU 1 vs 4	2.022	0.259	15.748
EDU 2 vs 4	1.331	0.169	10.462
EDU 3 vs 4	1.140	0.105	12.373
CHILDT	1.073	0.845	1.364
TACTI	1.923	1.312	2.819
TTYPE1 0 vs 1	0.262	0.073	0.937
GENDERW 0 vs 1	0.327	0.093	1.149

Association of Predicted Probabilities and Observed Responses

Percent Concordant	88.6	Somers' D	0.773
Percent Discordant	11.3	Gamma	0.774
Percent Tied	0.1	Tau-a	0.367
Pairs	2898	c	0.887

Output 6.27 PROC LOGISTIC Output for COLLE including the GENDERM variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	COLLE	COLLE
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	111

Response Profile

Ordered Value	COLLE	Total Frequency
1	1	42
2	0	69

Probability modeled is COLLE='1'.

NOTE: 24 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables			
EDU	0	1	0	0	0
	1	0	1	0	0
	2	0	0	1	0
	3	0	0	0	1
	4	-1	-1	-1	-1
TTYPE1	0	1			
	1	-1			
GENDERM	0	1			
	1	-1			

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	149.245	108.135
SC	151.954	132.521
-2 Log L	147.245	90.135

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	57.1100	8	<.0001
Score	48.4263	8	<.0001
Wald	29.2882	8	0.0003

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
EDU	4	6.0229	0.1974
CHILDT	1	0.3345	0.5630
TACTI	1	11.2336	0.0008
TTYPE1	1	4.2466	0.0393
GENDERM	1	3.0394	0.0813

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.4992	1.0251	11.6509	0.0006
EDU	0	1	1.7507	0.7161	5.9774	0.0145
EDU	1	1	-0.0140	0.4788	0.0009	0.9766
EDU	2	1	-0.4322	0.5480	0.6219	0.4303
EDU	3	1	-0.5866	0.7387	0.6304	0.4272
CHILDT		1	0.0706	0.1222	0.3345	0.5630
TACTI		1	0.6540	0.1951	11.2336	0.0008
TTYPE1	0	1	-0.6706	0.3254	4.2466	0.0393
GENDERM	0	1	0.5586	0.3204	3.0394	0.0813

Odds Ratio Estimates

Effect		Point Estimate	95% Wald Confidence Limits	
EDU	0 vs 4	11.806	0.991	140.680
EDU	1 vs 4	2.022	0.259	15.748
EDU	2 vs 4	1.331	0.169	10.462
EDU	3 vs 4	1.140	0.105	12.373
CHILDT		1.073	0.845	1.364
TACTI		1.923	1.312	2.819
TTYPE1	0 vs 1	0.262	0.073	0.937
GENDERM	0 vs 1	3.056	0.870	10.732

Association of Predicted Probabilities and Observed Responses

Percent Concordant	88.6	Somers' D	0.773
Percent Discordant	11.3	Gamma	0.774
Percent Tied	0.1	Tau-a	0.367
Pairs	2898	c	0.887

Output 6.28 PROC LOGISTIC Output for ANIM (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	ANIM	ANIM
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	134

Response Profile

Ordered Value	ANIM	Total Frequency
1	1	58
2	0	76

Probability modeled is ANIM='1'.

NOTE: 1 observation was deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
KMOTH	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	185.338	112.673
SC	188.236	124.264
-2 Log L	183.338	104.673

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	78.6653	3	<.0001
Score	63.5057	3	<.0001
Wald	36.8948	3	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	3.2758	0.0703
TACTI	1	33.9801	<.0001
KMOTH	1	4.1327	0.0421

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq

```
Intercept       1     -6.5253      1.1535       32.0028        <.0001
AGE             1      0.0262      0.0145        3.2758        0.0703
TACTI           1      1.1001      0.1887       33.9801        <.0001
KMOTH     0     1     -0.7250      0.3566        4.1327        0.0421

                        Odds Ratio Estimates
                             Point          95% Wald
          Effect          Estimate      Confidence Limits
          AGE                1.027       0.998       1.056
          TACTI              3.005       2.076       4.349
          KMOTH 0 vs 1       0.235       0.058       0.949

    Association of Predicted Probabilities and Observed Responses
          Percent Concordant     90.2    Somers' D    0.806
          Percent Discordant      9.6    Gamma        0.807
          Percent Tied            0.2    Tau-a        0.398
          Pairs                  4408    c            0.903
```

Output 6.29 PROC LOGISTIC Output for ANIM including the GENDERW variable (BML in 134-Record Dataset)

```
                       The LOGISTIC Procedure
                          Model Information
       Data Set                     WORK.INTERVIEWS
       Response Variable            ANIM                 ANIM
       Number of Response Levels    2
       Model                        binary logit
       Optimization Technique       Fisher's scoring

               Number of Observations Read         135
               Number of Observations Used         134
                           Response Profile
                  Ordered                        Total
                    Value     ANIM           Frequency
                        1     1                     58
                        2     0                     76

                  Probability modeled is ANIM='1'.
NOTE: 1 observation was deleted due to missing values for the response or explanatory
      variables.

                       Class Level Information
                                            Design
                   Class       Value     Variables
                   KMOTH       0                 1
                               1                -1
                   GENDERW     0                 1
                               1                -1

                      Model Convergence Status
           Convergence criterion (GCONV=1E-8) satisfied.
```

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	185.338	106.186
SC	188.236	120.676
-2 Log L	183.338	96.186

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	87.1517	4	<.0001
Score	68.4665	4	<.0001
Wald	35.5691	4	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	7.4452	0.0064
TACTI	1	20.6446	<.0001
KMOTH	1	1.0130	0.3142
GENDERW	1	7.8305	0.0051

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-6.4879	1.2242	28.0881	<.0001
AGE		1	0.0489	0.0179	7.4452	0.0064
TACTI		1	0.9046	0.1991	20.6446	<.0001
KMOTH	0	1	-0.3640	0.3617	1.0130	0.3142
GENDERW	0	1	-0.9212	0.3292	7.8305	0.0051

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	1.050	1.014	1.088
TACTI	2.471	1.673	3.650
KMOTH 0 vs 1	0.483	0.117	1.993
GENDERW 0 vs 1	0.158	0.044	0.576

Association of Predicted Probabilities and Observed Responses

Percent Concordant	91.7	Somers' D	0.835
Percent Discordant	8.2	Gamma	0.836
Percent Tied	0.1	Tau-a	0.413
Pairs	4408	c	0.918

Output 6.30 PROC LOGISTIC Output for ANIM including the GENDERM variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	ANIM	ANIM
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	135
Number of Observations Used	134

Response Profile

Ordered Value	ANIM	Total Frequency
1	1	58
2	0	76

Probability modeled is ANIM='1'.

NOTE: 1 observation was deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables
KMOTH	0	1
	1	-1
GENDERM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	185.338	106.186
SC	188.236	120.676
-2 Log L	183.338	96.186

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	87.1517	4	<.0001
Score	68.4665	4	<.0001
Wald	35.5691	4	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	7.4452	0.0064
TACTI	1	20.6446	<.0001
KMOTH	1	1.0130	0.3142
GENDERM	1	7.8305	0.0051

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-6.4879	1.2242	28.0881	<.0001
AGE		1	0.0489	0.0179	7.4452	0.0064
TACTI		1	0.9046	0.1991	20.6446	<.0001
KMOTH	0	1	-0.3640	0.3617	1.0130	0.3142
GENDERM	0	1	0.9212	0.3292	7.8305	0.0051

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	1.050	1.014	1.088
TACTI	2.471	1.673	3.650
KMOTH 0 vs 1	0.483	0.117	1.993
GENDERM 0 vs 1	6.311	1.737	22.938

Association of Predicted Probabilities and Observed Responses

Percent Concordant	91.7	Somers' D	0.835
Percent Discordant	8.2	Gamma	0.836
Percent Tied	0.1	Tau-a	0.413
Pairs	4408	c	0.918

APPENDIX G: PROC LOGISTIC OUTPUTS FOR GENDER-NEUTRAL LAND USE

Output 6.31 PROC LOGISTIC Output for Agriculture (BML in 134-Record Dataset)

```
                    The LOGISTIC Procedure
                      Model Information
          Data Set                     WORK.INTERVIEWS
          Response Variable            AGR                  AGR
          Number of Response Levels    2
          Model                        binary logit
          Optimization Technique       Fisher's scoring
                  Number of Observations Read         136
                  Number of Observations Used         134

                        Response Profile
                     Ordered                   Total
                       Value     AGR       Frequency
                           1     1               112
                           2     0                22
                                 112               .
                                 83.58209          .

                 Probability modeled is AGR='1'.
NOTE: 2 observations were deleted due to missing values for the response or explanatory
      variables.
NOTE: 2 response levels were deleted due to missing or invalid values for their
explanatory, frequency, or weight variables.

                    Class Level Information
                                       Design
                       Class     Value    Variables
                       KFATH     0               1
                                 1              -1

                   Model Convergence Status
              Convergence criterion (GCONV=1E-8) satisfied.

                     Model Fit Statistics
                                          Intercept
                             Intercept          and
                  Criterion       Only   Covariates
                  AIC          121.671       78.559
                  SC           124.569       90.151
                  -2 Log L     119.671       70.559

                  Testing Global Null Hypothesis: BETA=0
          Test                 Chi-Square       DF     Pr > ChiSq
          Likelihood Ratio        49.1122        3         <.0001
          Score                   40.6442        3         <.0001
```

Wald	21.8772	3	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	8.5691	0.0034
TACTI	1	11.3325	0.0008
KFATH	1	9.0598	0.0026

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-4.9977	1.3240	14.2487	0.0002
AGE		1	0.0710	0.0243	8.5691	0.0034
TACTI		1	0.9423	0.2799	11.3325	0.0008
KFATH	0	1	-1.2551	0.4170	9.0598	0.0026

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	1.074	1.024	1.126
TACTI	2.566	1.482	4.441
KFATH 0 vs 1	0.081	0.016	0.417

Association of Predicted Probabilities and Observed Responses

Percent Concordant	89.9	Somers' D	0.800
Percent Discordant	10.0	Gamma	0.800
Percent Tied	0.1	Tau-a	0.221
Pairs	2464	c	0.900

Output 6.32 PROC LOGISTIC Output for Agriculture including the GENDERW variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	AGR	AGR
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	136
Number of Observations Used	134

Response Profile

Ordered Value	AGR	Total Frequency
1	1	112
2	0	22
	112	.

83.58209 .

Probability modeled is AGR='1'.

NOTE: 2 observations were deleted due to missing values for the response or explanatory variables.

NOTE: 2 response levels were deleted due to missing or invalid values for their explanatory, frequency, or weight variables.

Class Level Information

Class	Value	Design Variables
KFATH	0	1
	1	-1
GENDERW	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	121.671	80.157
SC	124.569	94.646
-2 Log L	119.671	70.157

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	49.5145	4	<.0001
Score	42.1785	4	<.0001
Wald	22.4157	4	0.0002

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	6.4607	0.0110
TACTI	1	11.2693	0.0008
KFATH	1	7.6951	0.0055
GENDERW	1	0.4000	0.5271

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-4.9516	1.3112	14.2611	0.0002
AGE		1	0.0653	0.0257	6.4607	0.0110
TACTI		1	1.0021	0.2985	11.2693	0.0008
KFATH	0	1	-1.1911	0.4294	7.6951	0.0055
GENDERW	0	1	0.2330	0.3684	0.4000	0.5271

Odds Ratio Estimates

Point 95% Wald

Effect	Estimate	Confidence Limits	
AGE	1.067	1.015	1.123
TACTI	2.724	1.517	4.890
KFATH 0 vs 1	0.092	0.017	0.497
GENDERW 0 vs 1	1.594	0.376	6.753

Association of Predicted Probabilities and Observed Responses

Percent Concordant	90.2	Somers' D	0.805
Percent Discordant	9.7	Gamma	0.806
Percent Tied	0.1	Tau-a	0.223
Pairs	2464	c	0.903

Output 6.33 PROC LOGISTIC Output for Agriculture including the GENDERM variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	AGR	AGR
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	136
Number of Observations Used	134

Response Profile

Ordered Value	AGR	Total Frequency
1	1	112
2	0	22
	112	.
	83.58209	.

Probability modeled is AGR='1'.

NOTE: 2 observations were deleted due to missing values for the response or explanatory variables.

NOTE: 2 response levels were deleted due to missing or invalid values for their explanatory, frequency, or weight variables.

Class Level Information

Class	Value	Design Variables
KFATH	0	1
	1	-1
GENDERM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	121.671	80.157
SC	124.569	94.646
-2 Log L	119.671	70.157

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	49.5145	4	<.0001
Score	42.1785	4	<.0001
Wald	22.4157	4	0.0002

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	6.4607	0.0110
TACTI	1	11.2693	0.0008
KFATH	1	7.6951	0.0055
GENDERM	1	0.4000	0.5271

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-4.9516	1.3112	14.2611	0.0002
AGE		1	0.0653	0.0257	6.4607	0.0110
TACTI		1	1.0021	0.2985	11.2693	0.0008
KFATH	0	1	-1.1911	0.4294	7.6951	0.0055
GENDERM	0	1	-0.2330	0.3684	0.4000	0.5271

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	1.067	1.015	1.123
TACTI	2.724	1.517	4.890
KFATH 0 vs 1	0.092	0.017	0.497
GENDERM 0 vs 1	0.628	0.148	2.659

Association of Predicted Probabilities and Observed Responses

Percent Concordant	90.2	Somers' D	0.805
Percent Discordant	9.7	Gamma	0.806
Percent Tied	0.1	Tau-a	0.223
Pairs	2464	c	0.903

Output 6.34 PROC LOGISTIC Output for River Fishing (BML in 134-Record Dataset)

```
                    The LOGISTIC Procedure
                       Model Information
Data Set                       WORK.INTERVIEWS
Response Variable              FSHRIV                FSHRIV
Number of Response Levels      2
Model                          binary logit
Optimization Technique         Fisher's scoring

         Number of Observations Read         136
         Number of Observations Used         111

                       Response Profile
            Ordered                         Total
              Value     FSHRIV          Frequency
                  1     1                      42
                  2     0                      69
                        48                      .
                        35.8209                 .

             Probability modeled is FSHRIV='1'.

NOTE: 25 observations were deleted due to missing values for the response or explanatory
variables.
NOTE: 2 response levels were deleted due to missing or invalid values for their
explanatory, frequency, or weight variables.

                    Class Level Information
                                        Design
             Class      Value     Variables
             HUNT       0                 1
                        1                -1
             AZO        0                 1
                        1                -1
             TTYPE1     0                 1
                        1                -1
             KTHEM      0                 1
                        1                -1

                    Model Convergence Status
         Convergence criterion (GCONV=1E-8) satisfied.
                      Model Fit Statistics
                                           Intercept
                          Intercept              and
         Criterion             Only       Covariates
         AIC                149.245          120.039
         SC                 151.954          133.586
         -2 Log L           147.245          110.039
```

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	37.2060	4	<.0001
Score	32.8640	4	<.0001
Wald	24.9532	4	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
HUNT	1	9.9490	0.0016
AZO	1	17.1082	<.0001
TTYPE1	1	4.3255	0.0375
KTHEM	1	6.3631	0.0117

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	0.4919	0.3834	1.6464	0.1994
HUNT	0	1	-1.0624	0.3368	9.9490	0.0016
AZO	0	1	-1.1298	0.2732	17.1082	<.0001
TTYPE1	0	1	-0.5773	0.2776	4.3255	0.0375
KTHEM	0	1	-0.6806	0.2698	6.3631	0.0117

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
HUNT 0 vs 1	0.119	0.032	0.447
AZO 0 vs 1	0.104	0.036	0.305
TTYPE1 0 vs 1	0.315	0.106	0.936
KTHEM 0 vs 1	0.256	0.089	0.738

Association of Predicted Probabilities and Observed Responses

Percent Concordant	77.1	Somers' D	0.632
Percent Discordant	13.9	Gamma	0.695
Percent Tied	9.0	Tau-a	0.300
Pairs	2898	c	0.816

Output 6.35 PROC LOGISTIC Output for river fishing including the GENDERW variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	FSHRIV	FSHRIV
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	136
Number of Observations Used	111

Response Profile

Ordered Value	FSHRIV	Total Frequency
1	1	42
2	0	69
	48	.
	35.8209	.

Probability modeled is FSHRIV='1'.

NOTE: 25 observations were deleted due to missing values for the response or explanatory variables.

NOTE: 2 response levels were deleted due to missing or invalid values for their explanatory, frequency, or weight variables.

Class Level Information

Class	Value	Design Variables
HUNT	0	1
	1	-1
AZO	0	1
	1	-1
TTYPE1	0	1
	1	-1
KTHEM	0	1
	1	-1
GENDERW	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	149.245	121.723
SC	151.954	137.980
-2 Log L	147.245	109.723

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	37.5217	5	<.0001
Score	32.8714	5	<.0001
Wald	24.1046	5	0.0002

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
HUNT	1	9.0596	0.0026

AZO	1	7.9555	0.0048
TTYPE1	1	4.4135	0.0357
KTHEM	1	5.9724	0.0145
GENDERW	1	0.3010	0.5833

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	0.4857	0.3833	1.6057	0.2051
HUNT	0	1	-1.0283	0.3416	9.0596	0.0026
AZO	0	1	-1.3347	0.4732	7.9555	0.0048
TTYPE1	0	1	-0.5846	0.2783	4.4135	0.0357
KTHEM	0	1	-0.6690	0.2737	5.9724	0.0145
GENDERW	0	1	0.2561	0.4669	0.3010	0.5833

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
HUNT 0 vs 1	0.128	0.034	0.488
AZO 0 vs 1	0.069	0.011	0.443
TTYPE1 0 vs 1	0.311	0.104	0.925
KTHEM 0 vs 1	0.262	0.090	0.767
GENDERW 0 vs 1	1.669	0.268	10.407

Association of Predicted Probabilities and Observed Responses

Percent Concordant	77.7	Somers' D	0.636
Percent Discordant	14.1	Gamma	0.692
Percent Tied	8.1	Tau-a	0.302
Pairs	2898	c	0.818

Output 6.36 PROC LOGISTIC Output for river fishing including the GENDERM variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	FSHRIV	FSHRIV
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	136
Number of Observations Used	111

Response Profile

Ordered Value	FSHRIV	Total Frequency
1	1	42
2	0	69
	48	.
	35.8209	.

Probability modeled is FSHRIV='1'.

NOTE: 25 observations were deleted due to missing values for the response or explanatory variables.

NOTE: 2 response levels were deleted due to missing or invalid values for their explanatory, frequency, or weight variables.

Class Level Information

Class	Value	Design Variables
HUNT	0	1
	1	-1
AZO	0	1
	1	-1
TTYPE1	0	1
	1	-1
KTHEM	0	1
	1	-1

Class Level Information

Class	Value	Design Variables
GENDERM	0	1
	1	-1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	149.245	121.723
SC	151.954	137.980
-2 Log L	147.245	109.723

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	37.5217	5	<.0001
Score	32.8714	5	<.0001
Wald	24.1046	5	0.0002

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
HUNT	1	9.0596	0.0026
AZO	1	7.9555	0.0048
TTYPE1	1	4.4135	0.0357
KTHEM	1	5.9724	0.0145
GENDERM	1	0.3010	0.5833

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	0.4857	0.3833	1.6057	0.2051
HUNT	0	1	-1.0283	0.3416	9.0596	0.0026
AZO	0	1	-1.3347	0.4732	7.9555	0.0048
TTYPE1	0	1	-0.5846	0.2783	4.4135	0.0357
KTHEM	0	1	-0.6690	0.2737	5.9724	0.0145
GENDERM	0	1	-0.2561	0.4669	0.3010	0.5833

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
HUNT 0 vs 1	0.128	0.034	0.488
AZO 0 vs 1	0.069	0.011	0.443
TTYPE1 0 vs 1	0.311	0.104	0.925
KTHEM 0 vs 1	0.262	0.090	0.767
GENDERM 0 vs 1	0.599	0.096	3.736

Association of Predicted Probabilities and Observed Responses

Percent Concordant	77.7	Somers' D	0.636
Percent Discordant	14.1	Gamma	0.692
Percent Tied	8.1	Tau-a	0.302
Pairs	2898	c	0.818

Output 6.37 PROC LOGISTIC Output for Cattle Raising (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	CATT	CATT
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	136
Number of Observations Used	111

Response Profile

Ordered Value	CATT	Total Frequency
1	1	17
2	0	94
	19	.
	14.1791	.

Probability modeled is CATT='1'.

NOTE: 25 observations were deleted due to missing values for the response or explanatory variables.

NOTE: 2 response levels were deleted due to missing or invalid values for their explanatory, frequency, or weight variables.

Class Level Information

Class	Value	Design Variables
TTYPE6	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	97.047	92.553
SC	99.757	100.682
-2 Log L	95.047	86.553

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	8.4936	2	0.0143
Score	9.1632	2	0.0102
Wald	8.0741	2	0.0176

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	3.4150	0.0646
TTYPE6	1	5.3391	0.0209

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.0169	0.9517	10.0494	0.0015
AGE		1	0.0305	0.0165	3.4150	0.0646
TTYPE6	0	1	-0.6731	0.2913	5.3391	0.0209

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	1.031	0.998	1.065
TTYPE6 0 vs 1	0.260	0.083	0.815

Association of Predicted Probabilities and Observed Responses

Percent Concordant	68.5	Somers' D	0.376
Percent Discordant	30.9	Gamma	0.378
Percent Tied	0.6	Tau-a	0.098
Pairs	1598	c	0.688

Output 6.38 PROC LOGISTIC Output for Cattle Raising including the GENDERW variable (BML in 134-Record Dataset)

```
                 The LOGISTIC Procedure
                   Model Information
Data Set                      WORK.INTERVIEWS
Response Variable             CATT                 CATT
Number of Response Levels     2
Model                         binary logit
Optimization Technique        Fisher's scoring

        Number of Observations Read         136
        Number of Observations Used         111

                    Response Profile
           Ordered                    Total
             Value     CATT       Frequency
                 1     1                 17
                 2     0                 94
                       19                 .
                       14.1791            .

           Probability modeled is CATT='1'.
```

NOTE: 25 observations were deleted due to missing values for the response or explanatory variables.

NOTE: 2 response levels were deleted due to missing or invalid values for their explanatory, frequency, or weight variables.

Class Level Information

Class	Value	Design Variables
TTYPE6	0	1
	1	-1
GENDERW	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	97.047	94.473
SC	99.757	105.312
-2 Log L	95.047	86.473

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	8.5736	3	0.0355
Score	9.2236	3	0.0265
Wald	8.1296	3	0.0434

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	3.4803	0.0621
TTYPE6	1	5.3693	0.0205
GENDERW	1	0.0800	0.7773

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.0313	0.9531	10.1153	0.0015
AGE		1	0.0309	0.0165	3.4803	0.0621
TTYPE6	0	1	-0.6754	0.2915	5.3693	0.0205
GENDERW	0	1	-0.0785	0.2775	0.0800	0.7773

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	1.031	0.998	1.065
TTYPE6 0 vs 1	0.259	0.083	0.812
GENDERW 0 vs 1	0.855	0.288	2.536

Association of Predicted Probabilities and Observed Responses

Percent Concordant	68.3	Somers' D	0.374
Percent Discordant	30.9	Gamma	0.377
Percent Tied	0.8	Tau-a	0.098
Pairs	1598	c	0.687

Output 6.39 PROC LOGISTIC Output for Cattle Raising including the GENDERM variable (BML in 134-Record Dataset)

The LOGISTIC Procedure

Model Information

Data Set	WORK.INTERVIEWS	
Response Variable	CATT	CATT
Number of Response Levels	2	
Model	binary logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	136
Number of Observations Used	111

Response Profile

Ordered Value	CATT	Total Frequency
1	1	17

2	0	94
	19	.
	14.1791	.

Probability modeled is CATT='1'.

NOTE: 25 observations were deleted due to missing values for the response or explanatory variables.

NOTE: 2 response levels were deleted due to missing or invalid values for their explanatory, frequency, or weight variables.

Class Level Information

Class	Value	Design Variables
TTYPE6	0	1
	1	-1
GENDERM	0	1
	1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	97.047	94.473
SC	99.757	105.312
-2 Log L	95.047	86.473

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	8.5736	3	0.0355
Score	9.2236	3	0.0265
Wald	8.1296	3	0.0434

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
AGE	1	3.4803	0.0621
TTYPE6	1	5.3693	0.0205
GENDERM	1	0.0800	0.7773

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.0313	0.9531	10.1153	0.0015
AGE		1	0.0309	0.0165	3.4803	0.0621
TTYPE6	0	1	-0.6754	0.2915	5.3693	0.0205
GENDERM	0	1	0.0785	0.2775	0.0800	0.7773

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
AGE	1.031	0.998	1.065
TTYPE6 0 vs 1	0.259	0.083	0.812
GENDERM 0 vs 1	1.170	0.394	3.471

Association of Predicted Probabilities and Observed Responses

Percent Concordant	68.3	Somers' D	0.374
Percent Discordant	30.9	Gamma	0.377
Percent Tied	0.8	Tau-a	0.098
Pairs	1598	c	0.687

Glossary

Land Tenure

Bought: Rights over land acquired by paying the previous owner in cash, work, or other means. Bought land is owned by agreement and may have or not a legal property title.

Donated: Rights over land entitled to a community member by a different family group than its own family group.

Inherited: Piece of land distributed by the authority of a familiar group to a family member for productive purposes.

Worked: Land on agriculture worked by a community member or a family group.

Own right: Rights over land acquired as a family member.

Remote sensing systems resolution (or resolving power) are extracted from Ji (2002 p.270-271) and Jensen (1996 p.3-7):

Radiometric resolution: refers to the ability of the remote sensor to quantify incoming radiance reflected or emitted from the target (Ji 2002). It defines the sensitivity of a detector to differences in signal strength as it records the radian flux reflected or emitted from the terrain or target of interest (Jensen 1996).

Spatial resolution: is usually expressed as the minimum distance between two objects that will allow them to be differentiated from one another in an image (Ji 2002). Another useful rule is that in order to detect a feature the spatial resolution of the sensor system should be less than half the size of the feature measured in its smallest dimension (Jensen 1996 p. 4).

Spectral resolution: refers to the number and size of the spectral regions (intervals), or bands, of the electromagnetic spectrum a sensor can utilize to observe the Earth's surface. Sensors that record energy in a few bands of the spectrum are called multispectral remote sensing systems. Sensors that record energy in hundreds of bands are called hyperspectral remote sensing systems (Ji 2002). The size of the interval or band may be large (i.e., coarse), as with panchromatic black-and-white aerial photographs (0.4 to 0.7 µm), or relatively small (i.e., fine), as with band 3 of the Landsat 5 Thematic Mapper ™ sensor system (0.63 to 0.69 µm). Certain regions or bands of the electromagnetic spectrum are optimum for obtaining information on biophysical parameters. Careful selection of the spectral bands may improve the probability that a feature will be detected or identified and biophysical information extracted (Jensen 1996).

Temporal resolution: refers to the time interval at which a remote sensor repeats data collection at the same location. Many satellite remote sensing systems pass over the same spot on the Earth at systematic time intervals that range from days to weeks depending on their orbital height and swath width. Airborne remote sensing systems, however, provide the greatest flexibility as they are not constrained to specific days, but can be ordered on demand (Ji 2002). Analysis of multi-date imagery (multi-temporal analysis) provides information on how the variables are changing through time (Jensen 1996).

Fundamental elements of image interpretation (source: Narumalani, Hlady and Jensen 2002):

Shape: From, configuration or outline of an object that allows the photointerpreter to easily identify a feature (eg. building, tree).

Size: used to identify and differentiate between objects and features (e.g. road width)

Pattern: pertains to the overall spatial arrangement of objects. The pattern of the features in the landscape can offer clues to the type of cultural or natural features (e.g. drainage patters, apartment building complexes)

Height of or elevation of objects: can be used in combination with shape. The vertical dimension can be used to differentiate or to classify vegetation types based on heir height.

Shadows: can be an aid as well as a hindrance to image interpretation. They can provide a profile view of objects, thus enabling their recognition. Shadows can also create a pseudoscopic inversion effect.

Tone or color: refers to the brightness of an object based on its reflective characteristics within the electromagnetic spectrum. Objects and features can be identified or distinguished based on tonal characteristics in a black and white photograph or image or by their color in a true color or false-color image/photograph.

Texture: is the frequency of change in tone or color (also refer to as coarseness or smoothness) on the photograph or image. Because it is produced by an aggregation of features, the texture is dependant on the scale of the photograph and the homogeneity or heterogeneity of features in the photo.

Site: relates to the geographic and topographic characteristics of the object of interest in the aerial photography or image. Knowledge about a specific location can help the analyst's decision-making process.

Association: pertains to the probable occurrence of certain features in relation to others. Identification of a feature or object would tend to confirm or deny the existence of another or allow an analyst to draw conclusions based on environmental characteristics.

Classification Systems (source: FAO UNEP Land Cover classification system LCCS 2000)

Classification: is an abstract representation of the situation in the field using well-defined diagnostic criteria: the classifiers. A classification describes the systematic framework with the names of the classes and the criteria used to distinguish them, and the relation between classes. Classification thus necessarily involves definition of class boundaries that should be clear, precise, possibly quantitative, and based upon objective criteria. A classification should therefore be: Scale independent, meaning that the classes at all levels lf the system should be applicable at any scale or level of detail; and Source independent, implying that it is independent of the means used to collect information, whether satellite imagery, aerial photography, field survey or some combination of them is used.

Hierarchical: Most classification systems are hierarchically structured because such a classification offers more consistency owing to its ability to accommodate different levels of information starting with structured broad-level classes which allow further systematic sub-division into more detailed sub-classes. At each level the defined classes are mutually exclusive. At the higher levels of the classification system few diagnostic criteria are used, whereas at the lower levels the number of diagnostic criteria increases. Criteria used at one level of the classification should not be repeated at another, i.e. lower, level.

A priori classification system: the classes are abstractions of the types actually occurring. The approach is based upon definition of classes before any data collection actually takes place. This means that all possible combinations of diagnostic criteria must be dealt with beforehand in the classification. This method is used extensively in plant taxonomy and soil classification. The main advantage is that classes are standardized independent of the area and the means used. The disadvantage, however, is that this method is rigid, as some of the field samples may not be easily assignable to one of the pre-defined classes.

A posteriori classification system: differs fundamentally from the a priori classification systems by its direct approach and its freedom from preconceived notions. The approach is based upon definition of classes after clustering similarity or dissimilarity of the field samples collected. The Braun-Blanquet method used in vegetation science is an example of such an approach. The advantage of this type of classification is its flexibility and adaptability compared to the implicit rigidity of the a priori classification. The a posteriori approach implies a minimum of generalization. This type of classification better fits the collected field observations in a specific area. At the same time, however, because an a posteriori classification depends on the specific area described and is adapted to local conditions, it is unable to define standardized classes, and the relevance of certain criteria in a certain area may be limited when used elsewhere.

Definition of Land Use and Land Cover

[Source: LandInform Ltd for Office of the Deputy Prime Minister. 2006. National Land Use Database: Land Use and Land Cove Classification Version 4.4. (NLUD -United Kingdom)

http://www.communities.gov.uk/publications/planningandbuilding/nationallanduse

Last accessed March 31, 2009]

Land Use: relates to the activity or socioeconomic function for which land is used. For practical purposes it is usual to allow land uses to be defined on, above, or below the terrestrial surface (NLUD)

Land Cover: relates to the physical nature or form of the land surface. For practical purposes it is usual to restrict definition of land cover to the terrestrial surface (NLUD)

Forests (trees and palms)

Cativo: *Prioria copaifera*

Naidí palm: *Euterpe oleracea*

Nato mangrove: *Mora megistosperma*

Red mangrove: *R. harrisonii*

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