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Vulnerable People in Fragile Lands: Migration and Desertification in the Drylands of Argentina. The case of the Department of Jáchal

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Vulnerable People in Fragile Lands:
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The case of the Department of Jáchal

by

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Dedication

For my parents, Egidio Omar Adamo and María Irma Ana Flament

For my husband, Claudio Akel Barud

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Vulnerable People in Fragile Lands:
Migration and Desertification in the Drylands of Argentina.
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Land degradation is a critical issue in arid and semiarid agricultural areas because it affects the economic basis of rural livelihoods, changing the circumstances under which decisions are made. Migration may be considered an individual or household adaptive strategy used to confront environmental problems that threat the resource production base. A consensus has yet to be reached on how environmental causes contribute to human mobility, and to what extent. Part of the problem is that different types of environmental stress may cause different types of displacements. The other part is that it is extremely difficult to isolate environmental processes from the social, economic and political processes in which they are embedded. In this dissertation, I focus on the implications of desertification –land degradation in arid lands- for human populations. The general purpose is to explore population mobility as the demographic response to the interaction between socio-

demographic and environmental dynamics, represented by vulnerability and desertification, in the drylands of Argentina, selecting the department of Jáchal in the province of San Juan as the case study. The research strategy combines different types of data (census data, remote sensing images and interviews of small farm households) and uses a conceptual framework and the socioeconomic context as a guide for the analysis, integration and articulation of the different data sources.

The main findings show that land degradation plays a limited role in population mobility, although both have co-existed in Jáchal for a long time. The diversity in strategies, the reliance of the households on non-farm jobs, the underutilization of land and the chronic problems associated with farming may also indicate that the relevance or influence of land degradation and incipient desertification in livelihood decisions would be relatively low. However, those households that are more dependent on farming/ranching, local off-farm jobs or a combination of both may be also more vulnerable to environmental factors. In this case, environmental factors could trigger population movements in two different although not mutually exclusive ways: a) by lowering labor demand in agriculture in a scenario of scarcity of local non-farm jobs, and b) by interfering with the normal development of agricultural enterprises, thereby making it unprofitable for the families involved. The structure and composition of the local labor market act as intervening factors.

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Chapter 1. Introduction

THE RESEARCH PROBLEM

This dissertation focuses on the implications of desertification for human populations. The general purpose is to explore population mobility processes, in particular out-migration, as the demographic response to the interaction between socio-demographic and environmental dynamics --represented here by vulnerability and desertification, respectively-- in the arid areas of Argentina, selecting the department of Jáchal in the province of San Juan as a case study.

I think that this research is relevant for several reasons. First, I attempt to overcome some of the research obstacles in desertification and population research, namely the fragmentation of studies among disciplines, the lack of integration of social and environmental dimensions in a single framework, and the deficiencies in basic information (Comité Ejecutivo Regional 1996). Second, The findings of my research may lead to a better understanding of how the complexity of interactions between demographic and environmental dynamics work in desertification processes.

My aim is that an improved understanding could eventually be applied in the formulation of public policies oriented toward the long-term social sustainability (including in this term the demographic, economic and environmental sides) in the drylands of Argentina. In this way, I seek to collaborate, at least minimally, with the objectives and actions of the Argentine National Action Program Against Desertification (PAN) and with the different actors in the West-Central region.

Desertification and Population Mobility

People move and migrate for many different reasons, among them to escape from inadequate or deteriorating means of subsistence (Westing 1994:110). This is often the case in drylands under desertification where agricultural activity is significant, and where out-migration and other types of spatial mobility seem to be the most visible demographic outcomes of the interaction between population and environment (International Symposium on Desertification and Migrations 1994).

Since the physical and biological environment may be considered as part of the context that shapes social phenomena (Rindfuss and Stern 1998:3), environmental change --and particularly that leading to desertification-- becomes a critical issue in arid and semiarid agricultural areas because it affects the economic basis of the population's living strategies, by changing the circumstances and structure under which decisions are made (Blaikie 1994). In that scenario, migration may be considered an individual or household adaptive strategy to face the environmental problems that threaten to erode the basis for production.

Although there is consensus that environmental causes contribute to human mobility, there is little agreement about how they contribute and to what extent. Lonergan (1998) specifies some of the issues in studying population displacement due to environmental change or degradation. Part of the problem is that different types of environmental stress may cause different types of displacements. The other part of the problem is that it is extremely difficult to isolate environmental processes from the social, economic and political processes in which they are embedded (Lonergan 1998:10). While in the case of natural disasters (for example, earthquakes) the role of environment is immediately evident, this role is less clear in the case of desertification or land degradation, a process characterized by ‘cumulative changes or slow-onset changes’. The forms of population mobility seem more voluntary in nature due to the kind of environmental change they face.

The Drylands of Argentina

Argentina may be defined as an arid country. About 70% of Argentina’s area is in arid, semiarid, or dry-subhumid lands, and about 30% of its population lived in those areas in 1991. Drylands also represent 50% of agricultural value (Dregne and Chou 1992; Murray 1999; Degne 2000; INTA/FAUBA forthcoming).[1] Only 12% of the country’s water resources are located in the drylands (PAN 1996).

This country represents an ideal field site for the study of demographic responses to environmental change. A substantial amount of the land and the population in Argentina’s drylands suffer a double process of ‘desertification’, due to land degradation, on the one hand, and on the other to deteriorating living conditions and emigration, especially in non-metropolitan areas dependent on agriculture.

Studies of desertification in Argentina took a new impulse after the organization of the PAN. In 1996, Argentina became part of the “United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa” established in 1994.[2] After that, the Secretary of Natural resources and Sustainable Development of Argentina, the national focal point for the Convention, began the elaboration of the National Action Program to Combat Desertification (PAN), in collaboration with different government and non-government organizations.

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[1] The country is included in the category 2, according to the EDI (estimated drylands index). This indicator estimates drylands area as a percentage of the total land area of a given country. For Argentina, EDI = 1,926,260 km2 / 2,737,000 km2 = 70.4%. Category 2 includes countries with EDI between 75% and 50% (República Argentina 1996; Deng 2000; Murray et al. 1999; Dregne and Chou 1992)

[2] The Convention was incorporated into the national legislation as law No.24701.

One of the first actions of the PAN was the organization of Regional Workshops in 1996. The objective of the workshops was to elaborate a national diagnosis of desertification as well as to uncover regional differences.[3] The PAN's diagnosis suggested that the general consequences of desertification processes were the decline in agriculture productivity and deteriorating living conditions for the related populations, characterized by lower average incomes and higher levels of structural poverty, if compared with national averages (Programa de Acción Nacional 1996; República Argentina 1996; Secretaría de Desarrollo Sustentable y Política Ambiental 1996). This evaluation concluded that Argentine drylands were under a process of desertification caused by the combination of natural and human causes (droughts, overexploitation of native forests, fires, overgrazing, land abandonment, rural exodus, poverty, deficient irrigation techniques, etc.), but that the characteristics of the problem varied by region.[4]

The workshops' conclusions showed a high coincidence in the evaluation with respect to socioeconomic conditions. In general, all the regions share poverty,

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[3] The implementation of the PAN strategy was based on three key elements. The first was a regional division of the Argentine drylands taking in account variations in natural conditions and jurisdiction issues, but also the homogeneity of large ecosystems (this regionalization has already undergone several revisions). The second element was the active participation of local specialists with expertise in the particular issues of each region, who act as facilitators. The third element was the definition of a flexible and dynamic participatory strategy, at different geographic levels (national, regional and local) and including different social actors in several sectors (political, institutional, scientific, etc.). This last element was put into action with the Regional Workshops (Programa de Acción Nacional 1996).

[4] In the Semiarid Pampas, for example, the main problems were wind and water erosion processes exacerbated by periodical droughts. These processes were at least in part the consequence of inadequate agricultural practices. In Patagonia, instead, it was sheep overgrazing on natural pastures that triggered desertification processes. In the areas of irrigated farming (Cuyo, High Rio Negro Valley, Patagonia Valleys), desertification was driven by salinization and waterlogging resulting from defective irrigation practices. In the Semiarid Chaco, desertification was associated with deforestation, overgrazing and the expansion of the agricultural frontier. Overgrazing was also present in the Northwest and in the Arid Valleys and Central Sierras, in this last case combined with irrigation-related issues. In Cuyo, the issues were the aforementioned salinization and waterlogging in the central oasis combined with overgrazing and deforestation in the rest of the areas.

out-migration, instable land tenure, deficiencies in productivity and marketing, and little diversity in agricultural production. However, there is also diversity in socioeconomic conditions, and differences appeared in the intensity of the problems as well in the combination of the associated factors.

Because of the importance of agriculture for dryland populations, desertification or land degradation processes are important issues in the area, where can threaten the economic basis of an important proportion of the households. Certainly, they are hardly new problems. About 31% of irrigated land was under moderate to severe desertification, but as much as 68% showed at least slight symptoms (Dregne and Chou 1992).

Research Questions

I am interested in several aspects of the multifaceted and complex relationship between desertification and migration, which may be summarized in the following questions:

- To what extent and through what mechanisms are deteriorating living-conditions for human populations, economic vulnerability and land degradation related to each other in desertification processes?
- What is the role of population mobility –out-emigration, seasonal and circular migration, return migration, etc.- in this relationship?
- What are the characteristics, including motivations, of population mobility, and what are the contribution of land degradation to out-migration as well as the mechanisms for such a contribution?
- To what extent are these outcomes related to or embedded in other social and environmental processes, like globalization, economic restructuring, agricultural change, and climatic change?

I approach these questions with a preliminary model, which may be described as follows. In a specific place and time, desertification processes interact with individuals' and households' vulnerability to risk. Because desertification is, overall, a slow-onset process, I expect that this risk means loss of livelihood and not life-threatening situations. Therefore, it is mainly a case of economic vulnerability, and the principal risk is the loss of soil productivity, which in turn could lead to the decline of income and profit.

This threat, in turn, determines or influences the adoption of particular household and individual livelihood strategies, in order to maintain the standard of living or to secure survival. One of the possible strategies is labor out-migration or spatial mobility of one or more household members. The implementation of this particular strategy depends on the household's asset ownership and composition, family structure and life cycle stage, as well as macro-social conditions that create the structure of opportunities for the use of the assets (labor markets, financial institutions, agricultural markets).

The risk of being affected by land degradation is activity-specific: people engaged in agricultural activities are more vulnerable to desertification than the rest of the population. Due to their natural climatic characteristics, drylands present limitations for agriculture activity, even irrigated farming, and these limitations also contribute to desertification. Environmental constraints are linked to restrictions in water resources –rainfall, surface and underground- and to deficiencies in soil quality.

Because the quality and quantity of water and land resources vary over space, the degree of vulnerability of particular populations is influenced by their location in relation to the natural resources, and their access to them. For those working in agriculture, access to natural resources determines the degree of vulnerability. Regarding access to water, farmers with dryland operations and ranchers are more at risk than farmers with irrigated operations. Regarding access to land, small farmers and ranchers are more at risk than large ones, and tenants more at risk than owners.

Vulnerability is related to the family life cycle because of its effect on the administration and availability of other assets. Households in the earlier and later stages of the family life cycle are more at risk than households in other stages, because of shortages in family labor. Individual demographic characteristics also influence the degree of vulnerability, and women, children and the elderly are considered to be more vulnerable than adult males. The adoption of labor migration as a strategy to increase income, diversify income sources, and diminish risk in the presence of environmental hardship or other types of stress are related to the household's ownership of assets, among them human and social capital.

The contribution of desertification to out-migration and to population mobility in general is expected to be mediated by other factors. Among them, public policies and government programs can mask and alter the relationship between vulnerability, desertification and migration.

RESEARCH STRATEGY

In order to address the research problem just stated, I intend to accomplish the following objectives:

- To identify the environmental dynamic of the area over time as well as the on-going land degradation processes.
- To uncover the migration dynamics of the population and explore the migration decision-making process including reasons to migrate.

- To describe households' livelihood strategies, including demographic profiles and their changes, and the asset portfolio.
- To distinguish situations of human vulnerability to environmental hardship

The complex nature of population-environment relationships or interactions usually requires a research strategy that combines different and sometimes eclectic types of data and methodologies (Crumley 1999; Stonich 1989).[5] This research is not an exception, as it combines secondary data (mainly census data) with remote sensing images and interviews. Because of this, integration and articulation of the results of the analysis are crucial to accomplishing the objectives, and I think that the conceptual framework plays a key role in guiding that integration. In particular, I consider that the role of households' livelihoods is important here, because their analysis brings together population mobility, perceptions of environmental hazard, and experiences of environmental hardship.

I have chosen the department of Jáchal as my case study. According to Lutz (1994:56), the use of case studies and fieldwork in population and environment interactions research allows for the preservation of complexity by narrowing the spatial scope to clearly defined boundaries, in the hope of understanding at least one of the relevant relationships among demographic and environmental processes. In a more practical sense, it also allows for the overcoming of information shortages by collecting primary information about the particular problem.

For this research, I have made extensive use of census data from the population and agricultural censuses, which provide information at the province and

[5] The availability or pertinent information and data to address population-environment studies have been pointed out as one of the problems to overcome for the development of the field (Lutz 1994).

department level, from 1869 to the present.[6] These sources provided demographic and general socio-economic information. Some comparability issues had to be addressed, for example changes in the limits of the administrative units, in the questionnaires, and in the definition of some variables. Despite these constraints, censuses are practically the only source for information about rural and non-metropolitan populations, depicting a coarse picture of their evolution and characteristics.[7]

In addition to published tabulations, I requested and obtained information at the census tract level (not available in other ways) from the National Institute of Statistics and Censuses (INDEC - Instituto National de Estadística y Censos) to complete the characterization of the department of Jáchal and reveal internal heterogeneity. Census tract level information was also provided by other agencies, for example the local office of the National Institute of Agricultural Technology (INTA, Instituto Nacional de Tecnología Agropecuaria). Unfortunately, this information was only available for the 1991 census.

Some of these census data are displayed in maps. Through the dissertation, I relied on two digital base maps. One of them, authored by INTA, covers the entire country and is defined at the department level. The other one, authored by the University of San Juan, corresponds only to the province of San Juan and its department, but allows adding census tract data. Most of the spatial data processing has been done with ArcView© GIS 3.2 and ArcMap© 8.2

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[6] The last Argentine population census was fielded in November of 2001, after I finished fieldwork, and the last agricultural census, in 2002. Due to this, the usefulness of these two sources has been limited, since only provisional results were available while I was carrying out my research.

[7] Survey data are only available for urban populations living in metropolitan areas of 100,000 inhabitants or more, or in the capitals of the provinces.

Environmental data presented a difficult challenge. For the most part it was not available at the same spatial units as population and socio-economic data (province, departments, census tracts) and for the same time span. On the contrary, usually it was limited to only one point in time. For example the detailed INTA's Soil Maps and GIS, including indicators about soil degradation and constraints, were published around 1991 and never updated.

Due to this, I explored the evolution of environmental conditions and dynamics in the department of Jáchal, Argentina, using cross-sectional remote sensing data for 1973, 1987 and 2001. The objectives were to address the kind of processes that took place, to locate them in the department and in relation to human activities, and to elaborate preliminary hypothesis about their causes. The sources were three LANDSAT summer images that agree approximately with the area of the department. Summer was selected because it is the growing season --for natural vegetation and crops--, the rainy season, and also the time of year when the Jáchal River carries more water. Because of the extreme aridity of the region, cloudiness is not an issue. The technical details of data processing and analysis (performed with ERDAS Imagine© 8.5) are presented in Appendix A.

Between August and November of 2001, I conducted a single-round demographic survey and in-depth interviews for collecting information about the socio-demographic characteristics of small farmer households in Jáchal, identifying their living household strategies and socio-demographic characteristics, including migration histories, and recording testimonies of environmental stress[8]. Small

[8] Small farmers may be defined in a variety of ways. I followed Forni and Neiman's (1994) characterization. According to these authors, small farms should not be identified only by acreage, but taking also in account other criteria such as the type of labor (they are based in (unpaid) family work and almost never hire workers) and the low production scale and technological level.

farmers' households were selected as the unit of information and analysis for two main reasons. First, migration processes have been, historically, part of these household's living strategies. Second, they are more exposed to environmental hardship because of the nature of their income source, agriculture.

In the end, 21 in-depth interviews of small farmer households were collected in three localities of the department Jáchal –Jáchal Central, Huaco and Mogna- during fieldwork in 2001. The selection of the localities was based on particular environmental conditions, looking for populations more likely to have experienced environmental hardship beyond that due to the generally arid characteristics of the department. According to the available literature at the time and interviews with key informants from the area, two of the selected areas, Mogna and Huaco, showed signs of present and past salinization and water logging, while the third, Jáchal Central, was located in the sloping and seemingly deforested margins of the major irrigated area. The rationale behind the selection of the sites was that environmental issues are highly dependent on local physical conditions and historical development.

Since the selection of households was not designed to be representative but purposive, "snowball" sampling was used to contact respondents. In Jáchal Central, the facilitators for contacting farmers' households were mostly agrarian technicians in the National Social Agrarian Program. The exception is one household that I contacted after encountering the wife in a meeting of the local neighborhood association (they were discussing hail damage that day). In Huaco, the facilitators were a team of three high school students directed by one of their teachers, who had worked on local surveys before. Finally, in Mogna, I contacted one of the local municipal representatives, who agreed to help me in contacting potential respondents, except one of the respondents, who contacted me directly in one of the visits to the village.

The unit of information was the household, with the couple (household head and spouse) as respondents. The interview guide attempted to identify the characteristics of the productive unit, the household's demographic structure and composition, the socio-demographic characteristics of the members (including the migrants), the labor force status of the members, the household's sources of income, and reports of environmental hardship. In addition to this, the interview drew an abbreviate family migration tree for each household, completing the family migratory history with information about the mobility of the couple's parents and siblings, inquiring about place of birth, past residences, current place of residence, occupation, date and age of moving, and motivations[9]. Operatively, migrants were defined as those persons moving out of the department for at least three months, reserving the term spatial mobility for movements inside the department, and commuting for daily traveling to work. The interview guide and its annexes are displayed in Appendix B.

The demographic profiles of the households in the sample were compiled from the demographic survey. It included, for each member, age, sex, relationship with the head, schooling, occupation, marital status and number of children. It also included a separate module for registering these same characteristics for temporally absent members.

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[9] This indirect technique –asking respondents about the residence of their siblings and parents- follows the same rationale as indirect approaches to estimating mortality, and is an attempt to solve some of the problems associated with studying population mobility. A clear limitation is that only those migrants with siblings still in the department were reported (Zaba 1986). Bilsborrow et al. (1984:147) also warn that retrospective information about motivations may be difficult to collect from a proxy informant. However, this technique still could provide some clue whether the move was due to economic, family or other reasons.

The interviews were stored in a text dataset and analyzed using interpretative content analysis. The conceptual framework, and the characteristics of the local setting and environmental hazard in Jáchal provided the contextual background for the interpretation. The analytical tool between the texts and the contextual framework is the coding scheme (Lindón Villoria 1999:430), which follows the thematic module scheme of the interview guide as the first level of analysis, while a second level of codification looks at variations within each thematic module[10]. This coding or code book family tree) is displayed in Appendix C. Secondary sources of information and interviews with key informants were used for validity checking and also for complementing the interpretative framework.

The couple's family migration histories provided information about 349 individuals, with various degrees of detail. Because of the number of cases, sketches of the histories were registered in a second dataset, to facilitate the handling of the migration data. This information is used for the elaboration of patterns and trends of migration over time, and for the exploration of differences in these patterns by age, sex and origin.

STRUCTURE OF THE DISSERTATION

The dissertation is structured in the following sections.

The first two chapters establish the background for situating and interpreting the results of the analysis to be presented in the rest of the chapters. While chapter 2 will outline the conceptual framework of the dissertation, the objective of chapter 3 will be to provide an introduction to the department with emphasis on its socioeconomic characteristics, but also including a brief history of its development

[10] Codification was handled with Ethnograph© v5.08

and a succinct outline of the region in which it is inserted. The diagram in figure 1.1 illustrates the main elements of the conceptual framework, which are addressed in the rest of the chapters. The overlap in the central figure is important because it indicates that the risk of being affected by land degradation is the result of the existence of the environmental hazard, but also of people vulnerable to that hazard, for different reasons.

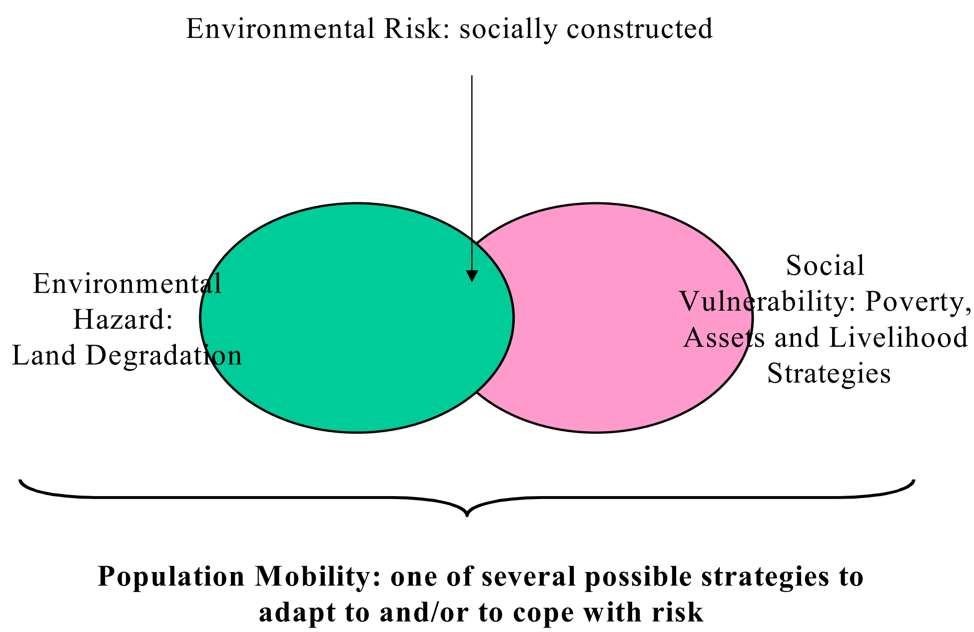
Chapter 4 focuses on population mobility processes in the department of Jáchal with the general objective of understanding the role of environmental factors in this local system. The examination of the patterns of spatial mobility in the department will provide a first insight into the embeddedness of the migration processes in a broader social context. The role of environmental factors, always entangled in a web of mediations, is likely to become more transparent in this analysis.

Chapter 5 addresses and evaluates environmental hazard in Jáchal. It summarizes the average environmental conditions and dynamics of the department to set a preliminary baseline or starting point for discussing environmental change. Next, it displays and discusses the results of the analysis of the remote sensing data in addressing environmental change and land degradation or desertification from 1973 to 2001. Finally, the chapter introduces a first insight into natural resource management and documented environmental problems in the department. As a counterpart, Chapter 6 people's experience of environmental hardship for each of the interview sites, taking into account the temporal and spatial dimensions and the mediating role of dwelling quality and services.

Chapter 7 explores households' livelihoods in order to better understand households' vulnerability to environmental risk and hardship, and population mobility as a response to those risks and hardships. It describes the socio-demographic characteristics of the households in the sample, inventories their assets or resources, and reviews their livelihood strategies.

Finally, chapter 8 presents the conclusions of the dissertation, highlighting the principal findings and offering paths to future research.

Figure 1.1: Land Degradation, Vulnerability and Population Mobility



Source: own elaboration based in Hewitt 1997, Blaikie et al. 1994.

Chapter 2. A Conceptual Framework for the Study of Environmental Fragility, Social Vulnerability and Migration in Drylands

INTRODUCTION

> The field of population and environment interactions […] is *complex* and *diverse*, capable of study at various *levels*, from the local to the global, and from various *viewpoints*: from the demographic, social and economic, the geographical, ecological and environmental…"(Zaba and Clarke 1994:36, emphasis added)

The relationships between population and environment dynamics have been studied from a number of different perspectives, which may be grouped into three basic types of approaches: linear, multiplicative, and mediated (Marquette and Bilsborrow 1997)[11]. The conceptual background of my research is framed within the mediated perspectives, more specifically in the political ecology or regional political ecology approach. These approaches emphasize three elements that I consider important for my research: socio-economic context, historical perspective, and spatial differentiation.

Mediated perspectives focus on the context in which the relationships occur, and on the mediating role of social, cultural, institutional, and political factors and relations[12]. To some extent, these perspectives are close to the theory of social

[11] Oversimplifying, linear views assume a lineal, reciprocal and direct relationship between a population and its environment. They are mainly based on the work of Malthus and Boserup, from which neoclassical and classical economics perspectives on resources and population growth were derived (Jolly 1994). Population growth is the privileged demographic variable within this perspective. Multiplicative perspectives consider that population interacts multiplicatively with other factors to impact the environment. They are basically represented by the IPAT (Impact = Population x Affluence x Technology) equation and its variations. This perspective weights the significance of population growth by levels of wealth (affluence) and technology.

[12] A more detailed description of the mediated perspectives is presented in Adamo (1997:21-27)

embeddedness Granovetter 1985), and they reminds us that population-environment relationships do not happen in a vacuum (Adamo and Guzmán 2001). The political ecology or regional political ecology approach emphasizes historical and structural factors as mediators in the relationship, incorporating the spatial and temporal dimensions of the relationship, and integrating different levels and geographic scales of analysis. (Gutmann et al. 1996; Little 1994; Schmink 1994; Blaikie and Brookfield 1987).[13]

The consideration of the context in which the relationship occurs is crucial in order to describe, analyze and understand the influence of land degradation or any other environmental process, on population mobility or other demographic processes. The context --which includes social, demographic, economic, cultural, political and environmental conditions (Rindfuss and Stern 1998)-- not only contains the relationship, outlining the limits of variation, but it also shapes it by determining the mediations between the two processes. In addition to this, contexts are specific in time and space. It is necessary to consider that in the long term population-environment relationships are recursive, in the sense that they affect each other continually and over time, and that this recursive character of the relationship makes it difficult to address the direction of causality.

Within this general macro-level framework, a person, household or community's risk of being affected by environmental hazards --in this case desertification or land degradation-- is socially constructed through the intersection or combination of two components: environmental hazard and social vulnerability

[13] Mediated perspectives have been further subdivided in different approaches that are in fact very similar between them. In addition to the political ecology approach, the 'development-dependency approach' concentrates on how development processes mediate population-environment relationships, while the 'complex system and adaptive strategy approach' adopts a systemic framework and looks at mediating factors, environment and population as a structured, complex and interrelated system (Bilsborrow and Marquette 1997).

(Blaikie et al 1994:21). To say that environmental risk is socially constructed implies that it is linked to the economic, demographic and political processes that regulate the distribution of power within a society (Blaikie et al. 1994).

Consequently, vulnerability does not exist independently of specific threat or stress, and it is important to establish clear points of reference by addressing vulnerability to specific kind of hazards, for example loss of life, loss of assets and property, or loss of livelihoods. Overall, the nature of the risk has changed over time: while vulnerability or exposure to morbidity and mortality seems to have decreased over time, economic vulnerability appears to be increasing (Cardona 2001; Downing and Bakker 2000; Kelley and Adger 2000). I assume that social vulnerability acts as the main mediating factor between environment and migration. I include here the different dimensions as well as the factors that determine the degree of vulnerability.

Because this research deals with decision-making processes, it is necessary to take in account not only structural factors but also those factors acting at the meso and micro levels of analysis, the household and the individual, which are the locus of the decision per se. In doing this, it is also necessary to specify how these different levels are articulated, including the mechanisms at play. This is the role that I am assigning to household livelihood strategies.

DESERTIFICATION: ENVIRONMENTAL HAZARD AND FRAGILITY

> Controversy has surrounded what exactly desertification is, what causes it and how it is manifested, where exactly it occurs, and how it links to natural phenomena and to social actions. (Thomas 1998)

The objective of this section is to specify the nature of the environmental hazard and its consequences for human population.

The United Nations Convention for the Combat of Desertification (CCD) defines desertification as *land degradation in drylands* due to different factors, including climatic variations and human activities (United Nations 1994:4). The term "drylands" refers to arid, semiarid and dry sub-humid ecosystems characterized by low and irregular rainfall and high evapotranspiration, and that are subject to cyclical droughts and to the consequent deficiency of moisture (UNSO 2000; Deng 2000).[14] Regarding land degradation, United Nations (1994:5) identifies it as

> [The] reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical and biological or economic properties of soil; and (iii) long-term loss of natural vegetation.

It is interesting to note that, according to this definition, an arid ecosystem could keep its biological productivity and still experience a land degradation process that affects the economic productivity and the people working the land. Also, this definition of land degradation seems to refer mostly to agricultural lands, or lands designated for land uses related to pasture or forestry. Blaikie and Brookfield (1987:7) describe land degradation as the result of an equation of forces, in reference to the complex interplay of natural and social factors that are involved in the process.

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[14] Moisture deficiency (aridity) is the most common climatic criteria used for the classification of arid lands. It involves the calculation of the ratio of precipitation to potential evapotranspiration (P/PET), also called aridity index, which should lie between 0.05 and 0.65 for an area to be considered as drylands. There are different ways of deriving this index from climatic data, but the underlying principles are basically the same (UNEP 1992:2; United Nations 1994:5; Middleton and Thomas 1997:2; UNSO 1997:5; Noin and Clarke 1998:2). Other definitions of drylands take in account only the amount of annual rainfall, and the limit between sub-humid and humid areas is set usually at 800 mm (Little 1994).

They affirm that the meaning of land degradation is always relative to its uses, which justify the inclusion of social criteria in the definition of the problem.[15]

A related issue is the question about how susceptible arid lands are to different kinds of natural and social processes, and how permanent the damage could be. Dryland ecosystems are often considered fragile lands in terms of their sensitivity and resilience to environmental stress caused by human activities, and a key element in this characterization is their slow recovery after a strong disturbance, for example a prolonged drought (Blaikie and Brookfield 1987; Kasperson et al. 1995; Warren and Agnew 1988).[16] However, a number of authors suggest that drylands are in fact quite resilient to impacts due to their own inherent tendency to instability, and that, in any case, definitions of resilience should be always related to specific land uses (Little 1994; Warren and Agnew 1988; Deng 2000). The underlying situation is that ecological dynamics of dryland ecosystems are not well known, which make it difficult --although not impossible-- to determine what states of the ecosystem should be regarded as problematic in terms of its productivity, and what should not (Thomas and Middleton 1994).

There is an on-going discussion about the causes of desertification. Although some authors affirm that human activities are the most important causes (Dregne 1986; Warren and Agnew 1988; Dregne and Chou 1992), the current dominant position in the literature is that processes leading to desertification include a

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[15] "…We could say that: Net degradation = (natural degrading processes + human interference) – (natural reproduction + restorative management)…" (Blaikie and Brookfield 1987:7).

[16] Kasperson et al (1995:10) define fragility as "…the sensitivity of a particular ecosystem to human-induced perturbations and its resilience to such perturbations…" Sensitivity refers to the degree of change of the ecosystem by the degree of human-induced stress, and resilience means the ability of the ecosystem to maintain its characteristics during perturbations, and to recover after them (Blaikie and Brookfield 1987:11). While defining land degradation as loss of resilience, Warren and Agnew (1988) suggest that drought is a frequent shock or disturbance in arid and semi-arid lands, and that, due to this, difficulties in recovering from drought use to be one of the warning signs of on-going desertification.

combination of human actions --among them deficient irrigation practices, overgrazing, wood cutting and burning, deforestation, overcultivation, and urban and industrial activities-- and natural phenomena, like local and regional climatic changes (Hulme and Kelly 1993; United Nations 1994; Thomas and Middleton 1994; Abraham 1995; Murray et al. 1999). In general, explanations of desertification in any specific place and time are complex, combining local ecological characteristics (climate, soil, water and biological resources), land use patterns and changes, land tenure and property systems, technology, population processes (growth, distribution, migration, fertility), social trends in inequality and poverty, and social institutions like land, labor and income relationships (Warren and Agnew 1988; Little 1994).[17]

Of particular interest for this research is the discussion about the consequences of desertification, which is also far from settled. For analytical purposes, consequences are generally divided into environmental and social. The environmental consequences of desertification include reduction of resilience to climatic variations, loss of topsoil and fertility due to erosion, loss of biodiversity, and local climatic changes. Indicators of ongoing desertification processes are increasing occurrence and duration of droughts, declining soil fertility, loss of soil, soil compactation and crushing, wind and water erosion, vegetation change and deterioration, and salinization of irrigated areas (Dregne 1986).

While the environmental consequences of desertification are quite well documented, its social consequences are more difficult to address due to the complexity of the interactions between natural phenomena and social processes, and to the mediations involved between them. To mention just a few, the social

[17] For example, droughts --a normal characteristic of drylands-- could increase the sensitivity of the ecosystem to particular forms of managements such as grazing, facilitating desertification (Prieto and Abraham 1996; Abraham and Prieto 1999)

consequences of desertification include aggravation of poverty, out-migration of the labor force, changes in the division of labor within households and communities, limited access to resources such as firewood and water, loss of income, and general deterioration of living conditions (UNSO 2000; Little 1994). In extreme cases, like prolonged drought, desertification could lead to absolute losses of population and acute depopulation, but this is not the norm.

The costs and consequences of natural disasters for societies and individuals are always mediated by social factors such as socioeconomic status and public policies, and desertification effects are strongly related to present and historical social conditions (Blaikie et al. 1994).[18] Desertification may affect water availability and land quality, damaging the economic basis of farmers, ranchers and peasants, reducing income and increasing risk and uncertainty. But the water and the land can be available but not accessible due to the characteristics of the agrarian structure, and unsustainable agricultural practices may result in higher profits.

One of the criteria for assessing the social impact of desertification is to look at the changes or reduction of plant yield or productivity in croplands and rangelands, which is directly associated to the aggregate economic effects of land degradation. The costs of desertification may be then measured in terms of the income foregone, which will be different for each type of land use because of variations in land and production prices for each of them (Dregne and Chou 1992). For South America as a whole, Dregne and Chou calculated that the income foregone in 1990 due to desertification-related processes was about U$S 2,690 millions (13% in irrigated land, 9% in rainfed cropland, and 77% in rangeland).

[18] "…The crucial point in understanding why disasters occur is that is not only natural events that cause them. They are also de product of the social, political and economic environment […] because the way it structures the lives of different groups of people…" (Blaikie at al. 1994:3)

VULNERABILITY, POVERTY AND ASSETS

> Vulnerability means not lack or want but *exposure and defenselessness*. (Chambers 1995:189, emphasis added)

The second component of risk is vulnerability. Because the distribution of any risk is not homogeneous among the different individuals or groups, the probability of being affected by desertification and drought is not random, meaning that there is not an equal and known probability for all the individuals or groups in a given society of suffering or being exposed to the same extent. The vulnerability to environmental hardship or risk is differential. The next question is: who is vulnerable to environmental hardship and why?

A first step in answering these questions is to understand what the term vulnerability stands for, since a number of definitions have been elaborated over the years (Longhurst 1994).[19] In general, vulnerability denotes the reduction or elimination of an individual or group's ability to respond to the external stress or threat on their livelihoods and well being that is created by the occurrence of a natural event or hazard (Cardona 2001; Kelly and Adger 2000). This approach focuses on the constraints that limit the adaptation or adjustment to the new situation. Blaikie et al. (1994:9) propose a related working definition, referring to vulnerability as those "…characteristics of a person or group [that affect] their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard…" However, given the dynamic character of vulnerability situations, it seems more appropriate to emphasize that the degree to which the personal or group

[19] I am interested here in the concept of vulnerability in social sciences. For a review of the term in natural and apply sciences, see Cardona 2001.

characteristics will affect the responses to the occurrence of natural hazards depends on the attributes of the phenomena and on the social context where it occurs.

Although vulnerability is often identified with poverty, these two terms are not synonymous. Chambers (1995:188-89) maintains that poverty refers to lack of physical requirements, assets and income. Vulnerability, on the other hand, focuses in the exposure to shocks, stress and risks, and in the lack of means to face the damage or loss. Moser (1998:3) argues that poverty is a static concept, essentially because of how it is measured, but that vulnerability is more dynamic and a better concept in measuring change.

There is a widespread belief that people living in arid lands –and particularly small farmers-- are inherently poor (Kates and Haarmann 1992), and as a result intrinsically vulnerable to all types of hazards. According to Deng (2000) economic characteristics of a 'typical' dryland area would include low levels of income, consumption, domestic savings, investments, human capital development, and of economic, social and physical infrastructure. These low levels derive from their dependency on natural resources, their demographic characteristics -high fertility rates and high illiteracy- and their social characteristics, which show high vulnerability to climatic variations and to social and political instability. The counterbalance of these negative features would be the presence of strong social cohesion and institutions, and of high levels of social capital (Deng 2000: 26-27). This view is as least a simplification of the complexity of both vulnerability situations and the relation between vulnerability and poverty.

There are empirical and conceptual reasons for the conceptual relatedness between poverty and vulnerability. Chambers (1995, 1989) considers that both terms are related because they are dimensions of a broader concept, deprivation. Kelly and

Adger (2000:330-31) argue that poverty is an indicator of vulnerability because it is directly linked to marginalisation and access to resources. According to these authors, poverty contributes to vulnerability through three mechanisms: a) the narrowing of coping and resistance strategies, b) the loss of diversification and the restriction of entitlements, and c) the lack of empowerment. Finally, Blaikie et al. (1994:9-10) state that, in general, the poor are more exposed than the rich to environmental hazard, they have fewer alternatives to living in fragile places, and the consequences are more severe and of longer duration for the poor than for the rich.

The degrees of vulnerability will vary according to the relative influence and combination of different factors.[20] These factors include demographic characteristics (age, ethnicity, gender, reproductive status, education, labor force participation and occupation), socioeconomic status and wealth, access to infrastructure and basic services, institutional characteristics, and economic and political contexts (Blaikie et al. 1994; Kasperson et al. 1995; Macías s/d; Cardona 2001). Vulnerability also presents spatial and temporal variations. In terms of spatial variations, the distribution of natural environments, housing and other elements of the social structure --like the services infrastructure-- is not uniform over the territory, while the temporal variations are related to the movement of people through different life stages, each of them with their own degree of vulnerability (Uitto 1998; Kasperson et al. 1995; Blaikie et al.1994).[21]

[20] "…The activities of daily life comprise a set of points in space and time where physical hazards, social relations and individual choice converge Patterns of vulnerability emerge at this convergence, at which several socioeconomic and personal characteristics of people have a bearing on vulnerability to disaster. Here are found sometimes (but not always) the effects of gender, age, physical disability, religion, caste or ethnicity. All of these may play a role in addition to poverty, class or major socioeconomic status…" (Blaikie et al. 1994:13)

[21] For example, Cloke and Park (1980:58) affirm that inequalities in the physical environment lead to inequalities in opportunities due to, among other things, the spatial variability of the quality and availability of natural resources.

Of particular interest here is the role of the households' socio-demographic characteristics in increasing or preventing vulnerability. Some authors have called this role 'demographic vulnerability', defining it as "…the household or domestic unit's demographic characteristics that, in a modern society, limits the accumulation of resources…" (Rodríguez Vignoli 2000:7). Analytically, these household socio-demographic characteristics may be grouped in three dimensions: a) structure, including relationship with the household head; b) the life cycle stage; and c) basic demographic conditions, including size, dependency, and composition by sex and age (Rodríguez Vignoli 2000). This point is further enlarged in chapter 7.

Moser (1998) links vulnerability to assets ownership, which she includes as part of the household's resilience or ability to cope with risk, hazard or crisis. Assets include labor, human capital, health status, housing and other productive assets like machinery, household relations, and social capital. As individuals, households and communities use assets and entitlements as means of resistance against adversity, Moser maintains that vulnerability is closely associated to asset ownership: the more assets people have, the less vulnerable they are. At the household level, responses to changes in the external environment are affected by internal life-cycle factors that influence household's structure and composition (births, marriages, deaths). There are also asymmetries in rights and obligations within the household according to gender and age, and these asymmetries will affect the ability to cope with economic difficulties. However, the capacity to reduce or avoid vulnerability also depends on the ability to manage the assets, and to transform them in food, income or other basic necessities. The management of the assets may be expressed as household strategies (Moser 1998).

Reardon and Vosti (1995) argue that the type of poverty is a key factor in understanding population-environment dynamics in rural areas. They identify several categories of poverty according to household assets[22]. The level and composition of the income produced by each of these assets determine if a household is poor or not, and the type of poverty. The authors are particularly interested in the concept of investment-poverty, a threshold they define as "…the ability to make minimum investments in resource improvements to maintain or enhance the quantity and quality of the resource base –to forestall or reverse resource degradation…" (pp.1498). Households above the threshold can invest, those below cannot. The threshold of investment-poverty is site-specific, and is determined by the local labor and non-labor input costs, and the type of investments necessary for the particular environmental problem or risk faced. Agriculture in fragile environments is risky, and households have a number of income and investment strategies to manage risk and cope with losses. Migration (long-term, seasonal, circular) may be included among the income strategies oriented to increase and diversify sources of income, through off-farm and non-agriculture work, and reduce risk (Bilsborrow 1992; Stark 1991).

Stark (1991:40) has suggested that small farm families confronted with risky situations would diversify their options by placing the most competent members in the urban sector, which is independent of agriculture. While this is still a frequent situation, rural restructuring has created non-farm alternatives in the countryside, so that 'rural' and 'farm' no longer are the same (Hart 1995), not even in developing

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[22] Households (and communities) can be poor in natural resources (land and water), human capital endowment (education, health, skills, persons in the household and the village), on-farm resources (farmland, pastures, irrigated land, livestock), off-farm resources (local labor markets, migration activity capital), and community-owned resources (roads, dams, social institutions (Reardon and Vosti 1995:1496-97)

countries. Because of this, diversification of income sources has increased to include urban, rural and in-place non-farm jobs.

MIGRATION AS A HOUSEHOLD LIVELIHOOD STRATEGY

The concept of family or household living strategies refers to the household's social ways of securing its material and biological reproduction, including in the concept economic participation and demographic behavior. The concept focuses on the domestic unit as the mediation between individual behavior and macro or structural socio-economic conditions, helping to explain different outcomes when facing a similar environment (Arguello 1981; Schmink 1984; Forni, Benencia and Neiman 1991; Hugo 1998). The starting or reference point for the development of household strategies is the aspiration of achieving and retaining a certain standard of living, which varies from society to society and over time. The achievement of that standard is generally linked to family income. For urban populations, such income is mostly derived from salaries and wages. For people engaged in agriculture, instead, income derives mainly from the productive unit, and only alternatively from off-farm sources. In both cases, available strategies are closely related to the dynamics of the labor market demand and the general opportunity structures, on one hand, and to the household structure and human capital composition, on the other (Schmink 1984; González de la Rocha 2000).[23]

Within the set of household strategies of rural households of developing countries, labor migration –seasonal, circular, or permanent- and other types of

[23] "…Opportunity structures are defined […] as probabilities of access to goods, services and to the development of activities. Opportunity structures impact household well-being since they are the framework where household members use their resources as assets or resistance means to mobilize in the face of hardship…" (González de la Rocha 2000:6)

population mobility of one or several members or of the whole household, is often considered as the demographic response to the change and deterioration of living conditions that the individual or household is dealing with (Davis 1965; Findley 1994). Faced with a context of on-going land degradation or desertification, subtle as this process could be, farm households would look for ways of reducing risk and uncertainty. The implementation of these strategies may be the response to a crisis or just an insurance against possible failure of a source of income (Massey et al. 1993; Hugo 1998; Blaikie at al. 1994; Bilsborrow 1992). The objective could be to diversify the sources of income, to reduce the number of consumers, or both (Blaikie et al. 1994; Hugo 1998; Ellis 1998; Schmink 1984)[24].

To consider migration as a rural household's livelihood strategy implies that the locus of the decision making process is not the individual but the household (Bilsborrow et al. 1984; Hugo 1998; Stark 1991; Harbison 1981). This is not to say that individuals do not play a part in the decision, but that it negotiated through the distribution of power within the family. This is why the household is considered to be the mediator or filter between the effects of desertification and the decision to leave.

Migration decision-making is also linked to individual and household demographic characteristics, and to the requirements of work in the family's productive unit. Size and composition of the household, proximity to towns and size of the farm may have a role in the decision-making process (Laurian et al. 1998). Young adults, young women, unmarried youths and those with work experience

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[24] Caldwell affirms that, during the 1970-74 drought in Africa "…both survival and better living standards have in tropical Africa long depended to a considerable degree on the possibility of migration…" (1975:27). An increase in out-migration flows is expected during droughts (Findley 1994; Caldwell 1975).

outside the origin area are more likely to migrate. People from households with lowers standard of living, less educated household heads and with previous migrants in the family are also more likely to move.

In addition to the effects of household and individual characteristics, migration and mobility in developing countries has also been shaped by macro-economic factors, like modernization of agriculture, internationalization of capital, and the spread of mass communications. Social networks appear as yet another essential part of the migration processes, linking places of origin and destination, and reducing the risks and costs of moving (Roberts 1995; Hugo 1998; Massey et al. 1993). Changes in migration and mobility patterns in developing countries include the increase of non-permanent mobility, seasonal movements, circular migration and commuting, which can last days or months, in rural and urban areas as well. There have also been changes in the composition of the migration flows. The presence of women has increased due to broader opportunities for them in the labor market, and this has opened new scenarios for the allocation of household members outside the house (Hugo 1998; Laurian et al. 1998; United Nations 1993).

DESERTIFICATION AND OUT-MIGRATION

Although there is consensus that environmental causes contribute to human mobility, there is little agreement about how they contribute and to what extent. Overall, there are two different but, in my opinion, not competing conceptual frameworks that attempt to explain the location of environmental causes in the migration decision-making process. They also seek to identify who is exposed to the risk of migrating and why, since migration is a selective process that does not affect all individuals and households equally.

In one of the frameworks, environmental factors are considered as contextual or underlying causes, under the assumption that environmental change –i.e., land degradation leading to desertification- may affect or interact with structural economic conditions, causing out-migration. From the point of view of agricultural activity, Bilsborrow (1992) identifies environmental change as a contextual variable affecting the economic, social and risk calculations of the potential migrant. These calculations then act as proximate determinants.[25] Bilsborrow distinguishes three categories of effects: a) income effects, when environmental change reduces the household or individual average income, b) risk effects, when environmental change –for example, soil erosion- increases the instability and uncertainty of income and other utilities, and/or c) social effects, when environmental change may make the environment less pleasant or healthy.

This perspective takes environmental degradation as given and consequently as part of the context, and from there it asks about how environmental factors influence population mobility. It does not inquire about the causes of environmental change, which could be or not relevant for a particular study.

The second framework considers environmental factors as proximate or direct causes of migration, stressing the relevance of particular environment-related events –for example droughts, floods, and earthquakes- as the trigger of the displacement (Suhrke 1994; Hugo 1996; Richmond 1993). Within this perspective, Suhrke (1994) presents a proposal for including environmental degradation as a

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[25] This is similar to Harbison's (1981:227) suggestion that context (or structural factors) "do not 'cause' migration", but are a re-evaluation of the components of motivation.

proximate cause of migration within the broader perspective of the development process, with the underlying factors being population pressures, patterns of natural resources use, and their interactions in fragile environments. The assumption behind this position is that the concentration of population in marginal areas like the drylands increases vulnerability to even small changes in the environment, raising at the same time the risk of displacement (Kates and Haarmann 1992; Lonergan 1998). An example of this could be drought occurrence, which is a normal feature of arid and semi-arid lands, but that could be a catastrophic event for populations living in those areas.

In this second proposal, the departure point is to question what is behind environmental change, but after it lacks a detailed account of how environmental change could affect migration decision-making. The mechanisms through which environmental change increases the risk of population displacement are missed in the second approach.

Given the complex and recursive nature of population-environment relationships, I think that it is possible to combine these approaches into a single one that could incorporate the "missing" spots of each perspective. These frameworks differ basically in where, in the recursive process, they begin the study of the relationship among environmental change and migration. Bilsborrow's (1992) typology of effects and the underlying causes of environmental degradation mentioned by Suhrke (1994) may be combined to complete the picture.

These perspectives share a main limitation, namely that environmental factors cannot be easily isolated, and that, in general, environmental degradation is just one in a cluster of causes leading to out-migration. In this scenario, the consideration of the rest of causes in the cluster, as well as the possible interactions and the context in which are embedded, is crucial.

Lonergan (1998) specifies some of the problems in studying population displacement due to environmental change. One part of the problem is that different types of environmental stress may cause different types of displacements. For example, desertification or land degradation is included among ‘cumulative changes or slow-onset changes’, and it is difficult to know what is the role of environmental change in these forms of population mobility that are more voluntary in nature due to the kind of environmental change they face. The other part of the problem is that it is extremely difficult to isolate environmental processes from the social, economic and political processes in which they are embedded (Lonergan 1998:10).

Type of Migration and Type of Migrants

The problem of identifying the type of movement is one of the major discussions in the migration and environment literature, because it implies the classification, characterization and definition of the "movers" as migrants or refugees (Swain, 1996; Hugo, 1996; Richmond, 1995; Suhrke, 1994; Jacobson, 1988). Non-forced migration flows and refugee-like situations have been linked to environmental migration. The principal characteristic of a refugee-like situation is the low level of control over the migration process, which is reflected in a high degree of vulnerability. Migrants are supposed to have a greater control over the situation, and be, in consequence, less vulnerable, although they are in fact moving in response to disagreeable conditions (Suhrke 1994).

Environmentally displaced people are characterized as moving voluntarily, looking for alternatives to bad (push) conditions at their place of origin. They have more control over timing and direction and less vulnerability than refugees have.

However, a degree of vulnerability is involved in environmental migration since it is considered a type of forced migration (Hugo 1996; Richmond 1995). One might say that there is a difference in the degree of intensity of both the hazard and the response between migrant-like situations and refugee-like situation, which are in relation with the duration of the event and the choice of the time to move. In migrant-like situations, environmental movements are similar to other migrations – particularly in cases of temporal labor migration- while it is not the case in refugee-like situations.

Suhrke (1994:6) called 'simplex displacement' the cases of "…displacement by processes such as deforestation and desertification, or by deliberate policies such as dam-building [in which] protection in the conventional sense [it is meant, according to the narrow or legal definition of refugee] is not the issue…". However, flows due to environmental causes may be different from the 'normal' flows in terms of their age and sex composition, type of movement and destination. In her research about migration and drought in the Sahel, Findley (1994) found a diversification of migration patterns during the drought period. Although the flows did not intensify, they were somewhat different in composition, with a higher number of women and children, which the author interprets as a strategy to reduce the number of consumers in the household. In addition to this, there was also a shift to circular patterns and short-cycle labor migration, and consequently, changes in destinations and in number of moves. Remittances from long-term migrants were still essential to the families, but households also put more workers in the local labor market. An interesting point is that very few respondents identified drought or famine as a reason for migration (Findley 1994:546). There was also a decline in the frequency of economic (essentially work-related) motivations in the responses, which the author assigns to the increasing number of women in the flows.

In the absence of adequate data to address the relationship between migration and desertification, the changes in the characteristic and composition of migration flows related to environmental events identified by Findley may be used as a proxy.

SUMMARY AND CONCLUSIONS

From a mediated perspective, this research focuses on people at risk of being affected by desertification in their places of origin and in out-migration as one of the responses to it. The risk is socially constructed as the intersection of vulnerability (social dynamics) and environmental hardship (environmental dynamics). Households and people engaged in agriculture in drylands are particularly vulnerable to the consequences of desertification processes, in part because to some extent vulnerability is embedded in their life style (Dow 1999). On the one hand, they are as disturbed as are the rest of the population in the area by the worsening of the everyday life conditions due to environmental hardship.[26] On the other hand, they are affected by the decline of their basic economic resources, land and water, in terms of quantity and quality.

However, to the extent that desertification is a slow-onset event, these effects are not uniform across the entire agricultural population (Blaikie et al. 1994). Some

[26] In her research about the role of rural Sahelian women in the fight against desertification, Monimart (1989a and b) describes how households' daily life has been deeply disturbed by desertification, affecting particularly women. One of the problems was the increased burden of the domestic tasks, like cooking, due to the scarcity or lack of water and wood near the village. As women are traditionally in charge of the fire and the water, they were the ones that had had to walk longer distances to gather them. Women also mentioned the out-migration of men as other significant disturbance of the family life. They linked this absence of men to marriage instability, increase of polygamy, growing family poverty, disobedient children, and to the general social destabilization in the area.

demographic groups –women, children- the elderly- may be more at risk than others groups are. Also, the degree of vulnerability will vary according to the household structure and composition, to its assets portfolio, and to the general macroeconomic and social conditions of the area. These conditions include the availability of alternative off-farm sources of income, access to government relief plans, and the characteristics of the agrarian structure. This research concentrates on voluntary migration flows, as opposed to refugee-like situations, keeping in mind that environmental-driven population movements are generally placed towards the forced end of the continuum.

Chapter 3. Introduction to the Department of Jáchal

The Department of Jáchal may be described as an example of a non-metropolitan and agricultural site in arid lands, with limited influences from larger urban centers –although not isolated from them-- an important proportion of rural population and a long history of settlement.[27]

The department is located in the north of the province of San Juan, in the west of Argentina (figure 3.1). Its area is 14,749 square kilometers (5,695 square miles), and the total population of the department in 2001 was 20,898 persons (INDEC 2002). This renders a population density of 1.42 inhabitants per square kilometer.

Jáchal's location falls within the Arid Diagonal of South America. In terms of human life and agriculture, its main ecological limiting factor is water availability to the extent that agriculture is not possible without irrigation. Precipitation is scarce and so are permanent rivers. Soil quality is not optimal, mainly due to climatic constraints.

The department has been included in the West-Central Area of the Argentine National Action Program to Combat Desertification (PAN) (1996). Originally, this region included the provinces of San Juan, Mendoza, San Luis, La Pampa, Catamarca, La Rioja and the departments of the South West of the province of Buenos Aires. Subsequently, the region was divided in two sub-regions.[28] One of them, which I will call Arid in the context of this research, includes the provinces of

[27] Administratively, Argentina is divided in provinces and these into departments, approximately equivalents to counties.
[28] Interview with Professor Stella Navone, School of Agronomy (University of Buenos Aires), expert in desertification issues.

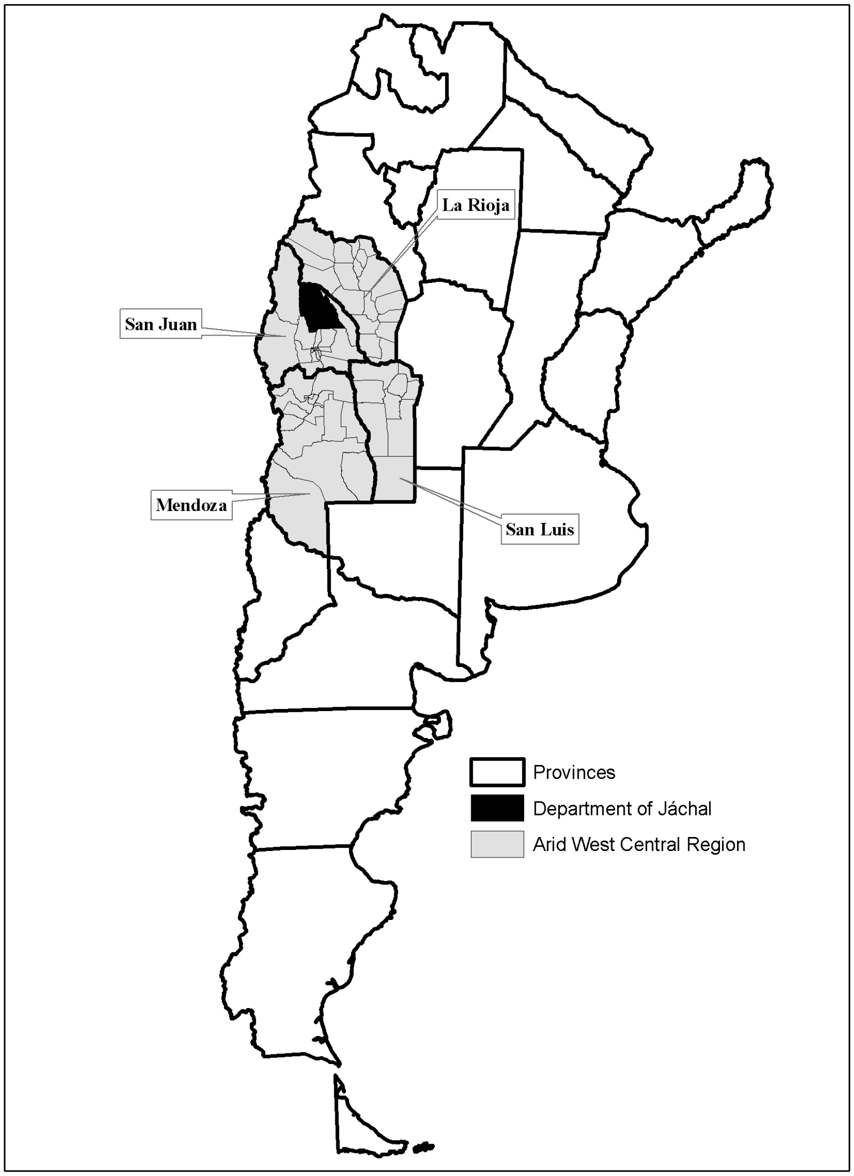
Mendoza and San Juan and the departments of the north of San Luis and of the south of La Rioja. The other sub-region, which I will call Semiarid, consists of the province of La Pampa and the departments of the south of San Luis and of the south of Buenos Aires. This new definition of the West-Central Region of the PAN leaves out the northern departments of La Rioja and the entire province of Catamarca.

Jáchal is included in the Arid West Central Region (AWCR). In contrast to the recent redefinition, I have incorporated in the regional context of Jáchal all the departments of the provinces of La Rioja and San Luis, mainly because of the historical links that exist among these areas and the department of Jáchal. For example, the area of Los Llanos in southwest La Rioja, excluded in the PAN definition, was a key component of the past livestock commercial circuits of the department of Jáchal and the province of San Juan. San Luis province has been traditionally included, with Mendoza and San Juan, in the region of Cuyo since the Spaniard Conquest. This Arid West Central Region (AWCR) is presented in figure 3.1.[29]

While subsequent chapters will address the issues of population mobility, environmental hazard, risk and hardship, and household's livelihoods, the objective of the present chapter is to provide an introduction to the department with emphasis on its socioeconomic characteristics, but also including a brief history of its development and a succinct outline of the region in which it is inserted. This introduction or background, together with the conceptual framework presented in chapter 2, will form the basis in which I situate and interpret the results of the analysis to be presented in the rest of the chapters.

[29] Defined in this way, the AWCR includes the same provinces that the Great Cuyo region of the Federal Investment Council (CFI, Consejo Federal de Inversiones).

Figure 3.1: The Arid West Central Region and the Department of Jáchal



Source: Own elaboration based in INTA/Aeroterra 1995.

A REGIONAL OUTLINE

The provinces included in the AWCR form the arid region by definition (Canziani 1997). The region occupies the central part of the Arid Diagonal that crosses Argentina from the Andes to the Atlantic Ocean. Its total area is 404,906 square kilometers (156,335 square miles), with a total population of 2.9 million in 2001. This is equivalent to 14.5% of Argentina's area and to 8% of its population.

Environmental profile

The range of aridity of the AWCR extends from semiarid on the east of San Luis (isohyet of 500 mm in figure 3.2) to arid on the west, along the Andean piedmont and foothills (isohyet of 100 mm)[30]. Dryness is more marked in the central part of the region, as can be observed by the trace of the 200 mm and 100 mm isoyets, and declines toward the east and the west. The arid characteristics of the area are reflected in the scarcity of surface water resources, and river discharges depend completely on the snowmelt from the Andes. Nevertheless, these resources have been essential for human settlement and for the development of agriculture --which is not possible without irrigation except in the east part of San Luis-- and to a lesser extent for ranching.

A recent study (Canziani 1997) confirmed the region's reliance on "alien factors" (snowmelt in the high Andes) for water provision. This study also found that the ENSO (El Niño-Southern Oscillation) phenomenon strongly affects the dynamics of snow in the Andes through drought occurrence.[31] "Drought" refers here to the

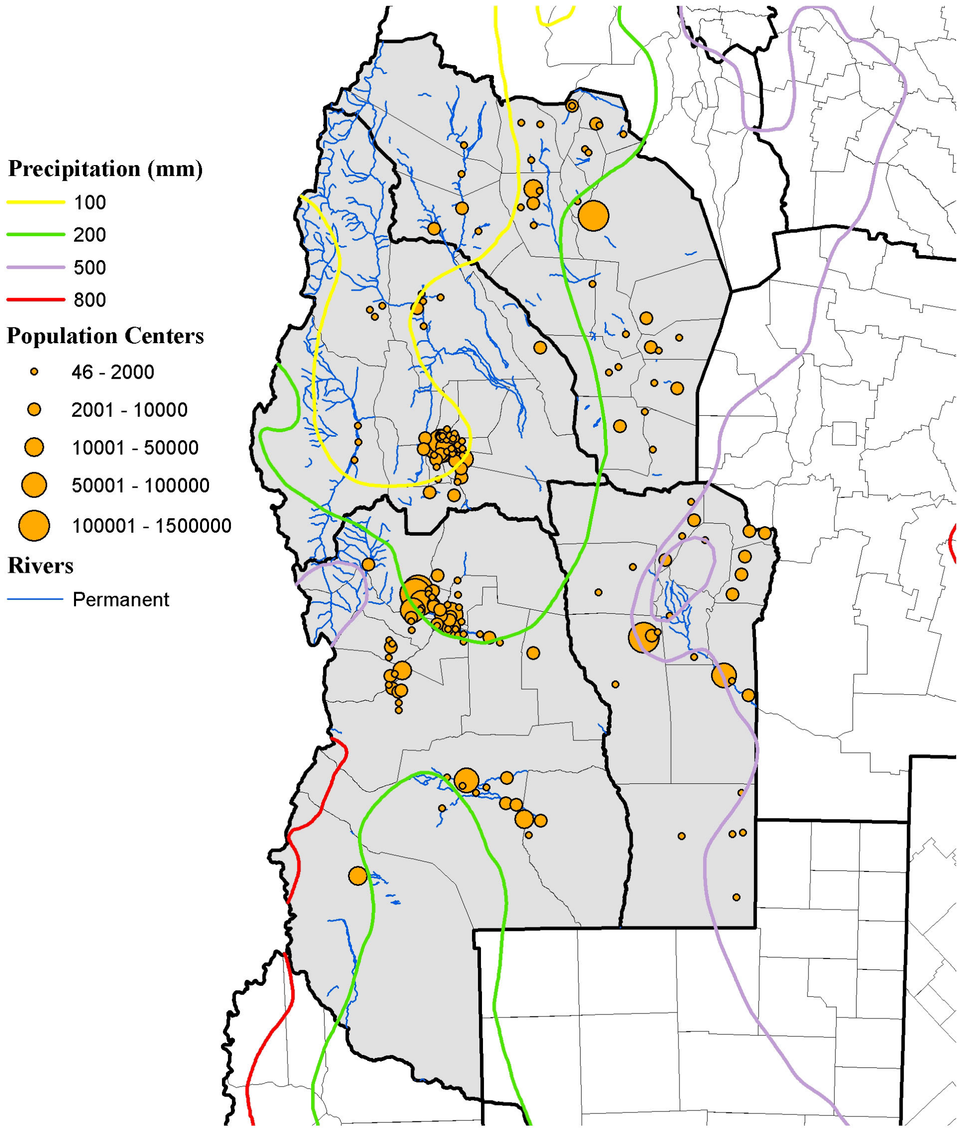
[30] "Isohyet" names a line on a map connecting places having equal annual or seasonal rainfall (Simpson and Weiner 1989)

[31] The study considered the ENSO a process different from climate change, while accepting that global warming could eventually influence the intensity and frequency of droughts although research to date has not confirmed such a possibility. In fact, Hoffmann at al. (1997), comparing the decades of

reduction of the amount of snow fallen during winter, which is directly linked to water availability in lower areas during the spring and summer. Less snow in the winter means drier conditions or even drought in the valleys and plains.

1981-90 and 1941-50 for weather stations located between the Capricorn Tropic and the Antarctica, found no significant increase in temperature in Argentina north of 50º S.

Figure 3.2: Aridity levels, surface water resources and population distribution in the AWCR provinces



Source: Own elaboration based in INTA/Aeroterra (1995)

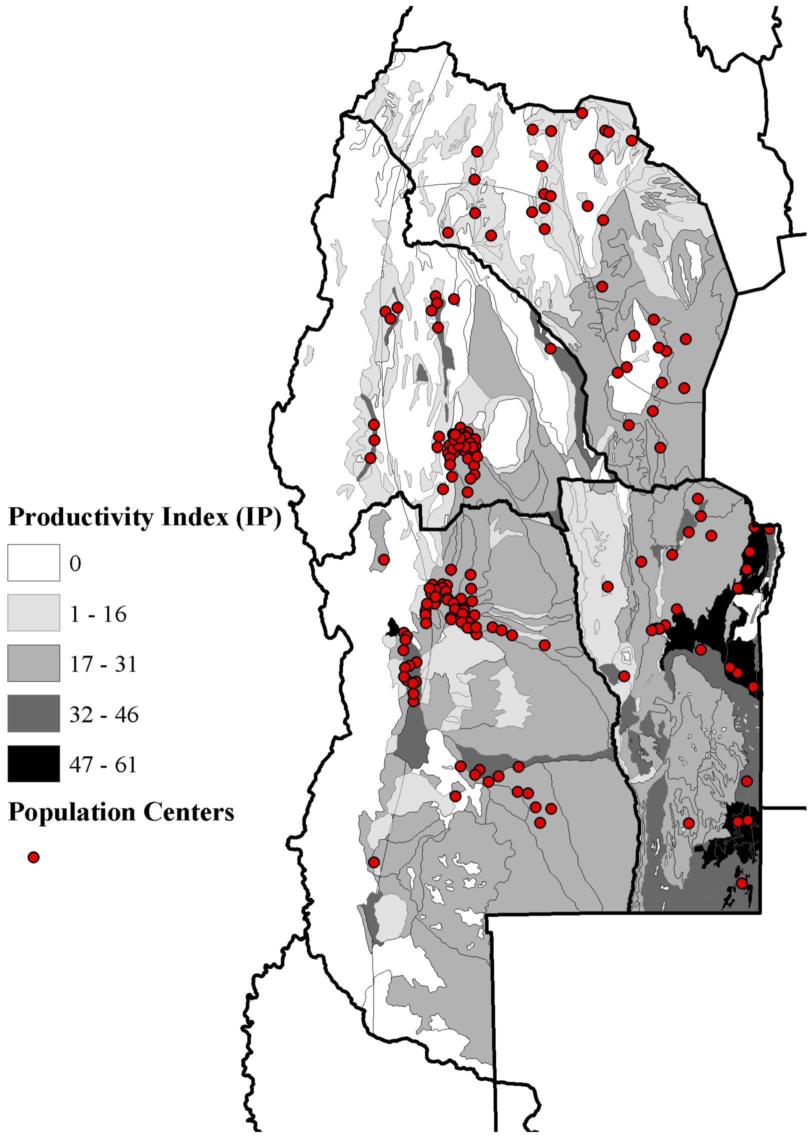
The geomorphology of the AWCR is complex, including the Andes, the Precordillera and Sierras Pampeanas (two areas of lower mountains), their foothills and piedmonts, the intermountain valleys, and the plains of the east that form the infamous *travesías*, known since the Conquest by their desolation and aridity.

Although classifications vary in the literature (Naumann 1999), the AWCR corresponds largely to the botanical province of Monte. The areas not included in that province are part of the provinces of Espinal (in the case of the southeast of San Luis) and Chaqueña (the rest of San Luis and east of La Rioja) (Movia 1986). Differences in vegetation cover, which is basically low, are determined by variation in climate characteristics --mainly precipitation- altitude, geomorphology, soil conditions and the patterns of human intervention.

In addition to aridity and the consequent scarcity of water resources, the AWCR presents other environmental constraints on agriculture. The most important are slopes, directly related to the geomorphology, and the quality of the soils (SAGyP and CFA 1995). Figure 3.3 displays the soil conditions of the region, in terms of their agricultural aptitude as measured by the productivity index, for the region[32].

[32] As a rule, the higher the index, the closer that area soil is to the optimal yield. For a detailed explanation of the productivity index, see chapter 5.

Figure 3.3: Soil Conditions in the AWCR



Source: Own elaboration based in INTA/Aeroterra 1995.

The hollow or white areas correspond to the mountains, sierras and other terrain not suited for agriculture. These areas are concentrated on the west and north of the AWCR, especially in the provinces of La Rioja and San Juan. The rest of the region presents a lower PI, below or around 30. In general, soil quality improves toward the east and southeast, where precipitation is higher and slopes moderate. It is interesting to note in the map that in some cases population concentration coincides with the best soils, but not always.

Among climate hazards, droughts are one of the major risks faced by agricultural populations, although its occurrence is not homogeneous across the region, since it is higher in the west. This is associated with evapotranspiration and water deficit, and to inter-annual variations in precipitation (Durán 1998). Vulnerability to the risk of drought may be attenuated by the presence of irrigation systems. Because of this, drought effects may be stronger in semiarid lands that lack these systems, as is the case of San Luis. The last drought registered in the study area was in 1995 (Halpert et al. 1996).

It is necessary to stress that although droughts are a common characteristic of arid climates, during their occurrence the resilience of the system declines. For example, Prieto and Abraham (1996) described the succession of dry cycles along the South American Arid Andes that caused low temperatures and humidity in the neighboring plains. According to the authors, in the south of Mendoza these events increased environmental sensitivity to overgrazing, resulting at the peak of the livestock trade cycle. The combination of these climatic events and human intervention since the Conquest could have triggered the current desertification process of the area.

Documented environmental problems in the AWCR include the degradation of natural resources (land, water and natural vegetation cover) due to land salinization, overgrazing and deforestation. Related problems are dune formation, air pollution -especially in urban areas- water availability, and erosion (Aeolian and hydrological) (Anastasi 1990; Durán 1998; Comité Ejecutivo Regional 1996; Brailovsky and Foguelman 1991; PROSA 1988). While some of the problems are recent, like air pollution in cities, others like salinization in irrigated areas and deforestation originated several decades ago. Irrigated farming in the AWCR is almost exclusively based on gravity techniques characterized by low water efficiency (Morello and Matteucci 2000). These techniques are strongly associated with salinization and waterlogging problems (Mainguet 1999).

Because the natural vegetation cover in the area is generally low and sparse, deforestation and degradation of natural vegetation has been overlooked. However, Prieto and Abraham (1999:15) found that the intense exploitation of algarrobo (Prosapis) in the eastern plains of Mendoza at the beginning of the 20th century triggered accelerated desertification processes in the area. The increase in the demand for wood and firewood resulted from population growth in the oasis, the needs of the newly initiated viticulture and wine making, and the expansion of the railroads. These elements were part of the changes associated with the substitution of livestock trade by intensive agriculture (viticulture) during the first three decades on the 20th century.

Although the geographic area of Prieto and Abraham's study is located to the east of Mendoza, their conclusions could be applied to the rest of the AWCR. In this respect, Movia (1986) has argued that overgrazing (by sheep, cattle and goats) has altered the natural vegetation cover in all the semiarid and arid mountains and plains of the Monte and Chaqueña provinces, facilitating erosion processes.

Demographic and Socioeconomic Profile

The total population of the AWCR was around 2.9 millions in 2001, representing 8% of the country's total population. Population density was 7.2 inhabitants per square kilometer in 2001, but the distribution is far from homogeneous, since population is heavily concentrated in the oasis areas and in the capital cities, as can be seen in figure 3.2. The dispersed rural population (people who are not concentrated in rural villages) is very sparse, among other things due to water scarcity[33].

The distribution of population by province and the evolution between 1970 and 2001 are displayed in table 3.1. As can be seen, about half of the population was concentrated in Mendoza each census year, with a small decline in the last decade.

Table 3.1: Evolution of total population, 1970-2001

	1970	1980	1991	2001	Annual Growth Rate (per thousands)
AWCR	1,677,056	2,040,837	2,448,383	2,855,399	17.17
La Rioja	136,237	164,217	220,729	289,820	24.35
Mendoza	973,075	1,196,228	1,412,481	1,576,585	15.57
San Juan	384,284	465,976	528,715	622,094	15.54
San Luis	183,460	214,416	286,458	366,900	22.36

Source: Census of Population 1970, 1980, 1991 and 2001

The more rapid population growth of La Rioja and San Luis --presumably related to the implementation in these provinces of the national policy of industrial

[33] Argentine rural population is divided in concentrated and disperse. The first one includes population living in villages or localities of less 2000. The second refers to population scattered in the countryside.

incentives in the 1970s-- did not substantially alter the population distribution in the AWCR. However, it points to differences in population dynamics among the provinces. The overall growth rate for the region between 1970 and 2001 was 17 per thousand, but this overall growth rate hides changes over time and by province in the rate components, the natural and migration growth rates. This information for 1970-80 and 1980-91 is displayed in table 3.2.

Table 3.2: Components of Population Growth, 1970-1980, 1980-1990 and 1990-1996 (per thousand) [34]

Province	Total Growth Rates			Natural Growth Rates			Migration Growth Rates		
	70-80	80-90	90-96	70-80	80-90	90-96	70-80	80-90	90-96
La Rioja	18.7	29.4	26.1	23.0	20.6	21.2	-4.2	8.8	5.0
Mendoza	20.7	16.9	13.9	18.7	16.7	14.8	2.0	0.2	-0.9
San Juan	19.3	13.1	9.8	22.1	18.6	17.5	-2.7	-5.5	-7.8
San Luis	15.6	28.9	26.2	17.5	15.5	17.0	-1.8	13.4	9.2
Argentina	18.0	15.8	13.3	14.9	13.8	12.2	3.1	2.0	1.1

Source: INDEC. www.indec.mecon.ar/nuevaweb/cuadros/2/idemograf_cua1-4.xls

Mendoza and San Juan follow the national declining trend in terms of total growth rates, while La Rioja and San Luis show a sharp increase in the 1980s followed by a small decline in the 1990s. These variations derive mainly from differences in the trends of the natural and migration growth rates. On one hand, natural growth rates declined in all the provinces between 1970 and 1990, but they increased slightly in La Rioja and San Luis in the 1990s. On the other hand,

[34] The source defines each of the rates as follow. A) Total growth rate: algebraic sum of the natural and migration growth rates. B) Natural growth rate: increase or decline of the population in a given period due to the balance between births and deaths. This rate does not include the effects of in- or out-migration. C) Migration growth rate: quotient between the net migration (in-migrants minus out-migrants) in a given period (usually one year) and the mid-period population. These rates do not differentiate between internal and international migrants. For Argentina, it refers to international migration.

migration growth rates show that La Rioja and especially San Luis become inmigration provinces during the 1980s and 1990s, which is probably associated with the policies of industrial promotion that favored the installation of factories in their territories and increased the demand for labor.[35] In contrast, out-migration in San Juan increased consistently over the years, while the rate in Mendoza could be classified as "indifferent".

Velázquez and Morina (1996) have suggested that changes in migration rates are related to changes in the position of the provinces in the national economy, which made them origin or destination areas for the internal migration flows. In this respect, the authors affirmed that one of the consequences of Argentina's new economic model and its differential territorial impact has been the modification of the migration flows. For example, the evolution of the per capita gross product, displayed in table 3.3, presents a close match with the evolution of the demographic indicators. As can be observed, the larger increases correspond to San Luis and La Rioja.

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[35] The main factories installed in La Rioja (ordered by production value) included integrated textile plants (spinning mills, fabric and garment), paper and cardboard plants, fur and leather processing plants, wines, chemical plants, and food processing (preserves and cans). In San Luis, the main factories included textiles, home appliances, basic chemical products, metal-mechanic industries, paper and cardboard, rubber and plastic, and leather (CFI 1999).

Table 3.3: Per Capita Gross Product Index, by province (100=national average)[36]

AWCR Province	1970	1980	1989
La Rioja	39	48	93
Mendoza	101	99	96
San Juan	52	58	70
San Luis	71	80	196

Source: Velázquez and Morina (1996:551)

The uneven effect of the changes at the national level on regions and social groups may also have provoked pushing factors --summarized in deteriorating living conditions-- in traditional and non traditional sending areas appeared more relevant than the objective conditions in receiving areas (usually large urban centers with growing unemployment rates).

The proportion of rural population in the AWCR provinces, displayed in table 3.4, shows a general decline between 1970 and 2001, following the general national trend, but the distinction between urban and rural may be blurred. Settlement patterns in arid areas with irrigated farming such as Mendoza and San Juan were characterized by a marked population concentration in the oasis (as can be observed in figure 3.2), and by a continuum between urban and rural areas. As was mentioned before, the settlement pattern in the region was determined by the location of water sources. The result is a fragmented habitat and a highly irregular population distribution, with elevated densities in the irrigated areas and in the provincial capitals, and extremely low densities in the rest of the region. As an example, the

[36] Velázquez and Morina (1996) normalized the per capita gross product, making the national average (summation of the per capita gross product of each jurisdiction divided among 24) equal to 100. For example, '39' (La Rioja in 1970) means that the per capita gross product was 61% lower than the national average.

San Juan metropolitan area concentrated 62% of the total population of that province in 1980 (Cozzani de Palmada s/d).

Table 3.4: AWCR Rural Population (%), 1970-2001

Province	1970	1980	1991	2001
La Rioja	48.5	38.3	24.3	16.7
Mendoza	34.1	31.1	22.2	21.1
San Juan	37.6	28.0	19.7	15.1
San Luis	42.9	29.9	18.9	12.8

Source: Censuses of Population, 1970, 1980, 1991 and 2001

Table 3.5 displays structural poverty levels in the AWCR region between 1980 and 2001, as measured by unfulfilled basic needs (NBI).[37] The proportion of households and population in structural poverty showed a sustained decline between these dates, and a trend toward homogenization.

Table 3.5: Poverty Levels (NBI), 1980, 1991 and 2001 (%)

Province	1980		1991		2001	
	Households	Population	Households	Population	Households	Population
La Rioja	31.6	36.6	23.6	27.0	17.4	20.4
Mendoza	20.4	24.4	15.3	17.6	13.1	15.4
San Juan	26.0	30.8	17.2	19.8	14.3	17.4
San Luis	27.7	31.9	18.7	21.5	13.0	16.5
Argentina	22.3	27.7	16.5	19.9	N/a	N/a

Source: INDEC 1984, 1994, 2003.

[37] Households with unfulfilled basic needs or NBI are those that present at least one of the following indicators of deprivation: a) crowding (more than 3 people by room); b) living in a inadequate dwelling; c) without toilet; d) children between 3 and 14 years old not attending school; e) four or more persons by each employed member that finished at least third grade in primary school (INDEC 1984)

However, levels of poverty as measured by line of poverty, based in income, showed a very different picture.[38] The figures for 1995 and 2001, displayed in table 3.6, indicate a large increase in the incidence of poverty in urban areas, which concentrates most of the population of the AWCR.

Table 3.6: Proportion of households below poverty line in metropolitan areas of the AWCR

Metropolitan Area	1995 (1)	2001 (2)
Great Mendoza	19.7	27.6
San Luis-El Chorrillo	24.1	30.9
Great San Juan	27.0	32.7
La Rioja	N/A	30.4

Source: (1) Paz and Piselli 2002; (2) INDEC 2002b.

Also, the available information shows a different picture for the rural population, as can be seen in table in table 3.7. Despite the decline between 1980 and 1991, levels of structural poverty for the rural population in 1980 and 1991 (there is not information for 2001 yet) were substantially higher than those relative to the total population presented in table 3.5. This agrees with Forni and Neiman (1994:49) when they affirm that the living conditions of rural populations portrayed by their NBI tend to be systematically worse than those of the total population.

[38] The measured of poverty using the poverty line is available only for metropolitan populations. It is derived from information of the Permanent Household Survey (EPH, Encuenta Permanente de Hogares), fielded twice a year in large cities (at least 100,000 inhabitants) and provincial capitals.

Table 3.7: Poverty levels (NBI) for rural populations (%)

Province	1980	1991
La Rioja	54.8	44.7
Mendoza	40.4	28.5
San Juan	47.8	34.1
San Luis	54.2	37.3

Source: Gatto and Quintar (1985); Murmis 2001

These higher poverty levels in rural areas are coincident with the social diagnosis of the participatory workshops (in Mendoza, San Luis and Valle Fértil) held during 1996 for the implementation of the PAN (National Plan of Action to Combat Desertification), and with other information sources. According to them, social problems in the AWCR included land distribution and tenure systems, dependence of agricultural activities, unemployment, out-migration (particularly of young adults and household heads), and poor quality of life in general (i.e., lack of adequate housing, health services, education and infrastructure), particularly in areas of low population density (Bustos Cara 1990; Brailovsky and Foguelman 1991; Comité Ejecutivo Regional 1996; Sawers 2000; INTA/FAUBA forthcoming).

In order to fully understand the placement of the AWRC within the country, it is necessary to consider that it is included among what is known in Argentina as 'regional economies'. This term refers to all those local and provincial economies that are not part of the Pampeana Region, the core or central area of the country. As a whole, these regional economies are regarded as more underdeveloped than the central region, showing at the same time more social and economic marginality (Manzanal 2000).[39]

In terms of their agricultural sector, these economies are specialized in industrial crops (sugar cane, rice, yerba mate, tea, cotton, tobacco, viticulture), fruits (pears and apples), and some vegetables (mainly peppers, tomatoes, onions and garlic). In contrast, the Pampeana area specializes in products for exportation, especially cereals (wheat and corn) and oil plants (sunflower and soy) in combination with cattle for meat and dairy.

The markets for these two areas used to be different, but there have been changes during the last decades. In general, the regional economies' production was marketed in the internal market. Because of this, their development and growth have been closely related to population growth and distribution, and to the living conditions (including salary levels) of the working population. The production of the Pampeana area –on the other hand-- was mostly for export (Rofman 1999; Mayo 1995).

Despite common features, the term "regional economies" hides profound differences among and within regions. These intra- and inter-regional differences broadened in the last decades as the result of the social and economic changes at the national and international level. In effect, since approximately the mid 1970s Argentina has experienced deep structural changes, which marked the end of the import substitution industrialization model, and the emergence and consolidation of

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[39] The topic of regional economies was developed in Argentina in 1970s as part of the discussions about regional inequalities (Alvarez et al. 2000). According to Rofman (1999:108), "…the term "regional economies" usually groups the Argentine regions located outside of the Pampa area. Because these regions are part of the global socioeconomic system, the same critical process that marks the current development of our society affects them. However, production and management processes, social structure, economic agents, links with the rest of the country and local political-administrative models of each of these regions present significant structural differences…"

the so-called neo-liberal model. This process of structural change was characterized by external openness, deregulation of markets and privatization of sectors that have been previously in the State's hands (Katz 2000:64; Rofman 1999; Spoor 2000). Industrial restructuring, concentration of property, increasing inequality and economic stagnation have been some of the consequences. Those economic activities linked to international markets or to internal sectors of high socioeconomic status experienced remarkable growth, while the sectors linked to the rest of the internal market, and particularly those specialized in salary-goods for popular consumption, lost dynamism (Aparicio et al. 2000; Manzanal 1990).

An example of this differentiation within the AWCR is the evolution of international trade by province. In Mendoza, the value of exports increased from 202 to 418 million dollars between 1988-89 and 1993-94. In San Luis and La Rioja, the increase was more modest, from 36 to 109 millions, and from 11 to 44 millions, respectively. Finally, in San Juan the increase was small, from 26 to 33 million dollars (Mayo 1995:Table 1).

Structural changes had a great impact in the agriculture performance of the regional economies, increasing heterogeneity among regions, but also between economic and social actors within each region (Aparicio et al. 1992; Rofman 1999). The general stagnation of agriculture was parallel to the increasing export trends of some crops, like tobacco, wine and sugar cane. Changes also included the increasing use of agrochemicals, machinery and technology in general, the modification of crop patterns, and the expansion of the vertical integration of agriculture and industry. In terms of the agrarian structure, there was a process of land and capital concentration, and a related reduction in the participation of small and medium farms in the sector.

The technological modernization modified labor requirements in agriculture, reducing the demand for permanent farm workers, but at the same time increasing internal differentiation in terms of qualification, as more qualified workers –for example, drivers and mechanics—were required for the new tasks (Aparicio et al. 1992). Part-time farming, pluri-activity and the combination of on-farm, off-farm and rural and urban non-farm jobs became common. In some cases, farmers abandoned farming, rented the land, and migrated to urban centers (Aparicio et al. 1992; Rofman 1999). Overall, non-family paid workers increased in all the regions between 1969 and 1988, while the numbers of farmers and unpaid family workers declined (Neiman 1996).

National policies also contributed to differentiation processes within the regional economies included the AWCR, in some cases by selectively benefiting some economic sectors and social groups and not others. For example, during the 1970s, the law of industrial incentives (promoción industrial) was implemented in the provinces of San Juan, La Rioja and San Luis. Its effects have been particularly evident in San Luis and to a lesser extent in La Rioja, while they were barely noticeably in San Juan.[40]

The tax deferments ('diferimientos impositivos') of the 1990s were a continuation of the industrial promotion of the 1970s and 1980s. One of the purposes of this policy was to encourage diversification in economic activities, including agriculture, where the main purpose was to reduce monoculture and reduce the exposure to crises of overproduction. This law is important to understanding some changes in crop patterns and land use at the department level, for example the

[40] As an example of this, the participation of "industry" in the Geographic Gross Product in 2000 was 42% in San Luis, 15% in San Juan and 17% in La Rioja.

increasing proportion of land dedicated to olives in Jáchal. The requirements of capital investment, strongly linked to accessibility of credit, have effectively limited the access and significance of this policy for small farmers, except in terms of off-farm employment and its indirect effects on the economic reactivation of selected areas (Rofman 1999). One exception to this has been the case of agrarian cooperatives (for example, FECOAGRO), which enabled some groups of farmers to participate in the program.

On the other hand, the Agrarian Social Plan (PSA, Plan Social Agropecuario) was created in 1993 with the objective of providing credit and technical support to groups of small and very small farmers. The National Secretary of Agriculture, Livestock and Fishery manages the Program through delegations in the different provinces. All these programs have been undermined in recent years by budgetary constraints at the national and provincial level.

This very brief overview of some of the significant changes of the last decades helps to understand the internal differentiation of the AWCR in agriculture performance. Heterogeneity is related to crop patterns and the place in the marketing circuits, which in turn have influenced differences in the living conditions of rural populations (Gatto and Quintar 1985:78-79).[41]

As can be seen in table 3.8, in 1980 three of the provinces –La Rioja, San Juan and Mendoza-- were specialized in industrial crops, while the main crops in San Luis were cereals and oil crops, a pattern more characteristic of the Pampeana Region.[42] This notion is reinforced by looking at the productivity level, higher in San

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[41]Although old and somewhat outdated, this research is still important for understanding the determinants of the living conditions of agrarian populations.

[42]Industrial crops include, among others, grapes, sugar cane, cotton, tobacco, yerba mate and tea, all of them typical of regional economies.

Luis than in the other provinces in the AWCR. The degree of specialization shows that monoculture (viticulture) was prevalent in Mendoza and San Juan, while La Rioja presented some diversification and San Luis was qualified as diversified. However, key issues such as the degree of control over the productive chain and how the province is inserted in it show that Mendoza had a better position at the time. It presented a major level of participation and control, and while its placement in the sector was secondary, it did better than the rest of the provinces, qualified as subordinated, marginal or dependent. At the same time, poverty levels were lower in Mendoza than in the other provinces. A preliminary conclusion from this table is that marginal participation and a subordinated position, regardless of the type of product, seem to be associated with worse living conditions (as measured by poverty levels) for rural populations.[43]

[43] Although lacking a formal definition of the terms, Gatto and Quintar (1985) considered as 'specialized' those provinces where one group of crops represented more than 55% of the value of the province's agricultural production. The 'level of participation and control' is determined by the weight of the provincial production over the total production for a particular crop. The type of insertion, which is related to the three previous indicators, refers to the degree of influence on price formation, credit markets, etc. For example, "central subordinate" means a central product but a subordinate position oin terms of control.

Table 3.8: Characteristics of Agriculture and Living Conditions of Agrarian Populations, by province

Province	Average Productivity (National Average=100)	Degree of specialization of agriculture	Type of Product	Level of participation and control	Type of Insertion in the National Economic System	Rural population (%)	Rural Poverty (%) (households)	Rural Poverty (%) (population)
La Rioja	67	Specialized, bi-product (olives and grapes)	Industrial Crops	Marginal	Subordinate and marginal	38.3	49.3	54.8
Mendoza	74	Specialized, mono-product (grapes)	Industrial Crops	Major	Secondary	31.3	35.9	40.4
San Juan	68	Specialized, mono-product (grapes)	Industrial Crops	Subordinated	Dependent and secondary	38.0	42.0	47.8
San Luis	163	Specialized with diversification (corn, sunflower and sorghum)	Cereals and oil crops	Marginal	Central and subordinate	30.0	50.3	54.2

Source: Gatto and Quintar (1985:78-79). Extract from table 17.

As in the rest of Argentina, the evolution of farming and ranching shows a reduction in the number of productive units between 1969 and 2001 (table 3.9). This decline was larger between 1988 and 2001. In San Juan, for example, the number of farms fell by almost 40%.

Table 3.9: Evolution of the number of productive units (farms and ranches) by province

Province	**1969**	**1988**	**2001***	**Change (%)**	
				69-88	**88-01**
La Rioja	10,060	7,197	7,591	-28.4	+5.5
Mendoza	33,667	35,221	24,092	+4.6	-31.6
San Juan	14,522	11,001	8,449	-24.2	-23.2
San Luis	8,406	6,962	4,234	-17.1	-39.2
AWCR	66,655	60,381	44,366	-9.4	-26.5

* Preliminary results

Source: Censuses of Agriculture 1969, 1988 and 2001.

A possible hypothesis is that the reduction in the number of farms masks fewer but larger units, but the evolution of farm acreage (displayed in table 3.10) does not support this, showing instead a mixed situation in 2001. In La Rioja, a 5% increase in the number of farms corresponds to a 24% increase in acreage, which could indicate more and larger productive units. The cases of Mendoza and San Luis seem to point to the elimination of small units, since the decline in the number of farms is higher than the reduction in the acreage. Larger productive units match with the trend toward the concentration of property and capital mentioned as characteristic of the new economic model. Finally, the case of San Juan seems to indicate the elimination of large properties, with a decline of almost 50% in acreage but ‘only’ 23% in number of productive units.

Table 3.10: Evolution of farm acreage by province (hectares)

Province	1988	2001#	Change 88-01 (%)
La Rioja	2,444,792	3,032,490	+24.0
Mendoza	5,278,442	3,880,221	-26.5
San Juan	1,204,185	608,632	-49.5
San Luis	6,053,557	5,383,253	-11.0
AWCR	14,980,976	12,904,593	+13.9

Preliminary country results, by province

Source: Census of Agriculture 1988 and 2001

There was a decline in the absolute numbers (probably linked to the reduction in farms) of people working permanently in farms, but also a redistribution in terms of category of worker, as can be seen in table 3.11. The proportion of non-family farm workers increased in three of the provinces, while it remained the same in San Juan. On the other hand, "family workers" is the category that experienced the largest decline, in absolute and relative numbers. These trends are consistent with the national trend (Neiman 1996).

Table 3.11: People working permanently in farms: changes (%) between 1969 and 1988, by province and type of worker

Province	Farmers	Paid and unpaid family workers	Permanent farm workers	Total
La Rioja	-60	-76	+61	-61
Mendoza	-55	-63	+18	-33
San Juan	-53	-68	-0.8	-43
San Luis	-45	-76	+35	-49

Source: Censuses of Agriculture 1969 and 1988

As part of the changes in the sector, pluri-occupation in off-farm and non-farm jobs, as well as part-time farming are becoming more common. The 1988 census of agriculture revealed that 67% of the farmers of the AWCR declared that they had another occupation, and 51% of them were employees (Neiman 1996).

A BRIEF HISTORY OF JÁCHAL

The territory that is today the department of Jáchal has a long history of settlement. Before the Spanish Conquest, two indigenous populations --the huarpes and the capayanes-- populated the area (Comadrán Ruiz 1962:149). These groups already practiced a rudimentary irrigated agriculture of corn, squash, beans and quinoa, using the water of the Jáchal River and other temporary and occasional streams.

The European settlement in the area began between 1736 and 1776, during the era that Comadrán Ruiz (1969) called the reorganization and settlement reinforcement period of Cuyo.[44] The new population settled in ranches and small villages, while the indigenous population was concentrated in "reducciones" or "pueblos de indios".[45] Irrigated agriculture followed settlement, and it was based on the expansion of wheat as the basic crop for subsistence and commercialization. Agriculture, ranching and commerce were complementary to mining, the principal activity of the Spanish Kingdom. As of 1735, the area of Jáchal had an estimated population of 561 people. San José de Jáchal, the only urban center, was founded in

[44] Comadrán Ruiz (1969:65) divided the history of the development of the urban centers and the population in the Cuyo region in six periods: 1) Foundational period, 1561-1595; 2) Fortification of urban centers, 1566-1595; 3) First expansion period, 1596-1660; 4) Crisis and deterioration period, 1660-1736; 5) Reorganization and settlement reinforcement period, 1736-1776; 6) Second expansion period, 1777-1810.

[45] The action of the Catholic Church was decisive in the creation of "pueblos de indios", whose main objective was to convert the native population to the Catholic faith. This was frequently the origin of the "parajes", which were areas of dispersed rural population. The villages of Mogna and Ampacama, located in the travesía on the east of the department, were at first "pueblos de indios" where the capayanes were concentrated.

1751, and the villages of Mogna and Ampacama in 1753. By 1777 the population in the area had increased to 684 (Comadrán Ruiz 1969, 1962; Torre Revello 1939).

According to Díaz and Luna (1991), Jáchal has experienced several economic cycles during its history. There was a mining period, already mentioned, which extended from the second half to the end of the 18th century. At this time, Jáchal took advantage of its location at the communications crossroad to mining centers in Perú, Bolivia and Chile. Cattle from Córdoba, La Rioja, San Luis and other departments of San Juan, with final destinations in the North of Chile, stopped and rested in the Jáchal pastures before crossing the Andes. The small town of San José de Jáchal was strategically located at the intersection of the roads leading to the north of Chile and Bolivia (the mining zones), and to the central region of the Government (Gobernación) of Buenos Aires. The declaration of Buenos Aires as the capital of the new Viceroyalty of Rio de la Plata in 1776 provoked a change in the trade routes and altered the geopolitical importance of the department location, and Jáchal underwent its "first decadence" (Davire and Malberti 1999).

Around 1820s, the importance of Jáchal increased again. The area specialized in feedlots for livestock to be marketed in the north of Chile, which triggered a large expansion of alfalfa fields. Alfalfa was an important element in the livestock-irrigated farming pattern that characterized the economy of west Argentina in the second half of the 19th century. The key factor in the emergence of this pattern was the increasing population in the north of Chile (Tarapacá and Antofagasta) due to mining activity (nitrates). This population formed a regional market for cheap food, and part of this demand was met with livestock imported from the provinces of Mendoza and San Juan in Argentina, which in turn got the livestock from the valleys in the Sierras Pampeanas (located to the east of the region). Around 1860, the gradual process of pacification in Argentine interior (the end of the civil wars), allowed more secure transportation of livestock from the Sierras Pampeanas to the grazing fields in the Andes, and from there to the North of Chile through different mountain passes (Denis 1987). With this increase in the livestock trade, alfalfa began to replace cereals, including wheat, as the main crop.

Within the context of this regional and at the same time international trade circuit, Jáchal began to specialize in livestock feedlots and livestock commerce with the north of Chile as early as the 1820s. The most evident consequence of this specialization in terms of land use was the large expansion of alfalfa fields (Davire and Malberti 1999). Around the same period, an incipient local flour industry and commerce also appeared in the department, with the expansion of wheat fields and the installation of mills. The administrative relevance of the department also increased, as a branch of the Customs Office opened in San José. The 1835 livestock treaty between the Chilean Government and the provinces of San Juan and Mendoza reinforced these trends.

The cattle period, from 1850 to the end of the 19th century, witnessed an expansion of the characteristics just mentioned. Cattle became the dominant product of Jáchal, while the main consumers were the workers of the copper mines in Chile. One again, Jáchal took advantage of its privileged position (Pannocchia 1979). It was located along the road from Los Llanos (La Rioja), the cattle production area, to the Chilean ports in the Pacific (Coquimbo and Huasco) (Moussy 1864). Even today, a number of abandoned or quasi-abandoned places in the 'travesía' mark those old cattle roads, where Mogna and Huaco were stopping points. The department had good irrigated pastures, which were more reliable than natural pastures, and the Villa de San José de Jáchal had urban services including a post office, banks, customs and other government offices. There was also financial capital in the area, derived from the prior commercial exchange with Bolivia and Chile, which was used for buying livestock and renting alfalfa fields.

The total crop acreage in 1850 was 9,807.5 hectares (24,234.8 acres). The 1859 census lacks detailed information in the 1850 census about crop patterns, but the number of mills (Jachal's mills represented 29% of all the mills in the province of San Juan) may be an indication of the importance of cereals, particularly wheat. The flour was traded in the provinces of San Luis, La Pampa, Catamarca, Tucumán and La Rioja. However, the profitability of these operations and the formation of a regional wheat market were only possible due to the area's geographic isolation from Buenos Aires (CFI/San Juan 1978).

The cattle trade began to decline around 1880, and with it also declined the importance of the extensive agriculture, especially alfalfa, that had grown up around the livestock trade.[46] At the same time, the wheat mill and flour industry and trade began to decline due to competition with other regions, as the process of national integration advanced. The final acceleration of the decline was triggered by two facts. One of them was the closing of the Chilean saltpeter mines after WWI, which eliminated the main market for the Jáchal trade. The second was the 1931 Argentine law ruling that all livestock crossing to Chile should go through the Las Cuevas Pass in the province of Mendoza. This law effectively eliminated the advantages of Jáchal's natural resources and location.

The next period was the intensive agriculture cycle, which lasts until today. It overlapped with the end of the cattle period when the railroad reached Jáchal in

[46] This date marked the beginning of the decline of the cattle trade circuit. It coincided with the beginning of the development of viticulture and the expansion of railroads (Abraham and Prieto 1999)

1931, which offered a solution to the marketing of the crops. During the 1940s the economic activity in the department changed dramatically to intensive irrigated vegetables, centered on onions and tomatoes. An indication of this change is the amount of hectares used for intensive crops, which increased from 87 has in 1947 to 2001 in 1976 (Díaz and Luna 1991). On the other hand, the flour industry disappeared almost completely.

Table 3.12 displays the evolution in the number of farms and acreage from 1850 to 1988. As can be observed, 1895 appears as the point of maximum expansion of acreage, coincident with the pattern of extensive crops and the dominance of alfalfa.

Table 3.12: Evolution in the number of farms and ranch operations in Jáchal

Census Year	Number of farms	Acreage (hectares)
1850	N/a	9,807
1895	1,217	21,264
1914	904	13,118
1937	724	10,029
1969	1,059	5,839
1988	1,174	4,883

Source: Censuses of Population and Agriculture

This economic activity created a particularly dynamic society of ranchers, farmers, ranch and farm foremen and laborers, officers, dealers and retailers, where the agricultural sector was an important source of permanent and seasonal jobs. People in farm and ranch related occupations represented 14% (2075) of the total population in 1908 (Censo de Agriculture 1908). Of these, 50% were temporary workers and 40% were farmers.

Since the 1930s, Jáchal remained marginalized from the new main commercial routes, and economic stagnation set in the department. The new regional economy was based on the viticulture of the oasis of San Juan and Mendoza (Balán 1978), which developed as a result of the investment of the financial capital accumulated during the trade period, the emerging internal market of Argentina, and the expansion of communications, especially the railroad.

Although it was the second oasis of the province of San Juan, Jáchal was never part of this picture.[47] In fact, since the 1930s the department of Jáchal underwent a period of deep change. From an economy based on wheat, irrigated pastures, livestock feedlots and export to Chile, the department shifted to an economy heavily dependent on horticulture, notably onion, tomato and garlic, marked with serious marketing problems and competition with other productive regions.

Around the 1940s, the shift to intensive crops was evident. In the 1937 census of agriculture, alfalfa acreage amounted to 3,727 hectares, 69% less than in 1895, while the number of farms diminished to 724 (table 3.12). This decline in crop acreage responded to a number of factors, among them the loss of dynamism in agriculture and the consequent new advance of ranching (for local consumption this time), the transition from extensive to intensive crops and, to a lesser extend, the increase in soil deterioration due to salinization.[48] The problems related to marketing of onions were already evident (Allub and Guzmán 2000). In contrast, wheat acreage

[47] For example, vineyard acreage reached 48432 hectares in 1908 in San Juan, with yields of 6520 kilograms per hectare. The acreage in Jáchal for the same date was only 313 hectares, representing 0.6%, and yields were substantially lower, just 4464 kilograms per hectare (República Argentina 1909). Also, while the railroad reached the city of San Juan in 1885, it arrived in Jáchal in 1931.

[48] Salinization of soils in the department is closely related to water availability, meaning that if there is enough water to wash the salt from the soils the problem is under control. The increase in salinization problems may be related to the 1945-1948 drought that struck the department. This topic will be further developed in Chapter 5.

in 1937 (4,090 hectares) showed a slight increase in comparison to 1895 (3,770 hectares). It is probable that it was used as forage. During the 1950s and 1960s, alfalfa continued to decline in acreage, while horticulture increased.

In sum, Jáchal showed an early integration into the world economy that was beneficial and positive before the 1940s since the department had a liaison position. However, after the 1940s it turned to having a terminal and very weak position. It is possible to interpret this as different types of dependence. During the 19th century, it was dependent upon regional, national and international commercial circuits and trends, from a position of relative strength based on the advantages of its location within the prevalent commercial circuits. In the second period, the advantages of the position were gone, and Jáchal was now embedded in a different commercial circuit where it occupied a marginal position.

The decisive change from extensive pasture to intensive gardens during the 1940s was contemporary with other series of events in the department of Jáchal, among them the extension of public and social services and infrastructure, which immediately resulted in the increase of public employment in provincial and national offices. In 1947 a branch of the Banco de San Juan opened in Jáchal. The expansion of educational and health services during the 1940s and the 1950s included boarding schools in rural areas for the sparse population, and sanitary posts in isolated villages (Davire and Malberti 1999).

JÁCHAL TODAY

Today, Jáchal is characterized as an economically depressed area. The primary sector is still dominant, based on irrigated agriculture under a structural crisis of onion monoculture. In addition to onions, the crop pattern includes tomatoes, other vegetables, forage, cereals, alfalfa, olives, quince, and wheat and corn in the subsistence part (chacra). Natural hazards make agriculture highly risky: from 8000 hectares in 1965-1966, the department fell to 3000 in 1967-1971, due to a prolonged drought that struck in the second half of the 1960s.

Crop costs are very high, which limits profitability since price formation is not local. In addition to this, credit is absent, closely related to the problems with farm ownership. Marketing means the subordination of small farmers to larger farmers and to other commercialization agents. On top of all this, there is competition with other production areas, like Buenos Aires and Santiago del Estero (Allub and Guzmán 2000; Casas 2001). The main reason for the contemporary low proportion of land under cultivation is that agriculture is not a viable, reliable and profitable economic activity in the department, although productivity has increased and costs have lowered over the years.[49]

Regardless of the decadence of the sector and the increasing monoculture problem, agriculture has continued to be significant in terms of employment and livelihoods in general, if not in terms of profit, although this significance has declined over time. Around 20% (3675 people) of the 1970 total population worked on a farm. One third of them were farmers and another third were unpaid family workers. In 1988, when the last available agricultural census was fielded, only 12% (2465) of the total population worked on a farm or ranch: 43% of them were farmers, and another 45% were family workers, similar to the 1908 proportion (INDEC n/d, 1990).

In addition to agriculture, other employment sectors are government (at the municipal, provincial and national levels), and commerce, particularly retail. There

[49] Interview with A. Estevez, 2001.

was a heavy reliance on public employment. The main public employers in 2001 were the different branches of the municipal government, the education and health provincial systems and the Department of Water Resources (DH, Dirección de Hidraúlica). There was also the local office of the National Institute of Agricultural Technology (INTA), but it had only two or three employees. Public jobs are full or part time, temporary or permanent, and present a wide range of qualifications, from professional to unskilled. One detail to consider is that most of the public offices operate from 7:00 am to 1:00 or 2:00 pm, leaving enough time for moonlighting in other occupations.

Schools, hospitals and other infrastructure services depend on the national and provincial government. Also, social programs for small farmers and other relief programs are organized by the national government, though its provincial or local branches, as is the case of the National Institute of Agricultural Technology, or the Social Agrarian Program.

In sum, as a key informant put it, "the main production in Jáchal are onions, but the main income source is government employment".[50] On the positive side, this may have improved the living standards of the population, at least those living in or near the urban centers and the villages. On the negative side, the increasing importance of public employment as an income source could have exacerbated the effect of the recent changes in the role of the State (from omnipresent to absent). Resentment was expressed in terms of feelings of abandonment and unequal treatment. (Allub and Guzmán 2000). The protests and suspicions about the distribution of temporary jobs in the public sector (pasantías), which is currently

[50] Alfredo Estévez, director of the office of INTA (National Institute of Agriculture Technology) in Jáchal, personal communication, 2001.

suspended, clearly illustrate this. This reliance on public employment reached a limit during the 2001-2002 crises in Argentina, when the provincial and municipal government suspended the payment of public employees' wages.

A note about irrigation institutions is in order here. Since 1858, when the first Irrigation Law was passed in San Juan, irrigation institutions have had a great influence in Jáchal. These institutions are the Juntas de Irrigation (local) and the powerful Departamento de Hidraúlica (Department of Water Resources). This last office not only controls water capture, transportation and distribution, but also provides an important number of jobs related to the management of water and the conservation of the infrastructure. Irrigation institutions have been at odds with the municipal government and other governmental offices since their foundation (Davire and Malberti 1999; Adamo 1991).

In July 2000, the overall unemployment rate for the department was 24% --18% in urban areas and 30% in rural areas-- while underemployment reached 39% (Casas 2001).[51] These numbers seem to contradict the assumption that unemployment in rural areas is very low because people migrate to urban areas looking for jobs.

Structural poverty in the department, as measured by NBI, declined over the years. It reached 33% of the population in 1980, 20% in 1991 and 18.3% in 2001 (INDEC 1984; CEPA 1994; INDEC 2003). This decline was more abrupt in rural areas, where the incidence of poverty went from 45% in 1980 to 19% in 1991, very similar to the 1991 urban figure of 22%.

[51] In considering these figures, it is necessary to take in account the typical seasonality of farm work. The 2000 survey was filed in July, the moment of the year when labor demand in agriculture (in and out of the department) is lower.

Taking into account the indicators of NBI in 1991, 26% of household heads had no education or incomplete primary school at the time[52], about 53% of the population lived in inadequate dwellings (in terms of the characteristics of the roofs, floors or walls), and 43% did have bathroom a toilet inside the house. All these indicators were higher for rural areas, where the lack of safe drinking water and access to other services were also common.

The incidence of poverty in 2000, as measured by the poverty line, was much higher. 67% of the households fell below the level, composed of 35% under the poverty line and 32% under the indigence line.[53] The groups considered most at risk of poverty include households with female heads, the elderly without pensions, unemployed youth and large households with male heads with low educational level (Casas 2001).

The distribution between urban and rural settings showed that indigence was concentrated in rural areas, with 72% of all the indigent households. According to Casas (2001), this concentration of the "poorest of the poor" was due to several factors: a) unemployment, underemployment and seasonal employment were more prevalent in rural areas; b) workers in rural areas had lower salaries and income in general; c) the proportion of female and male heads of household with low or very low education, and low incomes was higher; d) the proportion of larger than average households in the first phases of the family life cycle was higher; and e) the qualification of the labor force was generally low.

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[52] Education levels were within normal levels in 2002. In fact, Jáchal is regarded as having a good education system and infrastructure. The main problems were high primary school dropout and low secondary school continuation (Casas 2001).

[53] Casas (2001) calculated the poverty line at $500.00, and the indigence line at $220.00.

Casas went further, suggesting that the particular characteristics of the local agrarian structure also played a role in this higher incidence of poverty in rural areas. Very small farmers and small farmers (below 2.5 hectares), owners or renters, were the dominant group. The poverty levels of this group did not differ significantly from those of farm workers, traditionally considered the most disadvantaged[54]. Despite this somber picture, livelihood strategies in rural areas were found to be more diversified than urban ones. They include farming, subsistence crops, temporary jobs (in and out of the department), bartering (trueque), craftsmanship (artesanías), retirement funds, and remittances from migrant household members (Casas 2001).

Given the importance of agriculture in the history of the department, it seems logical that its social structure is linked to the agrarian structure. The agrarian structure shows elevated land concentration (Torrontegui 1969; Panocchia 1979; Allub and Guzmán 2000). In 1988, 50% of the farmers owned less than 10% of the land. A substantial proportion of small and very small family farms characterizes the agrarian structure, and land subdivision is higher in the irrigated areas (Pannocchia 1979; Allub and Guzmán 2000). Small farms (up to 5 hectares) represented 45 % of all farms in 1988, and those up to 1 hectare made up 13% (INDEC 1990). Although 77% of the productive units were owned in 1988, an important number of farmers do not really owned the land but were heirs with rights to it. Because of the consequent problems with land titles, the small size of landholdings and the absent owners, rent

[54] Rural poverty is considered a complex issue distinctive from urban poverty. In their study about rural poverty in Argentina, Forni and Neiman (1994) suggested that the determinants of poverty among rural populations included environmental constraints (climate, soils, water, etc.), structural constraints (survival strategies, agrarian structure, etc.), and labor constraints (including seasonality of labor as well as seasonal movements). The combination of constraints originates three types of situations: a) structural poverty or poverty due to restrictions in productive resources, b) cyclical poverty or poverty due to precarious or informal jobs, and c) residual poverty or poverty associated to geographical and social isolation or marginality. Reactive, adaptive or coping behaviors of the rural poor include, among others, subsistence cropping for domestic consumption, seasonal work with or without displacement, and economic networks with family members no longer in the household.

and sharecropping are common, resulting in an important number of tenants. Current rent costs are 25% of the production value.

In general, small and very small farmers regard their own labor force as their main resource, among other things because their resource endowment is scarce, and their technological level is low due to the lack of capital and the low profitability of the farm. Probably as a consequence of this, the subsistence component has persisted as a complement of households' livelihoods even though agriculture in Jáchal has always been market-oriented.

As was mentioned before, marketing problems permeate agricultural activity. On the one hand, there is little or no processing of production in the area. For example, the provincial law 22,973 approved the regime of industrial promotions or incentives in San Juan in the early 1980s. Under this regime, the cooperative ClanCay re-opened in Jáchal in 1986, dedicated to tomato processing. Its personnel amounted to 21 permanent workers and 189 temporary workers. The cooperative was the continuation of Clancay SRL, inaugurated in 1946 with 300 jobs (Davire and Malberti1999). However, when I began to work in the area at the beginning of the 1990s, the cooperative was already closed. Tomato acreage declined after that (figure 3.5).

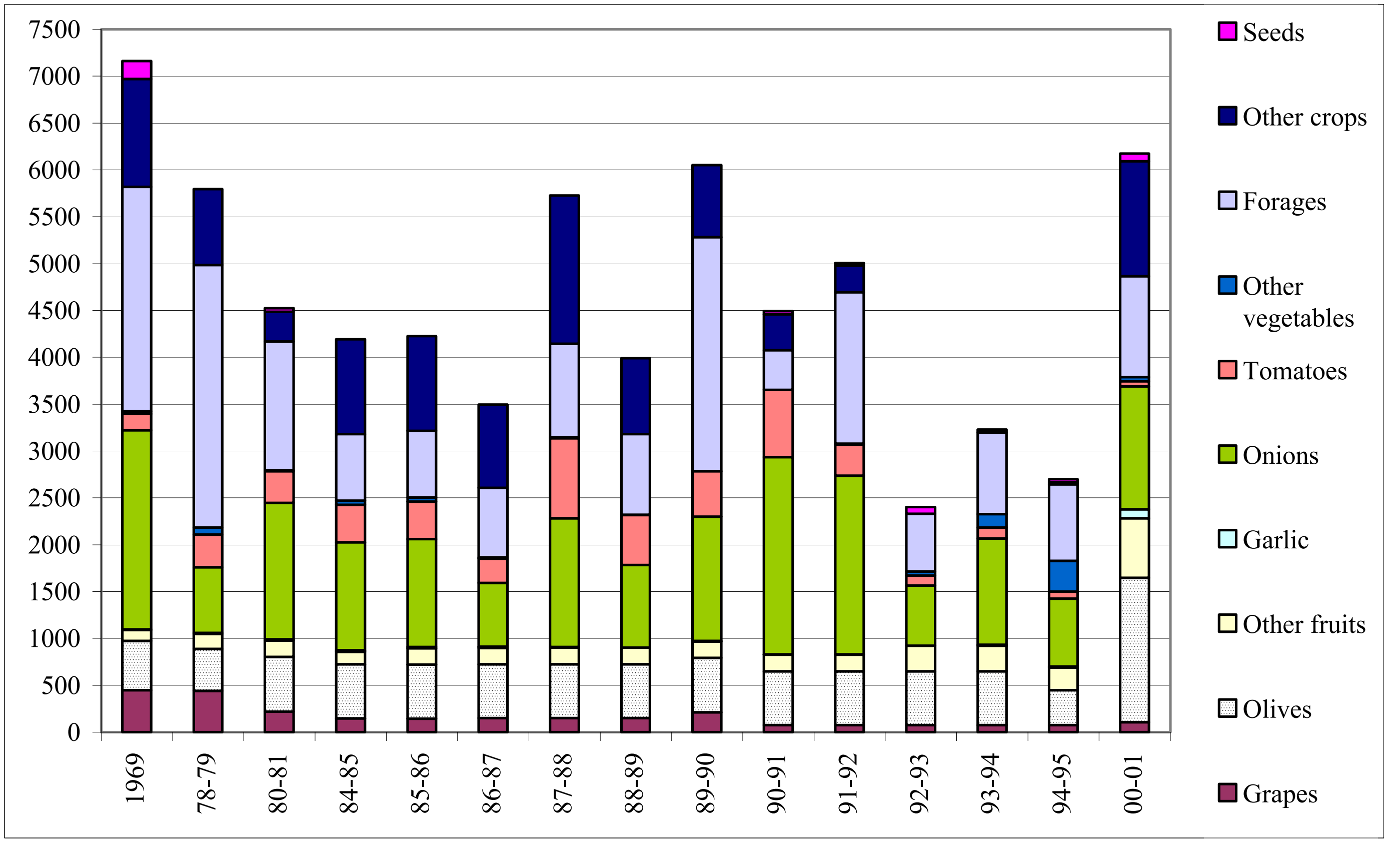
In addition to the land tenure issues that negatively affect access to credit, and the small size of most of the holdings, small onion farmers have been highly vulnerable to market fluctuations, due to their weak place in the marketing chain. This is reflected in the prices. For example, in 1996/98 the price of export was \$4.9 for a sack of 20 kilograms, but farmers got less than \$2.00 (Giacinti et al. 2001).

The vulnerability of small farmers and ranchers created a clear division between them and the larger farmers and ranchers, who are often also dealers and retailers dominating the local commercial scene (in this sense, not so much has changed since the 19th century society). As small farmers also work on the larger farms, there is a perception of social distance between small and large farmers, who often function both as farm workers (peones) and employers (patrones) (Allub and Guzmán 2000; Casas 2001).

Onions are still the main commercial crop. The department has comparative advantages and some limitations. These advantages include an early harvest, availability of land and water, lower incidence of fungus (fusario) than in other productive areas, a tradition of horticulture, and lower production costs ($1.8 against $2.00 in other zones in 2001), Disadvantages included soil salinization, excessive humidity during the harvest, and the problems with irrigation infrastructure and water distribution (Giacinti et al. 2001). There are also cyclical crisis of overproduction, and farmers operate in mostly informal markets due to production volume and their marginal location with respect to the principal consumer centers.

Total acreage between 1969 and 2001, displayed in figure 3.4, illustrates eloquently the instability of agriculture in Jáchal.

Figure 3.4: Distribution of total acreage by crop, 1969-2001

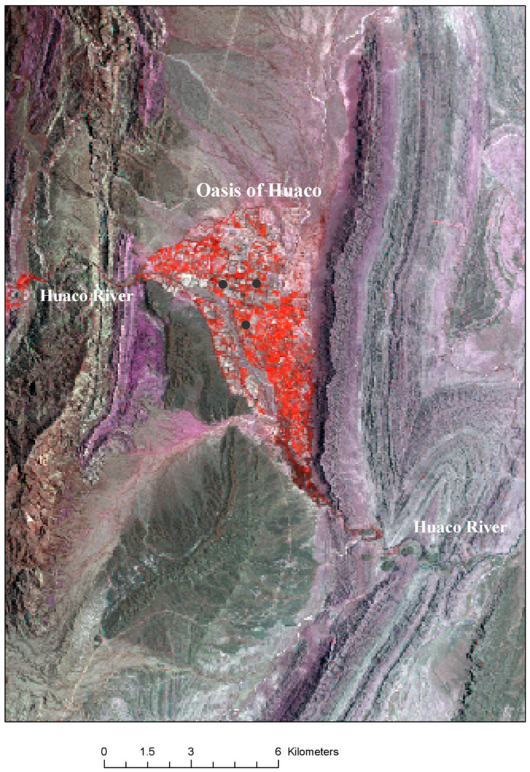


Source: San Juan. Instituto de Economía Agropecuaria e Industrial n/d; Departamento de Hidraúlica 2000.

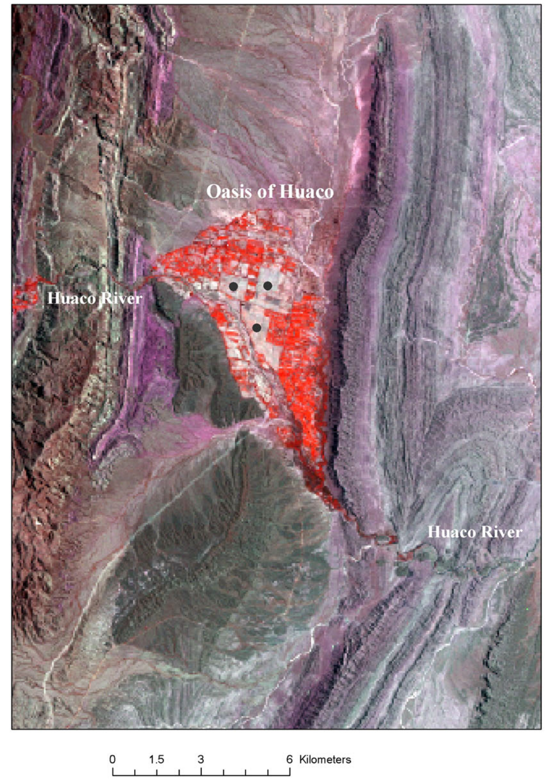
Being an annual crop and following market oscillations, onion acreage fluctuates widely from one season to the next, as can be seen in figure 3.4. This affects the entire economy of the department due to the links between this crop and the farm labor market. Forage (alfalfa and cereals such as barley and oats), also annual crops, present wide inter-annual variations in acreage too, following cattle prices. The reduction of tomato acreage after 1991 was already mentioned. The very small increase of seeds in 2001 is interesting, because it points to a diversification of markets, as well as the higher acreage destined for other crops, among them aromatics.

Another remarkable change visible in figure 3.4 for 2001 is the increase in olive acreage, a perennial crop. During the 1990s, the law 22,973 was the umbrella for the implementation of a regime of tax deferments in the province. The declared objective of these tax incentives was to diversify economic activity, especially agriculture. In Jáchal, the approved projects (called diferimientos) focused mostly on olives, and a large amount of land changed from annual to perennial crops. An outstanding example was Huaco, where about 50% of the farmers sold their land to just two diferimientos (allegedly of the same owner). The new large properties are clearly visible in the 2001 remote sensing image, displaying a sharp contrast with the 1987 one, as can be seen in figure 3.5.

Figure 3.5: "Diferimientos" in Huaco



1987



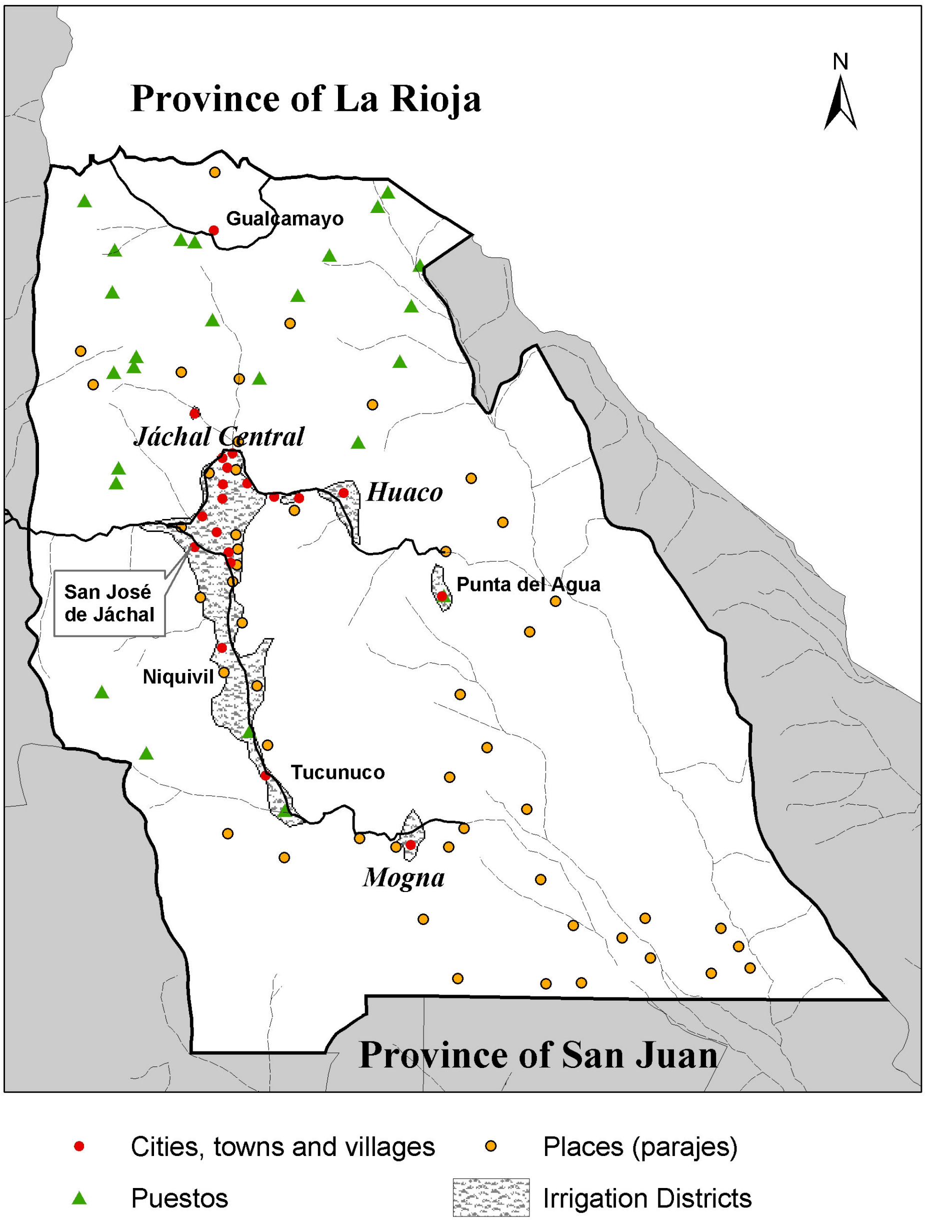
2001

Source: Landsat TM images, January, 1987 and 2001

The proportion of rural population in 2001 was still 48%, much higher than the national proportion (11%). In fact, the rural population showed a small increased in absolute numbers (2%) between 1980 and 1991, after a decline of 14% between 1970 and 1980. However, it declined again during the 1990s (INDEC 1997, 2002).

The only urban center, San José de Jáchal, founded in 1751, was a small city of 10,901 inhabitants in 2001 (INDEC 2002). The rest of the population was distributed in small rural towns and villages in the main and secondary irrigation areas. Very few people live in the countryside, along the main roads and in the "puestos" areas, temporary settlements in the mountain's natural pastures. The location of the population centers, puestos and places (parajes) is displayed in figure 3.6. Since the Spanish Conquest, the pattern of distribution has privileged the occupation of irrigated valleys following the drainage system, showing the capital importance of water availability (Allub and Guzmán 2000; Casas 2001).

Figure 3.6: Department of Jáchal

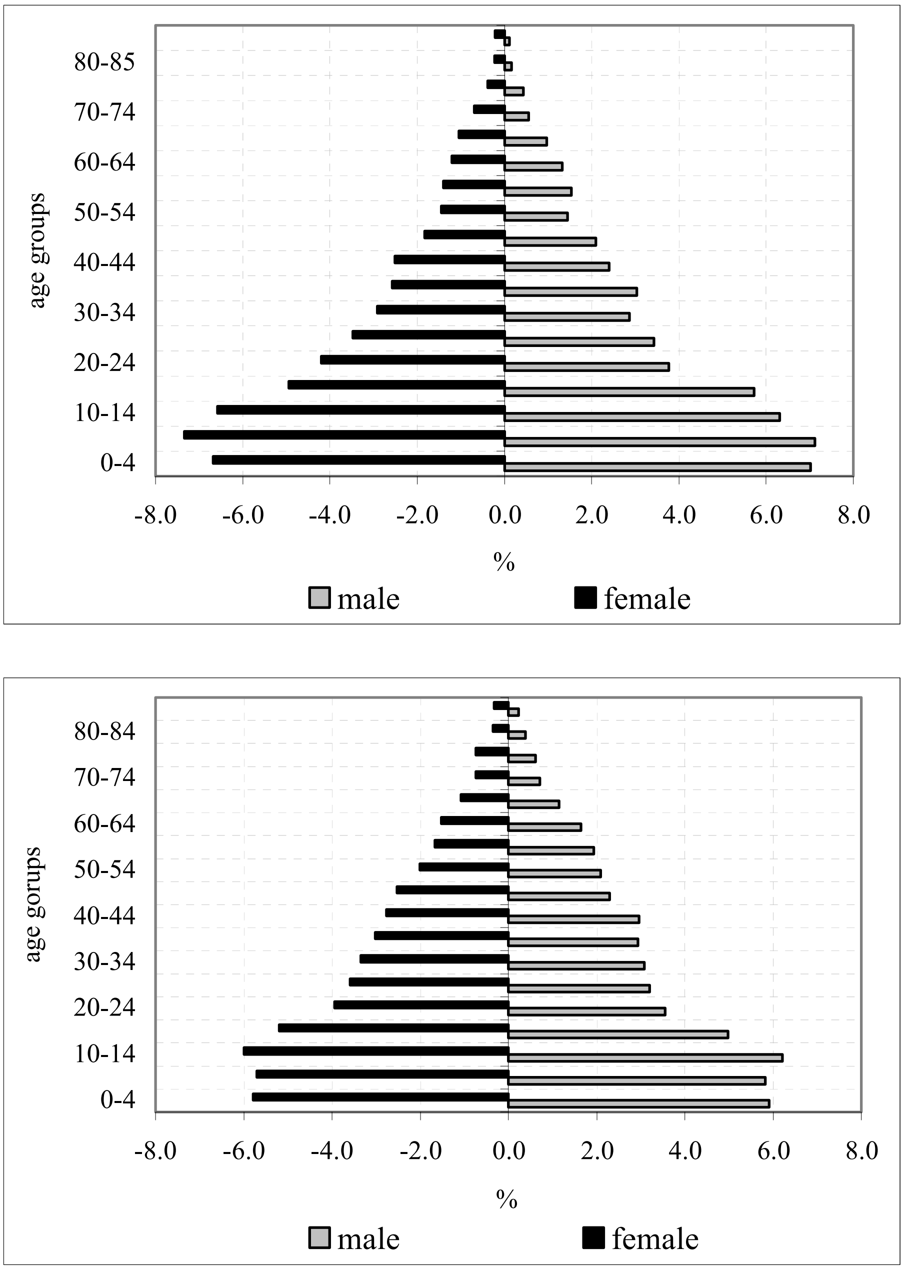


Source: Own elaboration based in Lizana 2001.

In terms of population, in 1991 the crude birth rate was 28.2 per thousand, while the crude mortality rate reached 6.1 per thousand and the infant mortality rate, 30.1 per thousand. There were a total of 4,225 households, with an average size of 4.7 members. The predominant household structure was nuclear (58.4% of the households), followed by extended (31.2% of the households). The proportion of households with a female head was 19%, with a higher proportion of extended households (45.5%).

The sex and age structure of Jáchal's population has changed in recent decades, as can be observed in figure 3.8. While in 1970 the shape of the pyramid corresponded to a rather young population with a high birth rate (wide base, narrow peak), in 1991 the pyramid base narrowed and its middle part widened, indications of a structure in transition. The proportion of children under age 15 decreased from 41.1% in 1970 to 35.4% in 1991, while the proportion of people age 60 and older increased but without reaching aging levels yet (from 7.3 in 1970 to 9.5 in 1991). Since fertility rates at the department level are not available, it is only possible to speculate about the processes behind the decline in the proportion of children. It may be due to women having fewer children (fertility decline), fewer women having the same number of children (out-migration effect), or a mix of both.

Figure 3.8: Age and sex structure, 1970 and 1991



Source: Censuses of Population, 1970 and 1991

The effect of out-migration on the age structure appears clearly as a deep indentation for both sexes and between ages 15 and 25. However, while in 1970 this effect appeared earlier for women that for men, in 1991 this difference had disappeared. Out-migration, particularly of young adults, has been signaled as part of the demographic dynamics of the area since the 19th century, and Allub and Guzmán (2000) have suggested that it is a normal part of small farmers' household strategies, useful either for diversifying sources of income or for diminishing the number of consumers, and sometimes for both.

Internal mobility within the department proceeds from the rural villages to the urban center, San José de Jáchal. Commuting between San José and neighboring rural areas becomes more common as the trend of separating place of work (the farm) and place of residence (San José) increases with the growing number of tenants (Allub and Guzmán 2000; Pannocchia 1979).

The 1988 agriculture census included information about the age and sex composition of people living and working permanently on farms, and about their relationship with the farmer.[55] As could be expected, given the prevalence of small and family farms, most of the people living and working on farms are either the farmer or their relatives (92% and 88% respectively). The proportions of children and of the elderly (33% and 8% respectively) were very close to those of the total population of the department. Women made up 48% of the people living on farms, lower than the department proportion of 51%.

[55] The 1988 Census of Agriculture did not include information about temporary workers.

Table 3.13: People living on farms, by age, sex and relationship with the farmer, 1988

Age and Sex Composition	Total	Farmer/Rancher	Relative	Non relative
Total	5006	840	3752	414
Up to 14 years old	1653		1474	179
Male	846		756	90
Female	807		718	89
15 to 59 years old	2965	663	2091	211
Male	1558	600	835	123
Female	1407	63	1256	88
60 years and older	388	177	187	24
Male	211	148	49	14
Female	177	29	138	10

Source: 1988 Census of Agriculture, unpublished data.

The distribution by age and sex was different for people working on the farms. Predictably, children made up a very small part of it, just 5%, although the participation of the elderly increased to 10%. Women represented only 16% of those working permanently on farms, concentrated in the active ages, 15 to 59 years old. However, this low percentage could be due to the "invisibility" of female work in agriculture, since most of it is related to the subsistence sector and not to commercial agriculture (Wainerman and Moreno 1987). Although the proportion of non-relatives increased from 8 to 12%, farming still appeared as an essentially family enterprise.

Table 3.14: People working permanently on farms and ranches, by age, sex and relationship with the farmer, 1988

Age and Sex Composition	Total	Farmer/ Rancher	Relative	Non relative
Total	2203	974	969	256
Up to 14 years old	106		97	9
Male	73		70	3
Female	33		27	6
15 to 59 years old	1876	801	834	238
Male	1580	754	607	218
Female	296	47	227	20
60 years and older	221	173	38	9
Male	189	153	27	8
Female	32	20	11	1

Source: INDEC. Censo Agropecuario Nacional 1988. Unpublished data

The evolution of people working on farms follows the national and regional trends, as can be observed in table 3.15. There is general decline of about 20% in the absolute numbers, which is concentrated among farmers and family workers. In contrast, non-family permanent workers increased by 15% between 1969 and 1988. In terms of relative significance, people working on farms amounted to around 15% of the 1970 population, but just 11% of the 1991 population, keeping the national trend of declining participation in agriculture.

Table 3.15: People working permanently on farms, Jáchal, 1969 and 1988

Category	1969	1988	Difference (%)
Farmer	1238	974	-21%
Paid and unpaid family worker	1287	969	-25%
Permanent worker	223	256	+15%
Total	2748	2203	-20%

Source: Census of Agriculture 1969 and 1988

THE INTERVIEW SITES

The inclusion of Jáchal within the PAN regionalization was problematic because of its mixed character. In my opinion, the department represents the intersection of the West Central Region and the Arid Valley Region. In a graphical way, the northwest (the Arid Valleys) extends south on the east of the department, while Cuyo (the West Central) extends north on the center and west. The result has been an array of different styles of life, from commercial irrigated farming to quasi subsistence goat ranching, which are not mutually exclusive.

The selection of the three interview sites, Jáchal Central, Huaco and Mogna, whose location is presented in figure 3.6, was guided by the objective of covering as much diversity as possible, in environmental as well as in demographic and socio-economic terms[56]. They share the general characteristics of the department, although their placement in the productive structure is different. In this respect, Jáchal Central is closer to commercial irrigated farming, while Mogna may be a good representative

[56] A more detailed account of the fieldwork in Jáchal is presented in Annex B.

of goat ranching. Huaco is somewhere on the margins of Jáchal, and at the same time it shares some of the characteristics of Mogna.

The interview sites are located in three different oases, covering in this way the spectrum of settled places of the department. In terms of census units, Jáchal Central corresponds to census tract 1, Huaco to census tract 7, and Mogna to census tract 6. Census tract 1 is the area of concentration of rural villages (32% of the population distributed in five villages lived there in 1991) and of agriculture activity (including almost 50% of the farms and about 35% of the irrigable acreage). It is also the closest to the urban center, San José de Jáchal. However, the interviews were fielded in the north, northeast and east edges of this area, where the advantages of the "central" position seems to be reduced. In particular, the limiting factors and hazards derived from geomorphology (slopes) increases.

The only village in census tract 7 is Huaco.[57] Located on the road to La Rioja, the oasis comprised 6% of the population in 1991, and also 6% of the farms in 1988. During the 1960s, Huaco experienced very intense out-migration, coupled with acute environmental problems derived from the construction of the Cauquenes Dam.

Finally, people in census tract 6 lived basically in the village of Mogna in 1991. They represented only 2% of the population. According to key informants (documentation about Mogna is scarcer than about the other areas of the department), few people farmed there by 2001, and most of the population lived from three basis income sources: goat manure, seasonal migration to San Juan, and revenues from the Santa Barbara Festivities.[58] In addition to being regarded as one of

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[57] Punta del Agua was the other irrigated village in the area, but it was almost depopulated by 1991.
[58] Interview with Liliana Ovalle of the Municipal Delegation of Jáchal in Mogna.

the poorest and more isolated places in the department, the area has been under a process of waterlogging for the last ten years.

The selection of the interview sites also responded to reasons of accessibility. Although not without difficulties, especially in the case of Mogna, the three places are located on acceptable roads. The driving distance from San José de Jáchal (assuming good weather) was 30 minutes to Jáchal Central, one hour to Huaco, and 2.5 hours to Mogna.

I did not try to be inconspicuous, since such thing was impossible in a place as Jáchal, but introduced myself as an Argentine doctoral student getting her degree from a university in the United States. In general, after the initial coolness, people reaction was good, and helped me as much as they could. As I lived in San José de Jáchal for three months, they got used to see me around, and in turn I learned and practiced the local social norms.

While I did not have to change the planned fieldwork substantially, I had to adapt certain issues, particularly timing. To make contact with possible respondents was considerably slower that I expected, since it implied several intermediaries. While I resented the "waste of time" at the beginning, after a few days I decided to spend that time visiting as many settled places in the department as possible. This activity gave me a better perspective of the community, including its territorial dimension. In the end, running out of time, I had to make a decision about the number of interviews. I decided to privileged the balance between the three sites (seven interviews in each of them) instead of the higher accessibility of the small farmer households of Jáchal Central.

SUMMARY AND CONCLUSIONS

The objective of this introduction to the department of Jáchal was to present a succinct outline of the regional setting, a brief history of the Department, and a summary of its socioeconomic characteristics. The introduction and the conceptual framework presented in chapter 2 form the basis to situate and interpret the rest of the chapters, which will address issues of population mobility, environmental hazard, risk and hardship, and household's livelihoods in Jáchal.

There are several points to keep in mind. The regional environmental profile showed that overall aridity is the dominant characteristic, and that water and not land is the most valuable resource. Over the years, human settlement and the forms of management of natural resources –irrigated farming, grazing, deforestation— have transformed the landscape, interacting with the natural constraints to trigger land degradation that in same cases has led to desertification.

Within this arid scenario, the demographic and socioeconomic regional profile displayed the wide internal diversity of the region in terms of its demographic trends, and economic and social development. However, there is also a general pattern, which includes the consistently higher levels of poverty of rural populations, the importance of the type of agricultural activity on living conditions, and the transformation of the sector during the last two decades.

In terms of population mobility, the emergence of La Rioja and San Luis as alternative receiving areas is relevant to contextualize migration patterns in Jáchal, in particular variation in traditional destinations.

The department of Jáchal is inserted in this regional landscape, but with its own characteristics. The brief history of Jáchal is an introduction to both the origin of the present state of events and the department particular placing in the national and provincial arenas. It also illustrates continuities and breaks in social and economic processes that I think contributed to explain resilience and vulnerability to stressful situations. Finally, the brief description of Jáchal current socio-economic and demographic conditions gives an idea of the Department's current opportunities structure where to frame households' livelihoods.

Chapter 4. Population Mobility in Jáchal: Patterns, Characteristics and the Role of Environmental Factors

> …I tell you what, there are no jobs here now, for the youngster, for the children, there is nothing. Entire families are leaving, because there are no jobs… And now, with the water logging, it is just worst… (*Catalina, Mogna, 2001)*[59]

The attribution of population movements to environmental factors is a difficult task (Little 1994; Suhrke 1994), even though out-migration and other types of population mobility have been pointed out as one of the most visible social consequences of environmental change in arid lands, particularly in the occurrence of land degradation.

In the case of rural and agricultural populations, migration has been often considered to be the first demographic response used by people to face, cope and adapt to stressful situations, as well as for managing the risk associated with agricultural enterprises in arid lands (Evers 1996; Barraclough 1995; Stiles 1997; Little 1994; Knerr 2001). However, demographic responses to environmental stress are not automatic and do not happen in a vacuum, isolated from other processes or events. On the one hand, environmental-driven displacement is framed within the broader local, regional, national and even international patterns of mobility of the population under consideration. On the other hand, as was presented in chapter 2, demographic responses are embedded in a multidimensional context represented analytically by a number of mediators, which are necessary to consider for understanding how, when and why environmental factors influence population

[59] All the respondents' names are fictitious to protect confidentiality. The translation of the interviews is not literal, attempting to keep the spirit and meaningfulness of the words.

mobility. These mediators include macro socioeconomic, institutional and environmental determinants, as well as such micro level instances as the household.

While many of these issues will be addressed in Chapters 7 and 8, the focus of the present chapter will be on population mobility processes in the department of Jáchal, with the general objective of understanding the role of environmental factors in this local system. The examination of the patterns of spatial mobility in the department will provide a first insight into the embeddedness of the migration processes in a broader social context. The role of environmental factors, always entangled in a web of mediators, is likely to become more transparent in this analysis.

A further topic to address is the character of the movers as migrants or refugees.[60] Stiles (1997:12) classifies as 'displaced person' those individuals that are internal migrants and whose primary reason for moving is the sudden and abrupt action of a 'natural force', for example hurricanes, flash floods and earthquakes. However, most environmental mobility fits into Stiles' category of voluntary internal migration, under the assumption that people made an unforced decision to leave.

Nevertheless, other authors argue that a certain amount of compulsion is always present in environmentally driven mobility. They consider that in this type of migration push factors in the origin area --including slow-onset environmental processes— are more important that pull factors in the destination area (Suhrke 1994; Stiles 1997). These push factors are generally related to economic reasons in one way or another, and in this sense "environmental" migrants are also economic

[60] Stiles (1997:12) categorizes 'people on the move' according to two criteria: geographic (internal or international) and primary motivation for moving (natural force, human coercion or voluntary).

migrants. This could be another reason why it is so difficult to distinguish the role of environmental factors in migration processes.

In order to outline the local system of territorial mobility in Jáchal, I concentrate on the classical topics of type of migration, characteristics of the migrants, mechanisms and motivations. One of the issues to explore is if environmentally driven migration develops a new or distinct pattern of population mobility or if it follows the paths of the existing ones. Other issues include composition of the flows and destinations, and the voluntary or involuntary character of the movements.

The chapter is mainly based on the analysis of the information provided by the family migration histories, although census and other secondary sources were also consulted. The use of the interviews introduces a different perspective about the migration and population mobility processes in the department, focusing on people and families in movement, their motivations and how migration interacts with other life course events.

From the original 21 household interviews, the family migration trees rendered information about 348 cases -- including the respondents (the household couple), their parents and their siblings-- that are grouped into 39 families. The sample is almost evenly distributed by sex: 182 men and 162 women, where "Women" are mothers, wives and sisters, and "men" includes brothers, husbands and fathers. The respondents' ages range from 20 to 81 years old, covering family migration experiences from around the 1930s to the late 1990s. Although obviously imperfect and limited, this spread in age allows us to look into population mobility in the department over time.

Information about ‘time of events’ is problematic. Except for their age, most of the respondents were vague about dates. Some of them became uncomfortable and even upset when I asked about their relatives’ dates and ages at migration, because in most of the cases they could not remember or were confused about them.

It may be relevant to point out that, although all the households in the sample were farm households, not all the respondents came from farm families. Out of 39 families, only 13 of the couple’s fathers (33%) had farming or ranching as their primary occupation, and this number increases to 23 (59%) if farming or ranching as secondary occupation is added. On the other hand, fathers in public employment represent about 25% of the cases.

For this small sample of households, the mean number of children by family is seven, with a minimum of 2 and a maximum of 13. There are some differences by interview location: on average, families in Huaco had more children (7.4) than families in Jáchal Central and Mogna (6.8 and 6.9 respectively). Also, there are differences over time. Younger respondents reported smaller families (6.5 children on average) than older ones (9 children on average).

This chapter is organized as follow. First, the general patterns of population mobility in the department are examined in order to delineate their evolution, using mainly census data and indirect measures and indicators. After this, the type of migration –permanent, temporary and within the department-- is explored. A section about people on the move follows, which includes the characteristics of the migrants, the importance of the social networks and the reasons for moving. Finally, the summary and conclusions are presented, with a focus on the role of environmental causes.

OUTLINE OF POPULATION MOBILITY AT THE DEPARTMENT LEVEL

The general patterns of population mobility in the department of Jáchal should be understood in the broader context of internal and rural-urban migration flows in Argentina. These flows, particularly rural-urban ones, have determined the country's spatial distribution of population and the levels of urbanization since the 1930s, although their importance has diminished in the last three decades (Lattes 1974, 1981).

Briefly, there have been four periods in the history of internal migration in Argentina (Balán 1992:27-28; Mazzeo 1996; Vitoria de Holubica 1988). The first of them covered the period from around 1860 until the economic crisis of 1930, and was characterized by positive net migration into rural areas due to the inflow of international migration in the Pampas and other rural regions of the country. A second period went from 1930 to 1945, and its distinctive mark was the beginning of the rural exodus, first in the Pampas and then in the rest of the country, mainly due to the acute economic crisis in the first decade of the period. A third phase started around 1945, and was characterized by negative population growth rates in rural areas and explosive population growth in the Great Buenos Aires area. The rural depopulation that affected the Pampas since the prior period became common to the rest of the rural areas of the country, and during the 1960s the intensity of rural-urban migration was particularly intense. The forth period began in 1970, when negative rural population growth rates started to decline as the magnitude of the rural-urban movements weakened.

Characterized as an area of expulsion, out-migration and other forms of spatial mobility are the key demographic processes that explain Jáchal's population structure and dynamics (Retamar 2001; Davire and Malberti 1999; Casas and Tejada

2001). A first indication of this is the evolution of the population growth rates in the department, displayed in table 4.1.

Table 4.1: Evolution of the population of Jáchal and comparison of growth rates, 1895-2001.

Census Year	Total	Urban	Rural	Inter Census Annual Growth Rate (%0)[61]				
				Jáchal			San Juan	Argentina
				T	U	R		
1895	12,591	960	11,631					
1914	13,097	1,122	11,975	2.1	8.2	1.5	18.5	35.9
1947	17,129			8.2			24.0	21.4
1960	19,254	6,886	12,368	9.0			23.3	17.9
1970	18,500	6,815	11,685	-4.0	-1.0	-5.7	8.7	15.6
1980	18,863	8,873	9,990	1.9	26.4	-15.7	19.3	18.0
1991	19,955	9,726	10,229	5.3	8.3	2.1	12.0	14.7
2001*	20,898	10,901	9,997	4.6	11.4	-2.3	16.3	10.5

*Provisional results.

Source: Argentina Censuses of Population, 1895-2001.

What appears as distinctive of Jáchal is that its population growth rates have been consistently lower than in the province of San Juan and in the country as a whole, with an increase of 8,304 people from 1895 to 2001.[62] Assuming that there were no large differences in mortality or fertility between Jáchal and the rest of the country, this very small population growth may be explained by a constant flow of out-migration[63]. For example, the annual growth rate for the 1960s was negative in

[61] The annual growth rate was calculated as exponential growth (Hinde 1998:154-56).

[62] Data from the 1869 Argentine census of population has not been included because at that time the department of Jáchal included the territory and population of the department of Iglesia.

[63] Although specific data for the department of Jáchal was not available, information for the province of San Juan shows that fertility, as measured through the TFR, has been consistently higher in the province than in the country as a whole, although the differences have narrowed over time. For example, in 1955 the TFR in San Juan was 4.7 and the national TFR was 3.3. In 1991, the TFR for the province was 3.5 while the national one was 2.9. Regarding mortality, life expectancy for the province has been similar, although slighter lower, than the national one. In 1947, male life expectancy for San

Jáchal, and this decade also shows the lowest population growth rate for the province of San Juan. The out-migration flow should have been particularly strong during this decade, when rural-urban and inter-province migration flows were highest in Argentina (Vitoria de Holubica 1988; Lattes 1981; Mazzeo 1996; INDEC/IEE 1998). After this turning point, rates were positive again, but without reaching the meager levels of previous decades.

Population growth in Jáchal has not been homogenous, however. When urban and rural populations are considered separately they show different developments. The urban population, concentrated in the small city of San José de Jáchal, has been growing almost continuously, although rates have varied over time since 1895. Instead, the rural population displays a declining although discontinuous trend, with small increases at the beginning of the 20th century and during the 1980s. Both the largest increase in urban population and the deepest decline in rural population correspond to the 1970s. This pattern agrees with the general trend toward urbanization, population concentration and rural depopulation in the rest of the country.

As a further illustration of this last point, figure 4.1 shows the population growth rates by census tract (CT) for the 1980-91 census period[64]. All census tracts in the department are rural except CT two, where San José de Jáchal is located. As may be observed, CTs lost population during the 1980s, except the urban area (CT 2) and CT 1. This last district corresponds to the most densely populated rural area of the department, where a number of villages are located. Population decline (negative

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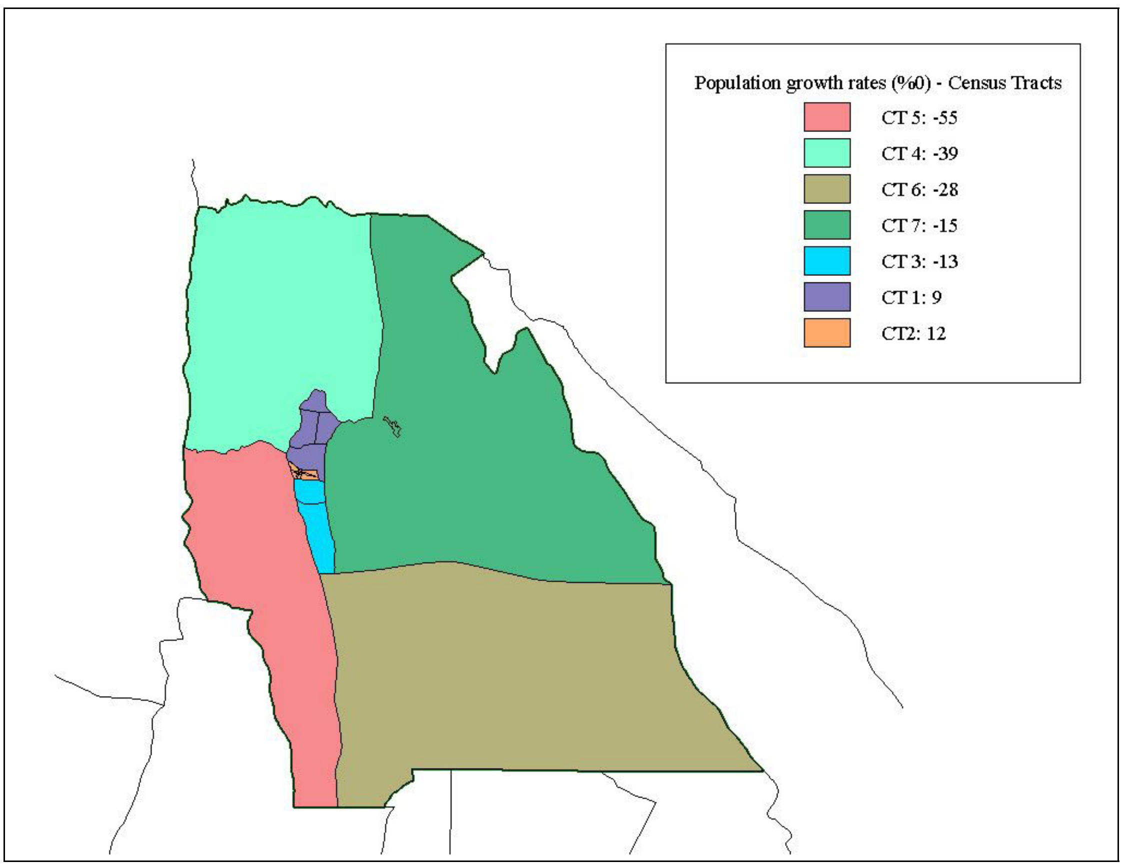
Juan was 53.1 years and for Argentina it was 56.9. In 1991, they were 68.1 and 68.4 respectively (INDEC/IEE 1998).

[64] Comparison with other periods is not possible because of the change in the number and the boundaries of the census tracts.

growth rates) was particularly large in CT 4 and 5, where the puestos (natural pasture areas of permanent or seasonal settlement, outside of the main irrigated districts) are concentrated. Finally, two of the irrigated districts, Huaco (CT 7) and Mogna (CT 6) also showed population decline. It is interesting to note that, in addition to other problematic situations, these last two areas have suffered several environmental problems over the years. These environmental problems will be addressed in Chapter 7.

Figure 4.1: Population growth rates (per thousand), 1980-1991, by census tract.



Source: Own elaboration based in Lizana 2001and the IEE San Juan.

The interview locations, Jáchal Central, Huaco and Mogna, are located in census tracts one, seven and six, respectively. Given the differences in growth rates among them, it is reasonable to expect that population mobility may also differ in these three locations.

The evolution of the net migration rates in Jáchal, displayed in table 4.2, may also be matched to the general description of the internal migration trends and to the population growth rates reported in table 4.1. As could be expected from a traditional sending area, net migration rates have been consistently negatives at least from the beginning of the 20th century, but not to the extreme of causing depopulation at the department level, since the population growth rate was negative only in the 1970s.

Table 4.2: Net migration rates, Jáchal

Inter-census Period	**Net Migration Rate (per thousand)**
1895-1914 (1)	[-28; -8]
1914-1947 (1)	[-20; -9]
1947-1960 (1)	[-23; -12]
1960-1970	No data
1970-1980 (2)	-19.65
1980-1991 (2)	-10.79

Sources: (1) Rechini de Lattes and Lattes (1969); (2) Caminos (1991).

Note: the numbers between brackets indicate the confidence or variation interval for the rate, according to the notation of Rechini de Lattes and Lattes.

In relation to this, Recchini de Lattes and Lattes (1969) characterized Jáchal as a department of moderate out-migration for the inter-census periods of 1895-1914, 1914-1947 and 1947-60, with negative but not increasing net migration rates.[65] There

[65] Recchini de Lattes and Lattes' (1969:63-64) typology includes five classes: 1. High out-migration (upper and lower limits of estimated net migration rates below –15 per thousand); 2. Moderate out-migration (net migration rates between –1 and –15 per thousand); 3. Weak out or immigration (net

is no information on migration rates for the 1960-70 decade at the department level. For the province of San Juan, the net migration rate for the 1965-1970 period was –12.8 per thousand (INDEC/IEE 1998), so it is possible to assume that it was still higher for Jáchal (Casas 2000).

Net migration rates in the department continued to be negative during the 1970s and 1980s.[66] For these decades, Jáchal was included in the category of a department of moderate to high out-migration according to the classification of Caminos (1991)[67]. Taking into account net migration rates at the department level in the rest of the country, Jáchal's rates in these two decades were quite high, particularly during the 1970s.

The information presented thus far gives an idea of the magnitude and evolution of the growth and net migration rates in the department of Jáchal as proxies for spatial mobility. This information says nothing about the type of movements that may be occurring, their characteristics, or the characteristics of migrants, or about why and how people are moving. To know about these issues we need to turn to the family migration histories.

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migration rates between –1 and 1 per thousand); 4. Moderate immigration (net migration rates between 1 and 15 per thousand); 5. High immigration (net migration rates 16 per thousand and over)

[66] The information for the 1991-2001 period is not available yet.

[67] Caminos classification (1991:7') includes three categories: a) departments of weak in- or out-migration, where net migration rates oscillate between –4 and +4 per thousand; b) departments of moderate to high in-migration, with rates higher than +4 per thousand; and c) departments of moderate to high out-migration, with rates lower than –4 per thousand.

TYPE OF MOVEMENTS

Casas (2001) recognizes three patterns of mobility in the department, which he organizes in a stage-migration fashion[68]. The first of these patterns includes the movements from isolated zones, like puestos and very small villas (Punta del Agua, Gualcamayo, Tucunuco) to larger rural villages like Huaco, Niquivil, or La Pampa. The second pattern consists of the movements from these villages to the city of San José de Jáchal or other destinations in the province of San Juan. Finally, the third pattern contains movements from San José de Jáchal to San Juan or other provinces like Buenos Aires.

The family migration histories enable us to enhance this picture of the territorial mobility system in the department. They confirm that migration strategies include Casas's patterns, which could be regrouped into permanent migration and mobility within the department. However, people have also engaged in non-seasonal and seasonal temporary migration. Furthermore, these movements are not mutually exclusive but may be and have been combined over the years.

Permanent Migration

One approach to permanent migration is to look at the places of birth and of current residence or death of the relatives reported in the interviews. Most of them were born in the department of Jáchal (325 or 93%), many of them at the interview site. On the other hand, only 191 (55%) of them were still living or had died in the department by 2001, which reinforces the image of the magnitude of out-migration. Of the 153 cases (44%) that were living or that had died outside of the department,

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[68] Stage migration is characterized by a succession of intermediate movements following the urban hierarchy of a particular country, it means, people move from the farm to the rural village, from there to a small city, and so on, until they reach the great city (Roberts 1995: 107)

107 (31%) of them were living in the same province, where the most common destination was Great San Juan, the capital. Other destinations outside the department included the neighboring provinces of San Luis, La Rioja and Mendoza, and other provinces that included Buenos Aires, Santa Cruz and Río Negro. Most permanent migration out of the department may be classified as rural-urban migration, but there were some cases of rural-rural migration as well. Overall, this information agrees with the trends found in the census and other secondary data.

In tables 4.3 and 4.4 these figures have been specified for each interview location: Huaco, Jáchal Central and Mogna. As before, most family members were born at the interview site (80%). People born in other places within the department amount to just 14% of the total number of cases, but they represent an important proportion of the Huaco cases. A third of these cases were born in the "puestos" and other third, in Punta del Agua.[69] Those born outside of the department represent only 7% of the cases and are concentrated in Jáchal Central, close to the urban area.

Table 4.3: Place of birth by interview location

Interview location	**Number of cases**	**Born in the interview location**	**Born in the department**	**Born out of the department**
Huaco	133	99 (74%)	33 (25%)	1 (1%)
Jáchal Central	117	90 (77%)	10 (8%)	17 (14%)
Mogna	98	87 (89%)	6 (6%)	5 (5%)
Total	348	277 (80%)	49 (14%)	23 (7%)

Source: Interviews in the department of Jáchal, 2001.

[69] The interviews recorded cases of people born in Campo Yanso, Gualcamayo, Agua de la Higuera and Panacán, all of them puestos located in the elevated pasture area in the north of Jáchal Central. Regarding Punta del Agua, it is an old and today almost depopulated irrigated area east of Huaco, on the beginning of the Travesía de Ampacama

Table 4.4 displays the current place of residence or place of death of those reported in the interviews and it is possible to observe broad differences in the intensity of out-migration by interview place by comparing table 6.4 with the figures in table 4.3. Huaco appears as the place that has lost more people to places outside of the department (54%). Jáchal Central has retained more cases (62%), and those living outside the department are distributed between San Juan and other places. Mogna is in the middle with 43% of its cases outside of the department, and as in Huaco the concentration of out-migrants in the San Juan area is remarkable. Finally, destinations within the department represent just 4% of the cases.

Table 4.4: Current place of residence or place of death by interview location

Interview location	Number of cases	In the interview location	In the department	Out of the department		
				San Juan	Other places	Total
Huaco	133	50 (38%)	11 (8%)	51 (38%)	21 (16%)	72 (54%)
Jáchal Central	117	72 (61%)	1 (1%)	22 (19%)	17 (14%)	39 (33%)
Mogna	98	54 (55%)	3 (3%)	34 (35%)	8 (8%)	42 (43%)
Total	348	176 (51%)	15 (4%)	107 (31%)	46 (13%)	153 (44%)

Source: Interviews in the department of Jáchal, 2001.

Given the evolution of the country’s internal migration flows, it is reasonable to expect that the figures just depicted had changed over time. To know if this is the case for Jáchal, I divided the cases in three groups according to the conjugal couple’ age. The distribution of cases by respondent’s age is displayed in table 4.5.

Table 4.5: Age distribution of respondents, by interview location

Respondent's Age Group	Huaco	Jáchal Central	Mogna	Total
1 – Up to 40, born in or after 1961	51	14	29	94
2 – 41 to 60, born between 1941 and 1960	57	82	15	154
3 – 61 and more, born in or before 1940	25	21	54	100
Total	133	117	98	348

Source: Interviews in the department of Jáchal, 2001

Table 4.6 shows that there are differences in the proportion of people born in the interview location by respondent's age group. Although most of the cases were still born in the location, these proportions were lower in the three places for the oldest groups of respondents, suggesting that more people were moving into these locations in the past. In the case of Huaco, the interviews indicated that these people were born mainly in other locations within the department, which agrees with the data in table 4.3. For Jáchal Central, these people moved from both outside and inside the department localities, for example the neighboring province of La Rioja or the puestos in the nearby mountains. Finally, in the case of Mogna, people born outside of the locality arrived mostly from Punta del Agua and Huaco.

Table 4.6: Proportion of people born in the interview location by respondent's age

Age Group	Huaco	Jáchal Central	Mogna
1 – Up to 40, born in or after 1961	72%	86%	100%
2 - 41 to 60, born between 1941 and 1960	84%	79%	67%
3 – 61 and more, born in or before 1940	56%	62%	89%
All ages	74%	77%	89%

Source: Interviews, 2001

There are also differences over time regarding current place of residence or place of death, as can be seen in Table 4.7. Trends in Huaco and Mogna differ from that of Jáchal Central. In those two interview locations, respondents in age group 2 reported more people living in the place than respondents in age groups 1 or 3. The contrary is observed in Jáchal Central. However, it is necessary to take censoring into account: while migration experience may be considered complete for age group 3, this is not the case for age group 1. Some of the relatives of respondents in age group 1 may still experience migration in the future.

Table 4.7: Proportion of people living or that died in the interview location by respondents' age

Respondents' Age Group	Huaco	Jáchal Central	Mogna
1 – Up to 40, born in or after 1961	33%	71%	65%
2 - 41 to 60, born between 1941 and 1960	46%	58%	80%
3 – 61 and more, born in or before 1940	28%	81%	39%
All ages	38%	61%	55%

Source: Interviews in the Department of Jáchal, 2001

So far the focus of the analysis has been on the geographic area. Turning now to the individuals, table 4.8 displays the propensity to migrate, calculated from the cross tabulation of each family member's place of birth with his/her place of residence or place of death[70]. The table shows only the results for out of department destinations.

Table 4.8: Propensity to migrate out of Jáchal by place of birth, total and by respondent's age group

Place of Birth	**Total**	**Age Group 1** Up to 40, born in or after 1961	**Age Group 2** 41 to 60, born between 1941 and 1960	**Age Group 3** 61 and more, born in or before 1940
Other places in Jáchal	41% (32)	17% (6)	35% (20)	83% (6)
Jáchal Central	36% (104)	20% (20)	42% (66)	28% (18)
Huaco	58% (101)	68% (37)	48% (50)	71% (14)
Mogna	43% (88)	31% (29)	9% (9)	56% (48)

Source: Interviews, 2001.

Note: numbers in brackets are the total of people born in each place.

Overall, the data match the information presented in table 4.4. For the total of cases, those who were born in Jáchal Central show the lowest propensity to migrate, while people born in Huaco show the highest. This distribution holds across all the age groups. People from Mogna and other places within the department present a similar predisposition to migrate.

[70] Propensity to migrate was calculated as: people born in place X living out of the department / people born in place X.

What seems to be different over time is the intensity of migration out of the department, with an overall declining tendency. People reported by respondents in age group 3 (65 years old and older) show a higher propensity to migrate in all places of birth except for Jáchal Central. But even in this place the highest propensity corresponds to people reported by respondents in age group 2.

People who moved permanently out of the department did not always proceed directly to their current place of residence or to the place where they died. In a process similar to stage migration, some of them lived in several other places before finally settling down. In some cases, people migrated temporarily to other places, coming back to Jáchal several times before leaving the department definitely, or they tried several different destinations until they settled definitely in one place. The following quotations illustrate this point.

> Well, he [my father] went [to San Juan] and worked… Before that, he used to work in the harvest, he also used to work here in Vialidad Provincial, he worked 15 years in the government. But then he was fired… And he began to leave in the harvesting season. He used to go and work two, three, five months to the most, he worked in the harvest and made money to come back and can live here. We were small children, my mother lived here selling milk, taking care of the crops… And then my father left, bought a plot in the city, and began to build a house, and my brothers were older by then, and they also decided to leave. I was there for a while, but then I came back, I married her [his wife], and remained here, but all my people are in San Juan. *(Enrique, Huaco)*

> He [my brother] went to San Juan looking for a job, and there he began to work. And then his boss moved to Río Cuarto [Córdoba] and asked him to go there, with all his family. *(Patricia, Mogna)*

> She [my sister] went to La Rioja to work in domestic service. She was there for a while and then she came back [to Huaco] to take care of my grandmother. And she stayed here for a while and then she went to San Juan. *(Nicolás, Huaco)*

Temporary migration

A different type of movement, more difficult to identify, is temporary migration or circulation. According to the interviews, both those who left the department permanently and those who are still living there have experienced this type of spatial mobility.[71] Two variations were reported in the interviews: non-seasonal and seasonal temporary migration.

Non-seasonal temporary migration involves moving out of the department to several and changing destinations, and returning home after a certain and variable period of time. In general, this type of movement is related to work opportunities and most of the migrants are males, married or singles.

> I have worked everywhere… I have been in La Rioja, Mendoza, San Juan… What happens is that I used to work in road construction, you see, making asphalt. And then I worked in the vineyards, cutting grapes… And now no, not anymore, now I am here [in Huaco]. *(Matías, Huaco)*

> I have been in Río Cuarto, I have been in Villa Mercedes, because those factories came to Villa Mercedes [San Luis][72], I was there because there was not work here… In 1980, yes… Because the work in the irrigation ditches ended in 1980, and then I had to leave, first to work in the Industrial Park in Las Chimbas, and from there I went to Córdoba, to Río Cuarto, and then I came back […] We were in Huaco, Punta del Agua, we went to La Rioja, then we went to Mendoza, you see? I was like a year in that, and then I went to Córdoba and worked there for four months. *(Guillermo, Mogna)*

Seasonal migration in Jáchal corresponds to those movements that occur at a fixed moment of the year that is determined by the agricultural cycle of specific

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[71] These two concepts are sometimes used as synonymous, although there are slight variations among them. For example, Urzúa (cited in Reboratti and Sabalain 1980: 1) defines temporary migrations as "…those that represent a temporal abandonment of the place of residence, without intention of establish new residence some place else…" Lattes (1984:80) defines circulation as "…a movement of short duration, repeated or cyclical and without the intention of establishing permanent changes of residence…"

[72] The respondent is making reference to a national policy of tax exemption for those industrial firms that established factories in the provinces of San Juan, San Luis, La Rioja and Tierra del Fuego, effective during the 1980s.

crops.[73] It is generally a rural-rural movement, where agricultural labor markets operate as the cyclical articulation between the sending and receiving areas (Aramburú 1984).[74]

Sending areas of seasonal migration circuits show certain characteristics, most of which are present in the department of Jáchal. They are in general economically depressed places, based in agriculture and with a marginal insertion in the commercialization circuits. Very small plots, farm laborers without land, and underutilization of the household labor force characterize the agrarian structure of these areas. Because alternatives to agriculture are scarce, migration of one or several members of the family to seek complementary sources of income appears as one option (Reboratti and Sabalain 1980; Reboratti 1983).

According to Reboratti's classification of circuits of seasonal migration in Argentina (1983), the department of Jáchal is included in the west-central circuit, whose destination area used to be the vineyards of the provinces of Mendoza and San Juan, the largest wine producers in the country. The harvesting period for the grapes is short, March and April mainly, and consequently the demand is extremely concentrated in just those months (Reboratti 1983). Harvesters from Jáchal, which has never been a vineyard area, generally migrate to work in the oasis of San Juan, where the most common destinations are the departments of Albardón, Chimbas or Angaco, close to the capital city.

[73] Seasonal migration has been defined as rhythmical population movements that follow the agricultural or growing cycle of certain crops like sugar cane, apples and grapes (Reboratti and Sabalain 1980; Reboratti 1983). However, depending of the sending area, seasonal movements may also include migration to tourist areas, mainly to the coast of Buenos Aires, during the summer months (December to March) (Giarraca et al. 2001)

[74] It is difficult in practice to differentiate rural and urban areas in irrigated places of the province of San Juan due to the dense settlement of the rural districts.

Seasonal mobility appears to be more widespread in Mogna. Several key informants mentioned that farm households in this locality have been engaged in seasonal migration for the grape harvest for generations.[75] "Ir a las uvas" (literally, to go to the grapes) is the local distinctive expression for this particular seasonal migration. Sometimes the whole family travels, other times just the grown children, depending on the phase of the family life cycle.

> I: Did your father work outside Mogna? P: Well, yes, always for the grape season, he traveled to San Juan. I: Your mother used to go as well? P: Yes, she used to go with my father, and sometimes she traveled with us too.[76] *(Patricia, Mogna)*

> When I was single, I also used to work for the vineyard season. And then, when the grape harvest was over, I remained [in San Juan] to work in the raisins […] Until I got married, and then I never came back. *(Mariana, Mogna)*

> I: Have you and your brothers worked in the harvest in Albardón? E: A lot, every year, I myself stopped going a few years ago. But it was a custom, a tradition of the people of Mogna to go. I: Always in Albardón? E: Well… the grape harvest is going in "cuadrilla" all around San Juan, in Chimbas, Albardón, Zonda, Ullúm. *(Eduardo, Mogna)*

Respondents in Jáchal Central and in Huaco also mentioned seasonal migration to the vineyards and other crops, although as something from the past. One possible explanation is the coincidence in time of grape and onion harvests (Allub and Guzmán 2000), although there was no mention of this fact in the interviews. Another possible explanation is a change in the conditions of the sending area. Although this will be explored thoroughly in another chapter, one of the alternatives

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[75] Interviews with Alfredo Estévez (AER INTA-Jáchal), Mónica Knopoff (PSA, San Juan) and Liliana Ovalle (Municipality of Jáchal at Mogna).
[76] I: interviewer, P: Patricia

to seasonal migration in Jáchal Central and Huaco, not available in Mogna, has been public employment.[77]

> For example, I stopped going to the vineyards about 10 or 12 years ago. *(Matías, Huaco)*

> We used to go to San Juan to work in the vineyards, I worked with a firm that had vineyards in Las Chimbas. I went several seasons, for three or four months each time, just the harvest. And then we came back here, to work… You know? There was no work around here, so yes or yes you had to go out to work, you see? In those years a lot of people went to the harvests, for a season, and then we came back to farm the land here. *(Nicolás, Huaco)*

Histories from respondents in Jáchal Central seem to indicate that other seasonal or temporary circuits may be in formation, for example the onion fields in the south of the province of Buenos Aires or other crops in the San Juan oasis that have sporadically attracted harvesters from Jáchal.[78]

> Twelve years ago (1989), I began to work in the onion fields in Bahía Blanca. One of our bosses in San Juan took us to work there. We worked there three months, we came back for the holidays, and then we went to Bahía Blanca again, until September. I was doing this until 1997. *(José, Jáchal Central)*

> He [my brother] went to Bahía Blanca to work temporarily, for three years, to the onion fields. He worked as regador. *(Manuel, Jáchal Central)*[79]

> Now [October] in Pocito is the working season, the garlic harvest, until January […] They [largest farmers] take people from here, by truck, to the fields to cut garlic. *(José, Jáchal Central)*

In some cases, temporary migration and particularly seasonal movements have been the prelude to leaving the department definitively, a first step to

[77] Reboratti (1983:4) affirms that "… the more typical characteristic of seasonal migrations is to be a system in instable equilibrium: the change or modification of any of the conditions that make the event possible affects the migration flow directly…"

[78] Onion fields in Buenos Aires are part of the irrigated area of the departments of Patagones and Villarino, in the SW of the province of Buenos Aires. This relatively new onion area has extended rapidly in the last years and, ironically, has appropriated a large portion of Jáchal's former commercialization markets (Interview to Alfredo Estévez, director of the Rural Extension Agency (AER INTA), 2001)

[79] "Regador" is one of the tasks related to the distribution and control of water in an irrigation system. In both Jáchal and Bahía Blanca, onion is an irrigated crop.

permanent migration usually to the Great San Juan area. Two common paths in going from a seasonal to a permanent migrant are to become administrators, sharecroppers or "contratistas de viña", and to get married.[80]

> So, they [my brothers-in-law] went to San Juan, worked in the vineyards, in the grapes, and then they remained there as 'contratistas'. *(Cristina, Mogna)*

> They [my siblings] worked for a while [in the vineyards], and then they came home, and then they left again. And then they married and they left Mogna for good. *(Mariana, Mogna)*

> He [my brother] used to be taken to… I mean, there was a man that used to come here and took them to Calingasta to work in the garlic, the pimiento, the tomato fields… He worked as a farm laborer… They took them and then they brought them back, you see? Until once he went and did not come back… He remained there (laughs). He had a girlfriend there and got married. *(Nicolás, Huaco)*

Spatial Mobility within the Department

Movements within the department do not correspond strictly to the definition of migration because the crossing of an administrative unit is not involved, even though they belong to the broader category of spatial or territorial mobility. Tables 6.3 and 6.4 showed that the magnitude of these movements appears modest compared with out-migration. This is confirmed by the cross tabulation of place of birth with place of residence of death, displayed in table 4.9.

[80] "Contratista de viña" is a particular type of sharecropping in the vineyard agro-industry (Reboratti 1983).

Table 4.9: Mobility within the department of Jáchal

Place of birth	Place of residence or death			
	Other places in Jáchal	Jáchal Central	Huaco	Mogna
Other places in Jáchal (32)	0	9	8	2
Jáchal Central (104)	0	62	5	0
Huaco (101)	1	3	37	1
Mogna (88)	1	1	1	48

Source: Interviews 2001.

Note: The numbers in brackets is the total number of persons born in that place.

Most of the people born in the interview locations have followed one of the following paths: a) they are still living in the location and are consequently non-migrants, or b) they have migrated out of the department. Regarding the people born elsewhere within the department, about 60% (19) of them moved to the interview locations, mainly to Jáchal Central and Huaco, and the rest have migrated out of the department.

Examples of mobility within the department are families moving from the "puestos" to the irrigated area, from places on the border of the oasis to more central and urban locations, and from remote irrigated districts like Punta del Agua to more central ones like Huaco.[81]

> My father saw that people were leaving Punta del Agua […] and that the school… well, children learned little there. And then my father said 'No, I am going to find a place in Huaco', he had all his family here [Huaco], because we had to begin the school, and he wanted for us to have a better education, to learn more and better in the school. And he found a farm here, so we all moved from Punta del Agua. *(Lorena, Huaco)*

[81] Interview with Mónica Knopoff, Agrarian Social Program (PSA) San Juan – 08/06/01

> My father went to Gualcamayo, to a 'puesto' with livestock, and there we lived, and there most of us were born. We left Gualcamayo when we were still small children, more or less 35 years ago. My father bought [a property] here and we all moved. *(Alberto, Jáchal Central)*

These quotations suggest that these residential changes may represent a profound transformation in living style. In all the cases, isolation is broken and the availability of services like better schools, health centers, retail and infrastructure (water, electricity, etc.) increase, marking a considerable difference with the past. Following Balán (1990:31), it is possible to consider these movements as an alternative form of rural-urban migration from dispersed to concentrated rural settlements that implies a progression toward more urbanized areas, although the receiving villages were still rural according to the census classification.

Mobility within the department may be temporary as well. This is the case of farm workers going to the central oasis of Jáchal, where large onion farms employed seasonal laborers in different moments of the growing and harvesting cycle. While most of these workers are smaller farmers in the same area, some of them come from other places within the department. For example, people from Huaco travel to work in the onion fields in Jáchal Central to complement public employment and temporary work in the public sector ("pasantías"). According to key informants, labor migration in Huaco is currently restricted to Jáchal.[82] Respondents from Mogna also mentioned this destination in combination with the traditional ones in San Juan.

> Before I went to the "colimba" (conscription), every year I used to go to the vineyards, and I also worked in the onion fields in Jáchal, planting onions. *(Guillermo, Mogna)*

[82] Interview with Alfredo Estévez.

PEOPLE ON THE MOVE: MIGRANTS, NETWORKS AND MOTIVATIONS

The mechanisms through which people migrated, the reasons and motivations behind spatial mobility and the selection of the migrants are all complex processes. Because households are at the center of migration decision-making, these processes are associated with household structure, gender and age composition, the position of individuals within the household, the household economic and labor situation, and also with family and individual aspirations. Social networks, particularly family connections, are also fundamental structures shaping the migration processes, among other things because networks tend to reduce the selectivity of migration processes over time, and broaden the pool of possible migrants or movers (Harbison 1981; Roberts 1995; Massey 1990; Massey et al. 1993; Hugo 1998; Brettel 2000; Knerr 2001).

The quotations of the previous section gave some clues about the characteristics of the migration processes in Jáchal, as people talked about their relatives as migrants, their destinations and how they got there, and why they moved. This section further explores these characteristics through the family migration histories.

Characteristics of the Migrants

One of the advantages of the family migration histories is that they add position in the household structure to that of sex and age of the migrants. In this way, it is not only a question of being, for example, male or female but also of being a parent or a child, or being the oldest son or the youngest daughter. Relationships – parents or siblings- were established from the point of view of the respondents, the conjugal couple of the household.

Most of the parents in the 39 families (82% in Huaco, 85% in Jáchal Central and 87% in Mogna) were still living in the interview location or had died there. However, as some of the quotes in the section above showed, fathers engaged in temporary migration or mobility within the department. In contrast with this, most of the siblings (62%) had migrated and were living or had died outside of the department (table 4.10). Overall, brothers migrated more than sisters, but there are notable differences by site.

Table 4.10: Proportion (%) of siblings living outside of the department, by sex and interview location

Interview Location	**Siblings**		
	Total	**Brothers**	**Sisters**
Huaco (91)	76%	78%	73%
Jáchal Central (78)	47%	60%	43%
Mogna (58)	59%	63%	54%
Total	62%	67%	55%

Source: Interviews in the Department of Jáchal, 2001

Note: the numbers in brackets indicate the number of siblings reported in each interview location.

The proportion of siblings living outside of the department is higher in Huaco than in the other two locations, for both brothers and sisters: approximately one out of four siblings had left the department. In addition to this, the difference between the groups is small. In contrast, in Jáchal Central proportions are lower, fewer than 50% of the siblings, but the difference between sexes is notable. A possible explanation is that public employment, particularly teaching, concentrates in this location, offering opportunities for women's employment. Finally, siblings in Mogna are in an intermediate position between Huaco and Jáchal Central, but although brothers tend to migrate more than sisters the difference is not as wide as in Jáchal Central.

Regarding differences over time, table 4.11 shows that siblings tended to migrate more in the past. Proportions are higher for age group 3 than for the other two groups. This trend is present for both sexes, and in addition the sex gap appears to have declined over time, from 20 points in age group 3 to 12 points in age group 1.

Table 4.11: Proportion (%) of siblings living or that have died outside of the department, by respondent's age group and sex

Respondent's age group	**Siblings**		**Brothers**		**Sisters**	
	Total	Out	Tot	Out	Tot	Out
1 – Up to 40, born in or after 1961	62	68 (62%)	38	25 (66%)	24	13 (54%)
2 – 41 to 60, born between 1941 and 1960	100	58 (58%)	57	36 (63%)	43	22 (51%)
3 – 61 and more, born in or before 1940	65	44 (68%)	28	22 (79%)	37	22 (59%)

Source: Interviews 2001

As was mentioned earlier, information about age at migration is scarce and not very accurate in the interviews, but it is possible to extract some inferences about timing by focusing on the intersection of migration with specific life course events such as finishing school, marriage, or the migration of parents.

For example, women used to migrate at earlier ages than men. According to the respondents, daughters in the families generally migrated when they finished primary school, when they were between 12 and 14 years old. The most common destination was San Juan city, where they usually worked in domestic service in 'decent' and upright households or "casas de familia"[83].

> She [my sister] was the oldest, so she had to go to work to help my father to feed us, we were so many. *(Rosa, Huaco)*

> When I was single I lived and worked in San Juan […] I went to San Juan when I finished primary school, I was more or less 14 years old then. I entered to domestic service in the house of a friend of one of my uncles. I worked there for many years and then I came back to Huaco. *(Lorena, Huaco)*

Currently, the age for this type of migration has increased to 17 or 18 years old, as secondary school has become the norm. However, and regardless of the education level, working in domestic service in San Juan or other major city is still one of the ways out of the department for women. A similar and more recent path is to work as a sales clerk.

Although men's age at migration seems to have been higher that women's, it varied widely, depending on the circumstances. Conscription --mandatory military service for men at age 21 or 18 (it changed over time)— forced almost every young man to leave the department and even the province for one to two years, until this service was abolished during the 1990s. If they had a job other than the family farm usually they had to resign and look for a new job again when they came back. A number of brothers did not return home or returned briefly to leave definitely afterwards.

> My brother went to Buenos Aires with my uncle. They came to visit my family, and my brother… he was just out of the "colimba" (conscription) and stuck to them and left with them. *(Mario, Huaco)*

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[83] Vitoria de Holubica (1988:69) includes the province of San Juan among those where the internal displacements of young women (ages 15-24) were more intense for the 1975-80 period. Giarraca et al. (2001:336), in their research about temporary migration in Tucumán (Argentina), affirm that women use to migrate at early and sometimes very early ages, have less job options than men, and rely more on old kin networks.

Again, the order of the siblings is important here, because the oldest brother left early, while the youngest one was generally the one who remained on the farm with the family, and helping in farming or ranching.

People may also migrate at older ages than are assumed. There were some cases of persons migrating in middle age because of the worsening of living conditions in the department: increasing unemployment, recurrent market failure or drought. Also, people migrate at older ages to reunite families. A number of respondents mentioned that, when their parent aged, they relocated near their siblings in the city, or that their siblings had moved to other locations to live near their grown children.

> I am getting old, and may be I will have to go… the brothers, the sisters are all there [Albardón]. *(Agustín, Mogna)*

> Her children moved her [my sister] there, as all them are living in Santiago [del Estero]. *(Mario, Huaco)*

An important event in affecting the timing of migration is marriage, in two ways. It could trigger migration because the new family may have difficulties making ends meet in the department, and move to make a living some place else.[84] If one of the spouses got a job someplace else, the other would follow. On the other hand, marriage may also be a deterrent to migration and a prelude to definitive settlement. This last is very common in seasonal migration.

Seasonal or cyclical migration usually begins when the migrants are in their late teens, and may last until they are in their fifties, depending on financial necessity and health. Both sexes may migrate to the grapes before marrying. After that, the

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[84] Although information is scarce, it seems that age at marriage varies widely in the interviews: for women, it ranked between 16 and 34, and between 18 and 38 for men. It also appears that there is not a pattern of decline or increase over time. For the country as a whole in 1970, Torrado and Rofman (1988:29) found that mean age at marriage was 28.5 for men and 23.4 for women in the case of farmers' families, and 21.6 for men and 20.7 for women in the case of farm workers' families.

women that remain in the villages generally stop migrating to the vineyards, but sometimes the entire new family migrates. A recent variation of this pattern is to have a permanent employer who provides employment from one season to the next.

> Before, we had to look for a job in the vineyards. Now no, my husband, my daughters and I have a permanent boss. They pick us up every year here in the village to go to work in the vineyards in Angaco [San Juan oasis]. *(Patricia, Mogna)*

Finally, “involuntary migration of children” (Reyes Suárez 1992) involves the cases of migration of families with children under 15 years old, which could be stretched to unmarried children as well. Several respondents reported this situation for their first movement.

> They [my siblings] were still all single, so when my dad and mom left all of them went together [to San Juan]. *(Claudia, Jáchal Central)*

> We moved definitively [to Jáchal] in 1946, I was 11 years old. We bought this property. The situation was very bad back there [La Rioja], we lived in the countryside. So, we bought here and came to live here. *(Pedro, Jáchal Central)*

A particular variation of this is the case of children removed from their families because of some particularly stressful period, due to a number and combination of reasons including but not limited to economic hardship, number of children, or the death of one of the parents. In San Juan these children are called “chiquitos dados” (literally, given kids). Generally, the children were “given” to other relatives (usually uncles or aunts), although friends or older employers could be also the recipients or the requesters. This could happen when the children were babies or when they reached an age adequate to help in certain tasks, which in turn depended on the child’s sex (the farm for the boys and domestic service and housekeeping for the girls).

> When my father died, it was very difficult for my mother to raise we all, and as my grandmother lived there [in San Juan], she took my sister. *(Matías, Huaco)*

> I: Why did he go to Mendoza when he was 12? M: Because one of my aunts requested my mother to send him, she was going to make him studied (gave him an education), all there. *(Matías, Huaco)*

The Importance of Networks

The family migration histories make clear that social networks have been essential for Jáchal's migration system (Retamar 2001). These are old networks, established through generations of migration out of and within the department, and even crystallized in institutions as the Casa de Jáchal in the city of San Juan.

For example, the presence of family members –older sisters or brothers, aunts or uncles, grandparents- or friends in the destination was what enabled the migration of very young women to the city.

> She (my sister) went to live with my aunt, my mother's sister, she went to Buenos Aires, she lived there, and married there. *(Cristina, Mogna)*

The migration of the oldest sister seems to trigger the migration of the rest of the daughters. Two different mechanisms were at play. In one of them, the first daughter followed the path of some relative, generally some uncle or aunt living in the city, or family friend. They provided assistance in the form of advice and a dwelling, making migration cheaper and safer for her and her family back home. Afterwards, younger sisters joined the oldest at the destination. In the second mechanisms, the interested family in the city, generally an acquaintance of the Jáchal family, asked the parents to send their daughter to work in the acquaintance's house.

> I was in San Juan. My sister went to work there because I got her a job, she went to the city having already a job. *(Lorena, Huaco*)

> A man, very well known to my parents, went to work in La Rioja as a teacher, and married there. And there went my sister, to work in their house. (Nicolás, Huaco)

This type of migration could be temporary in the beginning but in general it ended up being permanent. Usually, these women married someone in their new place and remained there.

> I always had my job [in San Juan] and when I was on vacation I came to see my parents. *(Rosa, Huaco)*

> She finished [primary] school, she went to San Juan to work, and she married there. *(Lorena, Huaco)*

Mechanisms for the migration of brothers were similar to the ones for sisters: relatives and/or friends in the destination, and the migration of one brother facilitated the mobility of the others. However, the job they had was in a different economic sector, as they used to work in the agricultural or construction sectors.

> I got a job in La Rioja because I had a contact there, my sister used to work for the same family. *(Enrique, Huaco)*

> My oldest brother called him [a younger brother], asked him to go to Santa Cruz, because things were going so good then. *(Rosa, Huaco)*

Motivations

Migration histories show that people move basically for two reasons: work and family, as can be seen in table 4.12. When asked what had been the principal reason for the move, respondents said that work was the most important. About 60% of the permanent migrants moved because of employment issues, regardless of period, age or sex, while almost all temporary movements were work-motivated. The second set of motives is related to family issues, which amounts to a little less than 25%, while other motivations include studying and environment related issues that together represent only 16% of the responses.

Table 4.12: Distribution (%) of the reasons to move for permanent migrants by place of interview

Motivation	**Total** (130)	**Huaco** (63)	**Jáchal Central** (32)	**Mogna** (35)
Work related (80)	61%	60%	59%	66%
Family related (30)	23%	21%	31%	20%
Study related (9)	7%	14%	0%	0%
Environment related (5)	4%	2%	0%	11%
Other (6)	5%	2%	9%	3%

Source: Interviews 2001

Note: the numbers in brackets indicate the number of cases.

There are some differences and similarities in the distribution of reasons according to place of interview. Work and family are the largest categories in the three places. Proportions in Huaco and Mogna are quite similar in their distributions for the first two categories. In Jáchal, the distribution is concentrated in only three categories, showing at the same time a lower proportion of work related reasons and a higher percentage of family-related ones. This is intriguing because men migrated more than women in this location. Study-related reasons represent a higher proportion in Huaco, while in Mogna environment-related reasons –for example, drought – are a higher proportion of the total than in the other two interview sites.

The distribution of motivations seems to be different for each age group of respondents, possibly a consequence of different family obligations at different ages, especially for women. Table 4.13 shows that the oldest respondents did not mention school-related reasons, and that the gap between family and work-related reasons was narrow. Instead, study-related reasons appeared in the histories of the youngest respondents, together with a higher concentration on work-related issues.

Table 4.13: Distribution of the reasons to move for permanent migrants, by age of the respondents

Motivation	**Total** (130)	**Age Group 1** Up to 40, born in or after 1961 (37)	**Age Group 2** 41 to 60, born between 1941 and 1960 (52)	**Age Group 3** 61 and more, born in or before 1940 (41)
Work related (80)	61%	78 %	54 %	56%
Family related (30)	23%	0 %	35 %	29%
Study related (9)	7%	13 %	8 %	0%
Environment related (5)	4%	0 %	0 %	12%
Other (6)	5%	8 %	4 %	2%

Source: Interviews 2001

Note: the numbers in brackets indicate the number of cases.

The distribution of reasons for migrating is different for brothers and sisters, as can be seen in table 4.14. Although in both groups work-related reasons are the modal category, the proportion is higher for brothers, while the inverse is true for family related reasons. Also, brothers show a higher proportion of study-related reasons than sisters.

Table 4.14: Distribution of the reasons to move for permanent migrants by relationships (siblings only)

Motivation	**Total** (130)	**Brothers** (70)	**Sisters** (48)
Work related (80)	61%	66%	56%
Family related (30)	23%	19%	33%
Study related (9)	7%	9%	6%
Environment related (5)	4%	3%	2%
Other (6)	5%	4%	2%

Source: Interviews 2001

Note: the numbers in brackets indicate the number of cases.

Work related-reasons

This category includes a number of different situations. Work-related motivations could mean not having work at all in the place of origin, and in fact this was the most common response in the three locations, for both sexes and all ages. Most of the time the respondents were making reference to plain unemployment.

> All the people that left [Jáchal]… they are leaving because of the lack of employment. *(Leoncio, Jáchal Central)*

> It was better to work outside, how we were supposed to survive other ways?. *(Guillermo, Mogna)*

The causes of unemployment in the department vary, but one of them is the decline of labor demand in agriculture because of the changes in land use and the general deterioration of the activity due to non-competitive prices or land degradation. In Jáchal, farmers have had problems with the commercialization of their crops because prices fluctuate sharply form one year to the next, and a persistent fungus that infects the soils and reduces the yields. As agriculture turns less profitable and risky, this is reflected in the decline of permanent, seasonal and temporary farm jobs, which have not been replaced by non-agricultural jobs. As one of the key informants told us "…Here, the main product is the onion, but people make a living working in the public sector…"[85]. Even public employment opportunities have declined sharply in the last years[86].

In other situations, however, "no work" could mean the impossibility of getting a job outside the farm sector in the place of origin. This could be the case for

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[85] Interview with Alfredo Estévez, director of the Rural Extension Agency (AER INTA), San José de Jáchal, 08/14/01

[86] The unemployment rate for the department was 24% in 2000, with a wide gap between rural and urban populations (30% vs 18%) (Casas 2001). A more detailed account of the department's socioeconomic conditions is presented in Chapter 3. The discussion of the households' livelihood strategies, including employment of the household's labor force and the situation of the agricultural sector in terms of employment, commercialization, etc., will be presented in Chapter 8.

members of the household working outside of the department in domestic service or construction. These circumstances could also be considered more as a case of personal preferences.

> They [my brothers] used to work here as I worked, in the farm helping my father. And as the onion market was already down, very bad prices… They had to go out in a hurry to look for resources. *(Mario, Huaco)*

> My brother left because of the lack of jobs. Here everyone works in agriculture, they are all farmers, and he did not like that, so he went out looking for another type of job. *(Rosa, Huaco)*

To work outside the farm is an important component of the equation because not all the families were farm families and consequently to work or help in the family plot was not always an available alternative. Even in the case of farm families, the number and sex of the children may have also prevented all of them from working in the family plot.

Family-related reasons

Family related motives also include a number of different situations: parents moving-in with their grown children, marriage, children taking care of their parents, families moving because of the employment of the household head, "chiquitos dados".

One particular situation is the migration of families when the children are still underage. As was mentioned before, this proportion is small but has a potentially important effect because in most of the cases they carried their entire families with them, in what has been called involuntary migration of children that moved when their parents changed residence. For this reason, age at migration may be lower in family-related mobility.

Sometimes work and family issues, particularly marriage, are combined in the reasons why families or couples move. Regarding marriage, a strong differentiation by sex appears to be present since this cause is frequently mentioned for women that follow their husbands, although the inverse also happens.

> "…The women [sisters] left because their husbands took them away…" *(Manuel, Jáchal Central)*

Study related reasons

The third motive mentioned by the respondents was study, meaning to enter high school or college. This has changed in recent decades as more secondary and high schools opened in the department.

> That was what happened with the schools, you see? There were only primary schools here. If you want to go to secondary school you had to go to [San José de] Jáchal… 25 km! The Videla Cuello High School is just 15 years old. *(Leoncio, Jáchal Central)*

However, upper level education still requires migration out of the department, generally to the San Juan metropolitan area. It is difficult for people migrating for study reasons to return to Jáchal, since the type of jobs available there do not match their new qualifications. An exception to this is teaching, which is one of the main sources of public employment in Jáchal Central and Huaco. In the case of Mogna, the teachers of the two public primary schools travel each week from San José de Jáchal, where they have their residences, and remain in the village from Monday to Friday.

> My brothers studied there [San Juan] and they cannot come back because of the employment, unfortunately there are not jobs here for them. *(Pablo, Huaco)*

Environmental related reasons

Fewer than expected respondents mentioned environmental factors as directly related to migration or mobility. These factors were frequent flooding, drought, salinization and waterlogging. In same cases, people chose to migrate temporarily, returning when the environmental problem was over, as in the case of drought or flooding. In other cases, people left permanently.

> And then the time came when the dam was built, and we did not have water. You know? The water had to be brought in tanks and they built pools… And at that time people began to leave to San Juan, Mendoza, La Rioja… And the irrigation ditches began to dry. And they became dryer and dryer, and people began to leave. *(Nicolás, Huaco)*

> They got married and then they migrated because of the job, her husband worked on the farm, and there was no water. *(Ana, Huaco)*

The respondents are referring to the Cauquenes Dam, built around 1965 to improve the provision of irrigation water to Huaco.[87] Although this topic will be developed later, it seems that this particular event was a turning point in Huaco history, and not only in terms of migration (Retamar 2001; Casas and Tejada 2001; Musso 1994). It is possible to find in the interviews the effect that the construction and filling of the dam, and a coincident drought had on out-migration during the late 1960s and early 1970s. However, it is also necessary to remember that these displacements occurred in a context of acute national and regional rural-urban migration. One of the key informants declared that at that moment, when an important amount of the population left Huaco, at least three factors were at play: the

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[87] The objective of the dam was to regulate the discharge of the Huaco River, avoiding its seasonal variations, and to expand the area of irrigated cropland already existent in Huaco. However, it turned to be a devastating project due to its "unintended" consequences, main among them the sudden salinization of the river water. The effect on agriculture was probably amplified for the scarcity of non-farm jobs in the area. This topic will be further developed in Chapter 5.

effect of the dam, the economic situation prior to the dam, and the "attraction of the city".[88]

Waterlogging in Mogna was also mentioned as a possible reason for leaving the village temporarily or permanently. There have been at least two different periods of waterlogging in this area, one in the1940s and another beginning in the mid 1980s that is still present. As usual, some temporary moves ended being permanent.

> Well, look, it started (people living) when waterlogging began, here the land was failing, yielding less, you see? And so they [the siblings] went to look for a job there [San Juan]. *(Omar, Mogna)*
>
> From Los Puestos to Mogna, everything was dry before. There used to be a lot of people in Los Puestos, but many of them left because they did not have any means. *(Omar, Mogna)*
>
> Few people farm in Mogna these days, very few… Then they go to work in San Juan, all because there is waterlogging. *(Cristina, Mogna)*

Also in Mogna, droughts were mentioned as a reason for leaving the village. It seems that farmers in Mogna have been badly affected by droughts despite the fact of being part of the irrigation system of Jáchal, probably because they are located down the river and at the end of the system.

> There were years of drought before, when my father went to Albardón. There was a drought then, there was not water for irrigation… there was not water in the river… When the water returned, then we came back here to work for a while [in the farm]. *(Agustín, Mogna)*

A few respondents in Jáchal Central and Huaco mentioned recurrent flooding of the house and the farm, due to a combination of topography and rain patterns, as a cause for moving. However, these movements were in general within the department and the destination was close to the prior residence.

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[88] Interview with Dante Tejada, teacher at Huaco High School and author (in collaboration with José Casas) of "*Huaco, Hondonada de Piedra*"

> [They had to move] because there, where they lived before in La Legua, water entered the house all the time during the inundation, that's why they had to move here [Entre Ríos, a nearby neighborhood]. *(Pura, Jáchal Central)*

A similar situation appears is this history about El Morado, a low hill that forms the boundary of the Huaco oasis on the East.

> Because of the rains, a barranca began to form there, and it was becoming more and more difficult to rebuilt the irrigation ditch. And people began to leave […] It was all monte there, the water run down and thee was no defense, all the water run down here. *(Nicolás, Huaco)*

SUMMARY AND CONCLUSIONS

In this chapter, I have outlined the characteristics of the population mobility system in the department of Jáchal, from net migration rates to the migration histories of families living there, reviewing the evolution of the trends at the aggregate level, the types of mobility displayed by the population, the characteristics of the migrants, the importance of the social networks, and the reasons for moving, including environmental factors.

From this outline, I think it is clear that population mobility in the department is an old and well-established process. It has been in place at least since the end of the 19th century according to the census information, and probably started when people settled in the department in the middle of the 18th century.

Population mobility has had important consequences for the evolution of population growth in Jáchal. First, judging from the number of children of the families in the sample, migration has probably offset what could have been high population growth, removing the "excess" population as people had to leave the department in order to make a living, with or without agriculture. Second, people have moved out of the department but also within it, and over the years this "internal" population mobility has changed the spatial distribution of the population. Although settlement was never dispersed in the countryside, it is now more concentrated than it used to be, and some areas that were once irrigated communities are today almost deserted, such as Tucunuco and Punta del Agua.

Although migration patterns seem to maintain themselves over time, there have been some changes in terms of the intensity of the flows, the propensity to migrate, as well as mechanisms and motivations. Some of these changes are probably related to major macro-economic and social changes, while others may reflect generational transformations in the population or the movement of individuals through the events of their life courses.

The migration experience, be it permanent or temporary, within or outside of the department, is present in all the interviewed households. Both men and women migrate, although timing, destinations and reasons may be different. Permanent migration is still frequent, according to the histories. Sometimes just one of the siblings of a family of maybe ten brothers and sisters remains in the department. Seasonal migration inserted in different circuits is also widespread.

The predominant type of migration, permanent or temporary, is somewhat different in each interview site, and Mogna is quite different from the other two places. Following Aramburú (1984:117), a possible interpretation is that the difference reflects two forms of articulation of the small farm households' economy with the agricultural markets and the rest of economy, which in turn is indicating differences in household's availability and control of resources.[89] One form is

[89]Aramburú suggests that those peasant units (households) that control more and better resources (including here natural resources as land, water and pastures) would tend to position themselves as

through goods markets or commercialized markets, and the other is through labor markets. In the first case, the migration of household members tends to be permanent, and in general the migrants are younger and better educated. Hired workers may substitute their contribution to the family farm during the periods of major demand as the harvest, and the household reduces fixed costs. Instead, temporary migration will be privileged in the articulation through labor markets. In this case, the household would not be able to replace the contribution of migrant members, who would only migrant during the periods of lower demand of labor in the family farm.

This scheme may be adequate to picture the difference between Jáchal, Huaco, and Mogna in terms of household livelihood strategies, which will be addressed in chapter 7. Preliminarily, I suggest that households in Jáchal Central and to lesser extent in Huaco correspond to the first form and households in Mogna to the second.

Turning now to environmental reasons, the evidence about the effect of environmental problems or changes on population mobility is scarce. As was presented in the chapter, only 8% of the responses made reference to those problems. Environmental hardship was hardly mentioned as a reason for moving, except in cases of drought or flooding, suggesting that the relationship may appear more transparent if environmental problems are acute and sudden.

Regarding the character of the mobility, people moving for environmental reasons seem to fit better in the category of migrants and not in that of refugees. Most of the cases mentioned by the respondents may be included in the category of

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providers of agricultural products and traditional handicrafts. Instead, those peasant units than control few or depleted resources would tend to position themselves as provider of labor.

voluntary internal migration. As the interviews revealed, environmental reasons are generally intertwined with economic ones, and in this sense environmental migrants are also economic migrants.

Some cases could be identified as natural force-driven internal migration or displacement, as in the case of people leaving Huaco during the late 1960s and early 1970s (although more research in needed to draw a firm conclusion about these circumstances). However, even in this situation economic motives were involved, since it was suggested that one of the reasons why environmental factors acted with such strength was the lack of economic and work alternatives to agriculture.

It is interesting to note that only the oldest group of respondents mentioned environment-related motivations. Three possible and not mutually exclusive interpretations may be: a) technological development or change currently prevent the effects of natural events; b) people are less engaged in farming and consequently less exposed to climatic events; and c) living conditions have improved and as a consequence people are less exposed to environmental hardship.

A number of questions remain unanswered, taking into account that the respondents were farmers, some of them from a farm family, living in a place where environmental problems have been reported. Why did so few of them mention environmental hardship as a reason for moving? What are the environmental problems? Are they adapted to them in such a way –for example, through the irrigation systems- that environmental hardship is not an issue anymore for most of the farm families? Are there alternatives to population mobility to cope with environmental hardship?

In conclusion, the links between migration and environmental processes linked to desertification appear elusive. In this very complex picture of population mobility in Jáchal, a preliminary interpretation is that the structure and composition of the local labor market emerge as possible intervening factors, because “looking for a job” is frequently mentioned as a reason to move. In this sense, environmental change in its different forms would trigger population movements to the extent that it affects agriculture. It could acts through labor demand in agriculture, lowering it in a scenario of the scarce local off-farm jobs, or could interfere with the normal development of agricultural enterprises, making it not profitable for the families involved.

Chapter 5. Aridity and Desertification: an Assessment of Environmental Hazard

As stated in chapter 2, the risk of being affected by land degradation and desertification may be considered as the result or outcome of the intersection between environmental hazard and social vulnerability (including coping and adaptation) in specific contexts (Blaikie et al. 1994:21; Hewitt 1997:24). In the present chapter, the objective is to address and evaluate the first element in the equation, environmental hazard. The term is used in a broad sense, including those physical agents, events, objective conditions or processes in the environment that create threats to livelihoods or lives (Hewitt 1997:25).

This assessment of environmental hazards takes into account the processes leading to land degradation as well as those elements of the natural dynamics of the ecosystem that could be dangerous, for example hail storms in the summers. For this, it concentrates on the average characteristics and on the variations of the physical and biological components of the environment, as well as on their evolution over time and their spatial diversity, including those changes attributed to human activities that may trigger land degradation or desertification.

Different data sources were integrated in this chapter. Bibliographic research of secondary sources –historical and statistical- provided important information to outline the average environmental conditions of the Department, the characteristics of natural resource management, and the past and current environmental problems. Key informants in the department provided valuable information about the last two issues. Finally, remote sensing data for 1973, 1987 and 2001 were used to explore the characteristics and extension of change in environmental conditions, using vegetation indexes as proxy. Although not without limitations, this sequence of satellite images allows for observing evolution and change consistently over time.

The chapter is structured as follows. The first section briefly summarizes the average environmental conditions and dynamics of the department to set a preliminary baseline or starting point for discussing environmental change. After this, the second section displays and discusses the results of the analysis of the remote sensing data in addressing environmental change and land degradation or desertification from 1973 to 2001. The third section introduces a first insight into natural resource management and documented environmental problems in the department. Finally, the conclusion summarizes findings and results, and discusses the nature of environmental hazards in Jáchal.

THE ENVIRONMENTAL FRAMEWORK

> One difficulty of examining land degradation in drylands regions is their inherent variability. (Middleton and Thomas 1997:ix)

This phrase from the *World Atlas of Desertification* defines perfectly the problems involved in establishing a baseline or starting point for a discussion of environmental change in Jáchal. This initial line is necessary because desertification, defined as land degradation in drylands (United Nations 1994:4-5), implies a negative change –i.e. reduction or loss of productivity-- with respect to previous environmental conditions, which could be considered as the "normal" or desirable state of affairs in the ecosystem in terms of its use and management (Blaikie and Brookfield 1987).

The distinctive characteristic of drylands is their aridity, defined as the lack or scarcity of moisture, caused by water losses (evaporation and evapotranspiration) exceeding water inputs (precipitation). However, there may be wide inter annual variations in the amount of rain, and also its distribution along the year is generally irregular and concentrated in a few months and sometimes in a few weeks. In turn, water scarcity and its variability influence and affect other components of the physical environment such as the drainage system, the formation and evolution of soils, and the natural vegetation cover. In addition to these temporal variations, spatial variations in the physical characteristics of the ecosystem should also be expected (Middleton and Thomas 1997), in this case due to differences in altitude, geomorphology and orientation across the large area of the department.

Water is a *naturally* scarce element in arid lands. This fact makes the carrying capacity of these areas lower by diminishing the availability of one of the components of natural capital, which in turn affects the availability, use and management of other components like land and biomass (Knerr 1998:213). It is at this point that the capture, conduction and distribution of water from stream courses, generally but not always through the implementation of irrigation systems, become an essential issue (Mainguet 1999).

In this section, I present an overview of the characteristics of the physical environment in Jáchal, including their periodic and a-periodic variations, focusing on those elements that are critical to people's well being and for agriculture: climate, water sources and availability, soils and vegetation. This outline will be part of the contextual background for interpreting the results of the remote sensing analysis.

An arid climate

Moisture deficiency or aridity is the most common criteria used for the classification of arid lands. It is usually measured though the aridity index, calculated as the ratio of precipitation to potential evapotranspiration (P/PET). This index should lie between 0.05 and 0.65 for an area to be considered as dryland.[90] There are different ways of deriving this index from climatic data, but the underlying principles are basically the same (UNEP 1992:2; United Nations 1994:5; Middleton and Thomas 1997:2; UNSO 1997:5; Noin and Clarke 1998:2). Other definitions of drylands take in account only the amount of annual rainfall. Usually, the limit between sub-humid and humid areas is set in the isohyets of 800 or 1000 mm (Little 1994; Strahler and Strahler 1988).[91]

In the case of Jáchal, available records for the department show an average total annual precipitation between 100 and 200 mm for the 1941-1990 series, depending on the location of the weather station. According to the precipitation criterion, these amounts classified the department as an arid area. The recorded evapotranspiration (using the Penman method) averaged more than 1000 mm for the same 1941-90 period (Cornejo 1997).[92] Combining the numbers, the aridity index would be roughly around 0.09, which also classified the department as an arid area, bordering on hyper-arid according to the UNESCO classification.[93]

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[90] Using the moisture deficiency criterion, drylands may be divided into the following zones: a) dry sub-humid, 0.5 P/PET < 0.65, b) semiarid, 0.2 P/PET < 0.5, c) arid, 0.05 P/PET < 0.2, and d) hyper-arid, P/PET < 0.05 (Middleton and Thomas 1997:5)

[91] Using the precipitation criterion, drylands may be subdivided into the following zones: a) sub-humid, 500 to 1000 mm, b) semiarid, 250 to 500 mm, and c) arid, 0 to 250 mm (Strahler and Strahler 1988:146)

[92] The term evapotranspiration refers to the water loss resulting for the combination of evaporation and transpiration of plants (Strahler and Strahler 1988:164)

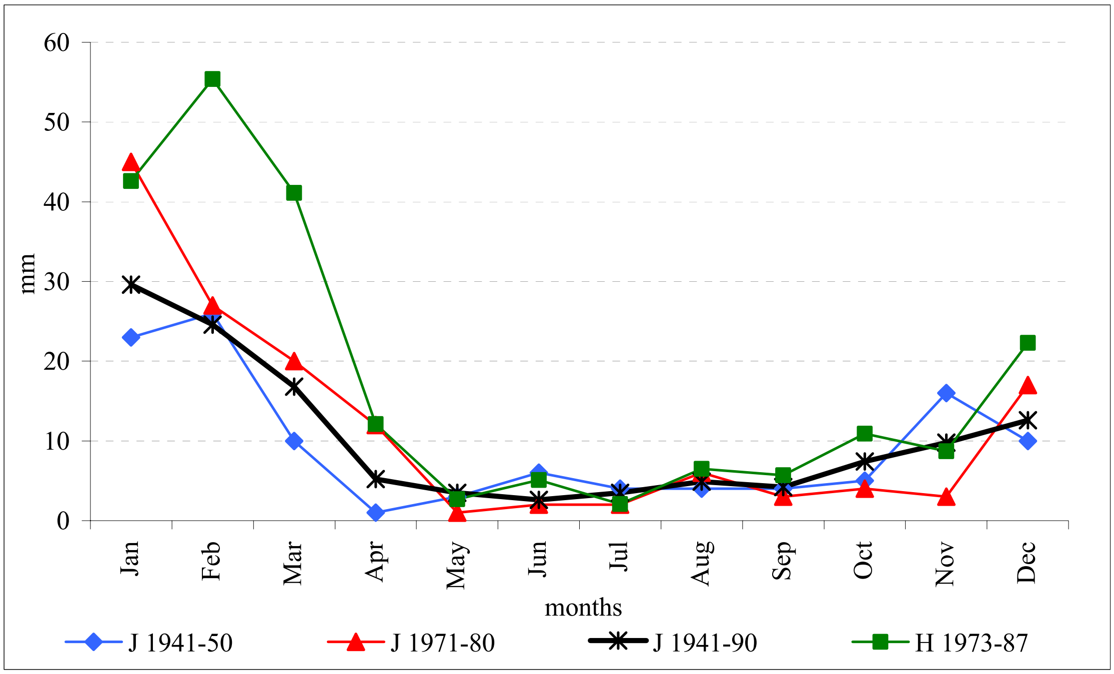
[93] Chiozza and van Domselaar (1958:131) included Jáchal in the region of "Arid Climate of sierras and bolsones", where the minimal amounts of precipitation of Argentina were registered. The department is crossed by the isohyet of 100mm (INTA/Aeroterra)

The constant water deficit makes agriculture impossible without irrigation, and also poses a heavy burden on the population in terms of availability of water for household needs –drinking, cleaning, etc. However, the small amount of local precipitation is not irrelevant since it is important for the dynamics of the native vegetation, which represents a forage resource for small goat farms and firewood for the general population.

Figure 5.1 displays the average monthly precipitation for the 1941-90 period and for selected sub-periods, for two weather stations, San José de Jáchal and Huaco. This last station is located to the east and at a lower altitude than San José. As can be observed, seasonality and inter-annual variations are present. The scarce annual amount is not uniformly distributed along the year but concentrated during the summer months, when precipitation may take the form of violent thunderstorms, with torrential rain and hail. Figure 5.1 also shows spatial variations in the amount of precipitation, although the annual pattern remains. Huaco's averages appear higher than Jáchal's for most months, particularly during the summer (December, January, February).

Precipitation amounts may vary from year to year, a typical feature of arid climates. Average precipitation for January, for example, could be as high as 45 mm (1971-80 series) or as low as 23 mm (1941-50 series). During the drought of 1970/71, annual precipitation in Huaco was only 70 mm, and acreage was reduced by 50% (Centro Regional del Agua Subterránea San Juan 1972).

Figure 5.1: Average monthly precipitation for the localities of San José de Jáchal and Huaco, selected series



Source: Compilation of data from the National Meteorological Service (SMN), Cornejo (1997) and the Global Bioclimatic Organization Data.

Hot summers, temperate winters and wide daily amplitudes in temperature also characterize the climate of Jáchal. For the weather station of San José, the average annual temperature is 16.7ºC, with mean temperatures for the warmer and colder months (January and July respectively) of 24ºC and 9ºC (Servicio Meteorológico Nacional). There is an ascending gradient of temperatures from west to east following the variations in elevation, which is reflected in the differences between San José and Huaco. For the 1973-1987 period, this last locality registered an average annual temperature of 17.3ºC, while the averages for the warmer and colder months were 25.3ºC and 9ºC, respectively (Cornejo 1997). Overall, temperature patterns seem to be more stable than precipitation.

The period free of frost is very long. This represents a potential advantage in the marketing of vegetables such as onions and tomatoes that form the bases of the commercial crops in the department. Farmers may enter the market very early or very late, diminishing the competition with other productive regions (Allub and Guzmán 2000).

Stream flows

Water availability in the department is tied to surface watercourses since the amount of precipitation is very small and the use of underground water is minimal.[94] The drainage system of Jáchal includes permanent, temporary and occasional streams. This system has played a key role in determining population distribution in the department, as can be seen in figure 5.2.

The largest of the permanent watercourses is the Jáchal River, an allochthonous watercourse that crosses the department from west to southeast, from its sources in the Arid Andes to its end in the Bermejo River. It arrives there as a temporary watercourse with the name of Zanjón, with its discharge greatly reduced due to irrigation (Palese de Torres 1958).[95] The mean monthly discharge was calculated as about 8 cubic meters per second (cms) according to Panocchia (1979), or 9.44 cms according to Allub and Guzmán (2000). In any case, the discharge is quite low considering this is the most reliable water source of the department.

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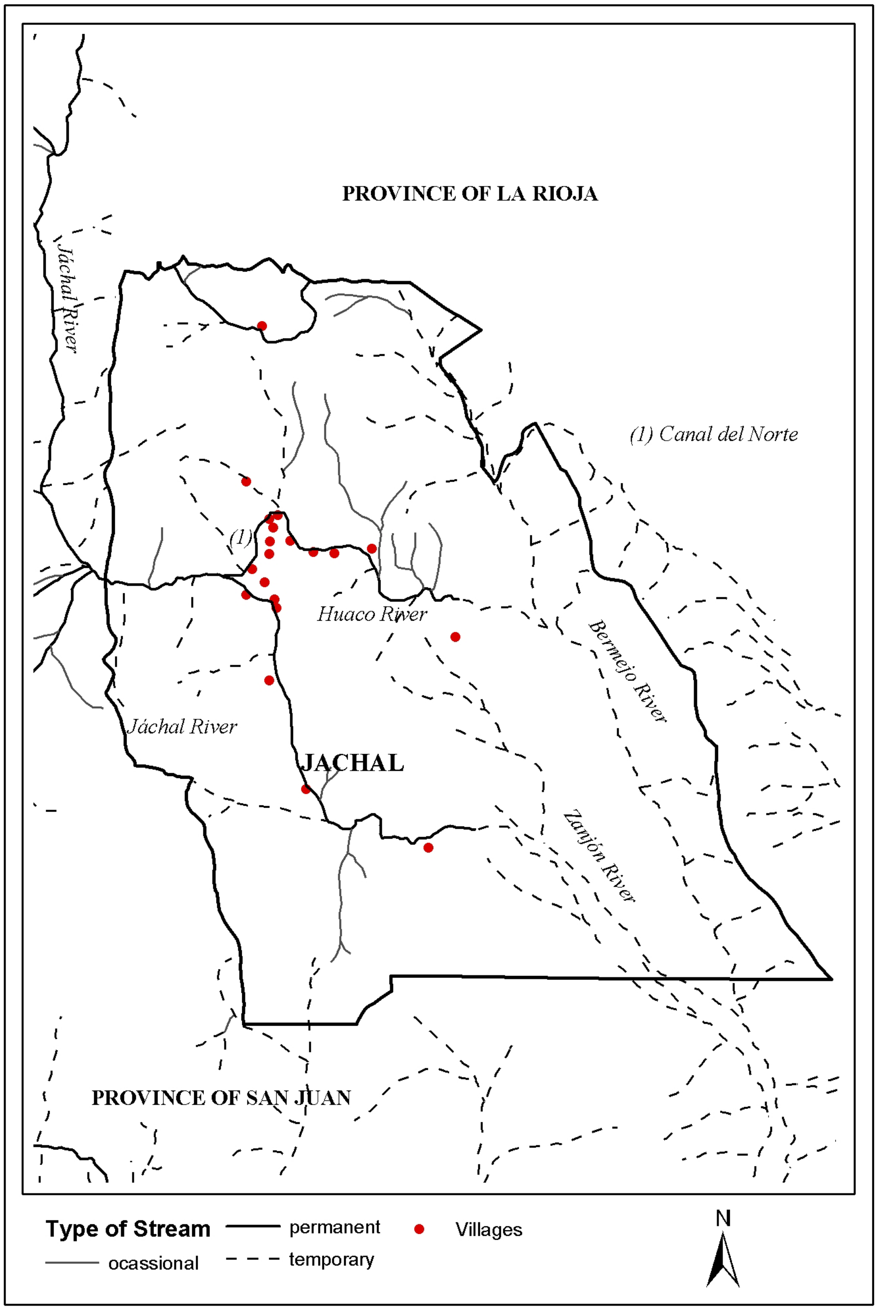
[94] The 1988 census of agriculture reported that 99% of the irrigated farms in Jáchal used only stream water (INDEC 1990). In 2000, there were only 10 working wells in the department, out of a total of 45. Seven were used for irrigation and one for drinking water (Departamento de Hidraúlica 2000).

[95] The term "allochthonous" applies to those watercourses whose source and upper reaches are located in a different and generally moister environment than the one where they end. These rivers receive no or very few tributaries when they pass through arid lands and are greatly reduced by evaporation and by the use of their waters for irrigation (Mainguet 1999:85).

A particular problem related to the Jáchal River is the high content of salts (sodium and boron) in its waters. This natural salinity became one of the main ecological constraints for agriculture and particularly for crop diversification.

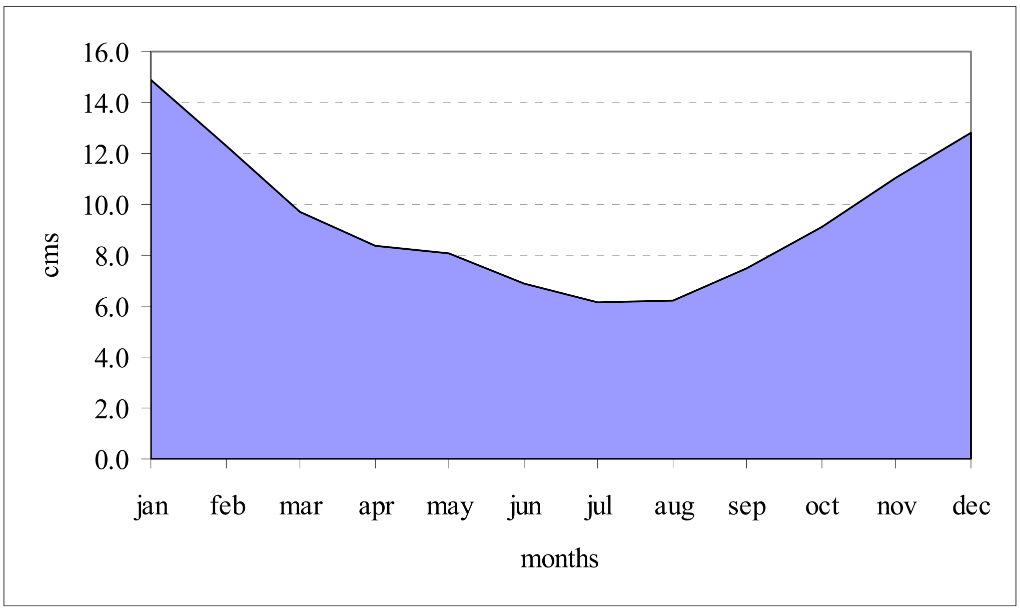
Figure 5.2: Drainage system of the department of Jáchal



Source: Own elaboration based in Lazina, 2001.

The Jáchal River displays strong seasonal and inter-annual variations in discharge, as can be seen in figures 5.3 and 5.4. Regarding annual seasonality, the summer months –December to February-- are the peak discharge season while the winter months represent the low discharge period. This pattern derives from the source of the river, the snowmelt in the Arid Andes.

Figure 5.3: Average Monthly Discharge of the Jáchal River (1921-1983)

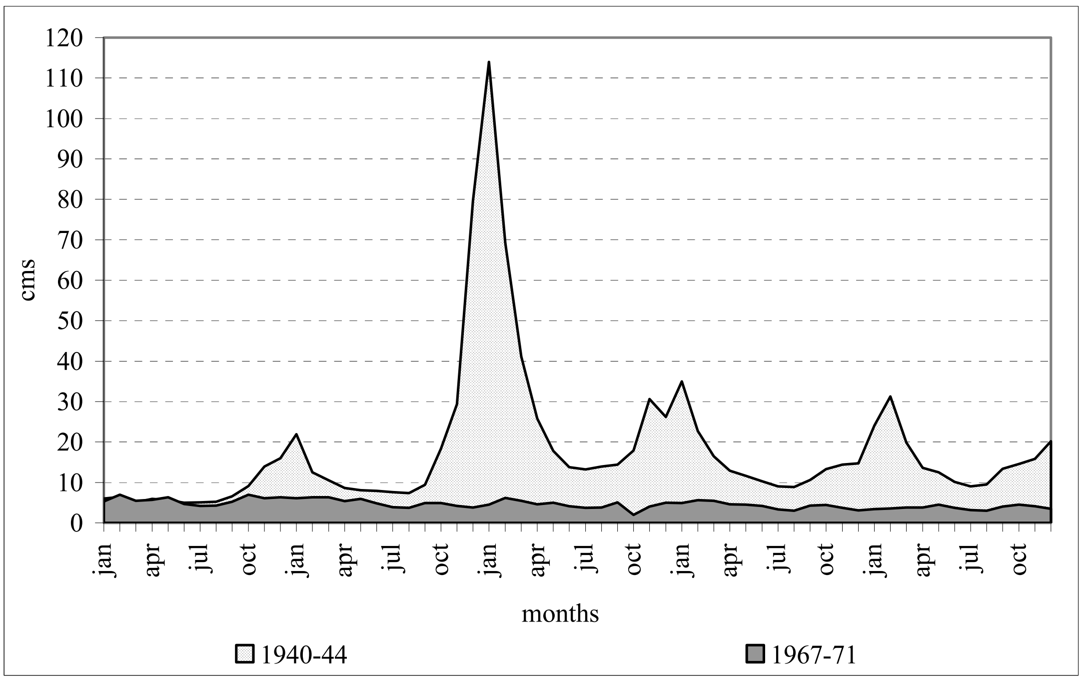


Source: Calculations based in data from the Dirección Provincial de Hidraúlica de San Juan. The measure point was the stream gauging station of Pachimoco, near San José de Jáchal

In addition to this annual pattern, the river discharge presents strong inter-annual variations, with series of humid and dry years, as displayed in figure 5.4. As can be observed, while the mean discharge for January for the 1921-1983 series was

15 mm3/s, in January of 1942 the river discharged 144 cms and in January of 1971, 3.40 cms.

Figure 5.4: Discharge of the Jáchal River in humid and dry years: 1940-44 and 1967-71 series



Source: see Figure 5.3

The other two watercourses used for irrigation are the Huaco River and the Agua Negra Stream. The Huaco River is the final segment of a system of temporary and occasional streams, discharges from the Jáchal River through the Canal del Norte (one of the main irrigation channels) and springs. Its mean discharge is calculated at around 0.5 cms (although records for Huaco are scarce and not very reliable), and seasonal and inter-annual variations are common since its regime is partially determined by rain and snowmelt (Adamo 1991). The Cauquenes Dam has highly modified the characteristics of this river.

Finally, the Agua Negra Stream has its origin in springs formed by seepage in the alluvial fan of the Jáchal River and in precipitation in its drainage basin. Its average discharge is between 1 and 1.5 cms (Adamo 1991), but may be as low as 0.6 cms. It also presents seasonal variations, with peaks during the summers (Centro Regional del Agua Subterránea San Juan 1972)

Soils

Soils are the next crucial natural resource for agriculture in arid lands after water availability. Soil formation (pedogenesis) is the result of the interactions between source rock, topography, climate (precipitation and temperature) and biological factors. In drylands, this process is slower because of water and organic matter scarcity, and the resultant soils are generally thin and of low agricultural potential (Mainguet 1999:46).

Figure 5.5 displays the distribution of soils in Jáchal, by type.[96] As can be seen, a substantial amount of the department area is categorized as rock and is consequently not suitable for agriculture purposes. In the rest of the department, the soils have been classified within the order Entisols, characterized by scarce organic material in its composition and the absence of distinct pedogenic horizons or soil strata. In other words, it is an incomplete soil, due to the nature of the parent material, the time since their formation, slopes, plowing, or climatic constraints, among other possible reasons.

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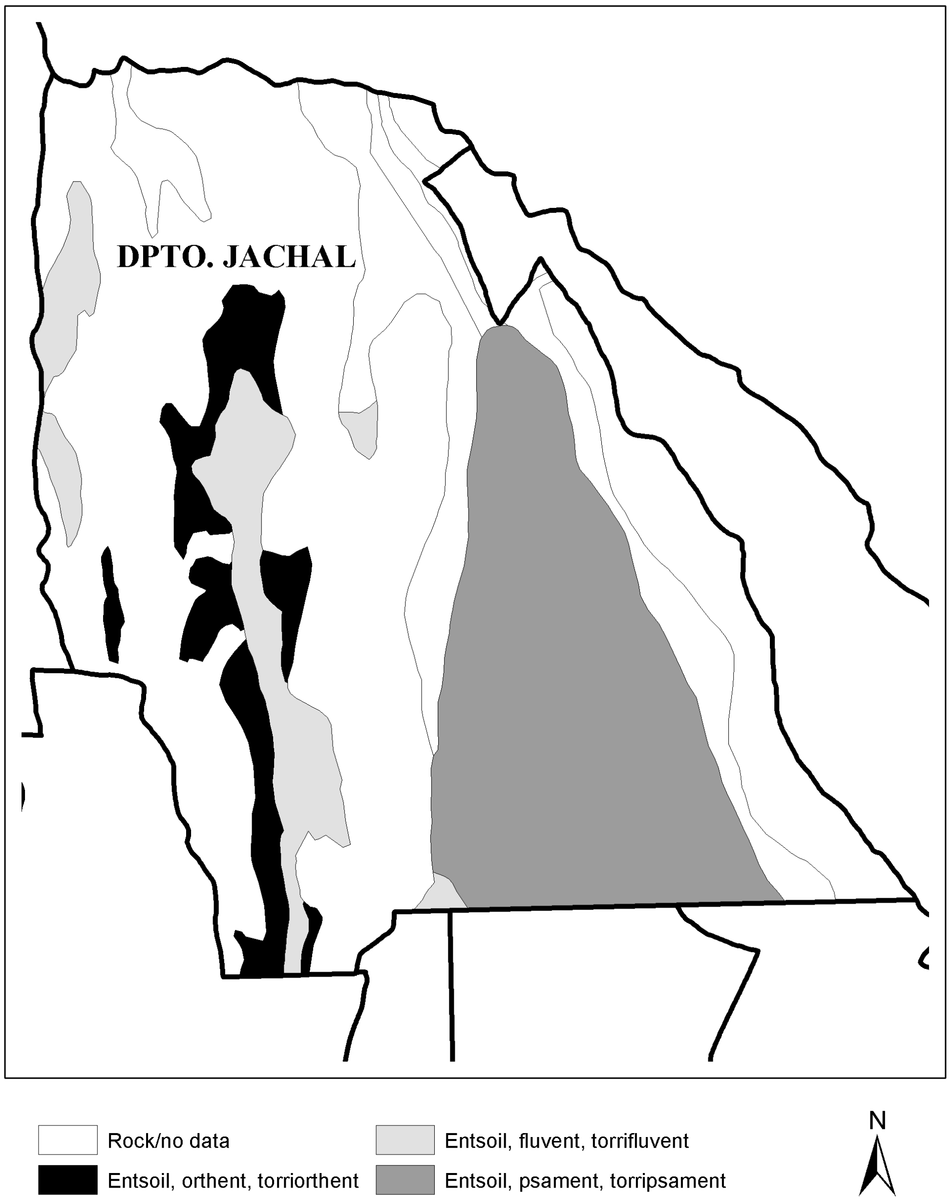
[96] Soils are classified according to the Soil Taxonomy, adopted for Argentina by the National Institute of Agricultural Technology (INTA/Aeroterra 1995).

Entisols may be found in any climate and under any vegetation cover. In Jáchal, they are the result of the physical characteristics of the environment, mainly its topography and particular erosion processes, the aridity of its climate, and the scarce organic matter available. Because these characteristics and processes vary across the department, three suborders of Entisols are found: fluvents, orthents and psaments. The suborder fluvent corresponds to the soils formed by stream alluvium on flood plains, run off surfaces and deltas. The only group of this suborder identified in Jáchal is torrifluvent, fluvent soils of arid climate that are not flooded frequently or for a long time. The suborder orthent identifies soils of glacial or sedimentary origin in terms of their composition, located on areas of recent erosion. The group found in the department is torriorthent, dry or salty soils of arid areas on moderate or high slopes. Finally, the suborder psament defines soils characterized by a sandy texture and low water retention capacity, derived from sand-textured parent materials such as dunes. The group torripsament, the only one present in the department, is typical of arid and semiarid zones (Strahler and Strahler 1988:463-62, 581-82; INTA/Aeroterra 1995; INTA 1990). Soils suborders and groups are displayed in figure 5.5 below.

Figure 5.5: Soils of the Department of Jáchal



Source: Own elaboration based in INTA/Aeroterra 1995; INTA 1990

Within the overall low performance that characterized drylands' soils, the different types of soils in Jáchal exhibit variations in their capacity to sustain agricultural activities. This is related to differences in chemical composition, to micro-level combinations of climate and geomorphology, and in some cases to decades of irrigated agriculture. In addition to the natural climate restrictions (aridity), fluvents and psaments present low and moderate-high salinity levels, respectively, while orthents are exposed to moderate slope erosion caused by streams and the run-off from rains (INTA/Aeroterra 1995).

A crude and indirect way to measure the soil capacity for sustaining agriculture is the productivity index (PI). This indicator is interpreted as a proportion of the highest potential yield or productivity of typical crops in the area. In other words, (100 - PI) is the percentage of decline in the optimal yield due to some characteristic or limitation (INTA/Aeroterra 1995, INTA 1990).[97] As would be expected, PIs are generally low in the department, but the index presents wide differences by type of soil and location. Fluvents, psaments and orthents show PIs of 33, 18 and 4 respectively. In combination with this, soils located on the west (the mountain area) have lower SPI regardless of type, due probably to the effect of slopes on soil formation.

Vegetation Cover

The natural vegetation cover of the department corresponds to the floristic Province of Monte. In its original conditions, the Monte includes three strata of vegetation --grass, shrub and trees- in a combination of sparse open woods and shrub

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[97] Basically, the productivity index IP is calculated taking in account climatic factors (like temperature and precipitation) (H), and soil factors (like drainage D, depth P, texture T, salinity Sa, organic matter M, erosion E, etc.). These factors are included in a multiplicative parameter: IP = H x D x P x T… and so on. The climatic factor (H) for San Juan were set in 65 due to aridity, which in turn determined IPs below 35 for the province's soils (INTA 1990).

steppes identified respectively by two species, algarrobo (*Prosopis)* and jarilla (*Larrea)*. In general, the species of the Monte are xerophytes well adapted to aridity. However, some species are also adapted to live in particular niches within the general arid environment: rocks, sand, clay, salt and marshes (Morello 1958; Cabrera 1958). For example, halophytes like "jume" and "zampa" usually replace xerophytes in areas of waterlogging (Centro Regional de Agua Subterránea San Juan 1972)

The natural vegetation cover is open with wide patches of bare soil and presents an irregular spatial pattern that follows micro-level changes in ecological conditions (Cabrera 1958). The presence of trees, for example, is closely associated to the availability of water in that particular place. The original vegetation cover has been extensively modified by human activities in and around the settlement areas. According to Panocchia (1979:86)

> In the farming area, native vegetation is totally degraded due to land exploitation. This can be observed in the margins, on the piedmonts and in the neighboring mountains.

This vegetation cover has been used for grazing and firewood and replaced by crops and other foreign species like poplars and eucalyptus planted along the irrigation ditches, a very distinctive feature of irrigated landscapes in Argentina. Vegetation cover in irrigated and settled areas appears much more dense and green, as can be seen in figure 5.6.

Figure 5.6: Natural (upper panel) and Modified (lower panel) Vegetation Cover: El Fical (Jáchal Central)

(Photos: Susana Adamo, 2001)

USE AND (MIS)MANAGEMENT OF NATURAL RESOURCES: A BRIEF REVIEW OF THE DOCUMENTED ENVIRONMENT PROBLEMS IN JÁCHAL

While environmental hazards may be linked to the natural dynamics of the arid ecosystem, it is also necessary to take into account how people have historically used the natural resources in the area –land, water, vegetation cover-- and what kind of environmental problems may originate from the forms of use and management, including irrigated farming and ranching, and the use of the natural vegetation cover for pasture and firewood.[98] Key informants in the area mentioned concerns about environmental quality and degradation, and there are also numerous pieces of information spread over a large number of very diverse secondary sources. In this section, I attempt to summarize and make sense of all this information, in order to have a first diagnosis of the environmental situation of the department before turning to the analysis of the remote sensing data.

According to the PROSA (1988) report, the degradation of natural resources in the province of San Juan has been notable, mainly due to human action on a fragile environment. This fragility derives from the typical characteristics of an arid climate combined with a rough topography with abundance of slopes and forms (mountains, piedmonts, valleys and plains), and loose surface materials and sands. Both aeolian and hydrological erosion are present. Specifically for Jáchal, the areas affected for these types of erosion included the piedmonts, the Bermejo River Valley on the east, the Jáchal-Niquivil-Tucunuco area south of San José, and the oasis of Huaco and Jáchal. Erosion in the piedmonts was classified as severe-grave, while in the rest of the areas it was classified as moderate-grave. Except for the Bermejo

[98] An incipient issue is the conversion of agriculture land to urban uses including higher density housing, but there is not yet enough information about it.

Valley, where exploitation was considered to be minimal, degradation had negative economic effects for the department, although the report did not specify what they were (PROSA 1988:147).

Another report (SAGyP and CFA 1995:155) related degradation in San Juan to a number of management issues, notably water management. According to its diagnosis, the irrigation system had deteriorated and its efficiency was low, in addition to administrative and operational problems, mainly related to payments, resulting form the San Juan Water Code. Excessive use of water and lack of adequate drainage were positively associated with degradation through salinization and waterlogging, and declining yields. Other constraints on an efficient use of natural resources were land ownership and lack of modern technology, according to this source.

A number of on-going processes in Jáchal could be eventually linked to land degradation, among them salinization of soils and water, waterlogging and deforestation (Pannochia 1979, Allub and Guzmán 2000). In fact, the recuperation of soils affected by salinization, waterlogging and depletion has been mentioned as a concern of the local authorities (Davire and Malberti 1999).

Irrigated farming and salinization

The major and probably older modification of the natural environment in Jáchal is the implementation of irrigated farming.[99] The irrigation system in Jáchal, run by the Dirección de Hidraúlica (DH, Department of Water Resources), provides water for crops by replacing local precipitation, and also provides relative protection against the strong discharge variations of the stream system during the summer

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[99] Irrigation is "…the use of artificial means to influence the supply of moisture to increase crop production…" (Yudelman 1989: 63).

months, which are the most hazardous for agriculture because of the coincidence of the extreme events of floods and droughts with the growing season of crops. I emphasize "relative protection" because the protection that the irrigation system provides may not be enough on occasions, due to the magnitude of the phenomena or to deficiencies in the system. The system also provides water for tap water distribution through a different network.

The irrigation system is based on three main sources: the Jáchal and Huaco Rivers and the Agua Negra Stream, although in terms of amount of discharge the most important of these sources is the Jáchal. There are three dams in the system: Pachimoco (for the distribution), Cauquenes (regulation) and Cuesta del Viento (electricity and regulation) (Allub and Guzmán 2000). The oldest one is the Pachimoco Dam, built in the 1930s, which deviates the waters of the Jáchal River to the North and South channels that forms the base of the irrigation system, but it is not a reservoir. The Cauquenes was built in 1962 and Cuesta del Viento was inaugurated in 2001. As of 1994, there were 299.80 kilometers of irrigation ditches --212 of them unsealed (dirt ditches)-- while drainages amounted to only 44 kilometers, rendering a ratio of 0.15. This means that for each kilometer of irrigation ditches there are only 15 meters of drainage ditches. In other words, it was easier to transport the water to the farm that to take it out. Poor drainage is a key element in increasing the risk of salinization (Mainguet 1999).

The irrigated area is subdivided into five irrigation districts: Jáchal (16,437 Has), Niquivil (1,500 Has), Tucunuco (1,030 has), Mogna (1,500 Has) and Huaco (1600 Has including La Ciénaga)[100]. The Jáchal River irrigates all the districts except

[100] Punta del Agua, located at the end of the Huaco River, is formally included in the Huaco District. However, this small village has been under an acute process of depopulation, and is not taken in

Huaco, which depends on the Huaco River. The Agua Negra stream contributes to the irrigation of the districts of Niquivil, Tucunuco and Mogna. The location of the districts is displayed in figure 5.7 below. As can be seen, the districts are located along the Jáchal River, with the exception of Huaco located on the Huaco River. The figure also emphasizes how small the irrigated area is compared with the total area of the department.

An issue to keep in mind is that the relative location of the districts is important in determining the quality of the service and the quantity of water they receive. Farmers and ranchers in Jáchal, at the heads of the irrigation system, have historically been in a better situation that those in Mogna, at the end of the irrigation system.[101] This difference is exacerbated in times of drought or water scarcity.

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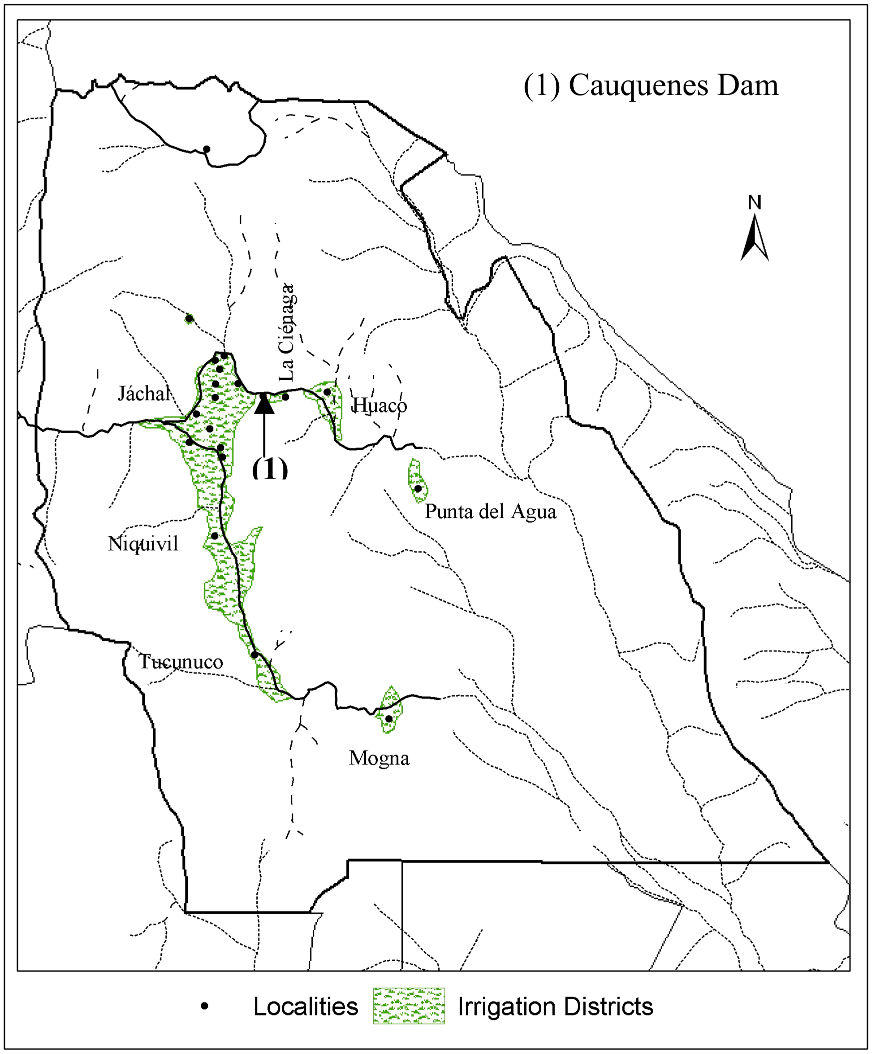
consideration in terms of the irrigated area. However, some farmers still rent land in the area due to the good quality of the soils and the adequate provision of water.

[101] "…The poorest producers, usually the furthest from the main outlets, seldom have the same access to regular and timely supplies of water as the larger, politically powerful producers who have close alliance with the managers of large systems…" (Yudelman 1989:67)

Figure 5.7: Irrigation Districts in Jáchal



Source: Own elaboration based in Lizana 2001.

According to the DH records, there are 22,000 hectares (54,363 acres) with water rights in Jáchal, but the actual area under cultivation has been consistently smaller. In 1988, the date of the last census of agriculture, the area set up for irrigation in the department amounted to 18,009.5 hectares (44,502.4 acres), but the area really irrigated was only of 6,439.9 hectares (15,913.3 acres), equivalent to 36% of the irrigation system.[102] The number of irrigated farms was 962 and 99.54 % of them relied on surface sources for irrigation (INDEC 1990).

There are several reasons for this situation, according to one of the key informants in the area.[103] One of them is related to the irrigation technology used in the department, by gravity: irrigation efficiency at the plot level with this technique is less than 50%, which means that more that 50% of the water is wasted. Efficiency at the level of the distribution network is also low due to the fact that most of the ditches are permeable and water is lost by infiltration or seepage. A second reason that would explain why the proportion of irrigated land in production is so low is simply that there is not enough water to irrigate all the land with water rights. According to the Water Code of San Juan, each farm with water rights in the province is entitled to 1 liter of water per second per each hectare. But the reality is that there is not enough water for everyone, and an "irrigation coefficient" is applied. This coefficient indicates what proportion of the amount fixed by law can realistically be served by the actual river discharge. For Jáchal, the coefficient is around 0.5, and varies each day (it is announced on the radio). It could be even lower in cases of hydrological crisis or emergency, i.e. drought. Finally, a third reason is

[102] The area systematized for irrigation represented only 1.2% of the total area of the department (14,749 sq kilometers).
[103] This information was provided by Alfredo Estévez, director of the Jáchal Experimental Rural Agency (AER/INTA), in August of 2001.

related to the natural salinity of the Jáchal River. Because the water is quite salty, farmers should use 30% more water than normally needed in order to keep the salt out of the soils.

Irrigated farming in drylands is frequently associated with salinization, which in turn is considered as one of the processes linked to desertification (Adamo1997; Thomas and Middleton 1993; Vera y Romero 1993; Mainguet 1999).[104] Jáchal is not the exception to this rule (Panocchia 1979; Adamo 1991). For example, Harza de Argentina (1971) reported salinization due to the salt contained in the waters of the Jáchal River as a potential problem, closely related to the availability of enough water to 'wash out' the salt from the affected soils. According to this same study, out of 40,478 hectares of potential agriculture land, only 20,528 hectares or 51% were really productive. Table 5.1 displays the distribution of potential agricultural land for the different irrigation districts.[105] As can be observed, there was a wide variation in the proportion of productive land for each locality, but in every case it was less that 50% of the total available agricultural land. While slopes appear as the main constraint in the Jáchal district, a third of the potential land in Mogna and Huaco is affected by salinization, and overall the Mogna appeared as the most disadvantaged district.[106] While potential land in slopes may be considered as definitively no suited for agriculture, lands affected by salinization may be recuperated. These results were

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[104] Basically, salinization is a form of chemical degradation that implies the accumulation of soluble salts and sodification (accumulation of sodium ions). The consequences include unstable soil structure, decreasing soil permeability and porosity, reduced biological activity and content of organic matter, elevated pH (around 9), and reduction of the natural or cultivated vegetation cover. Salinization may be due to natural processes (for example, excessive evaporation in arid climates) or it may be caused by human activities (for example, deficient irrigation techniques). In this last case it is called secondary salinization (Mainguet 1999:235)

[105] The irrigation districts of Jáchal, Huaco, Niquivil and Tucunuco are located mostly over fluvents soils, while the district of Mogna is situated over psaments (figure 5.5).

[106] The situation of the Niquivil and Tucunuco districts was not clear, because part of the "potential land" included in the acreage of the district was a large and naturally salty marshland.

similar to those presented by the SANINDTEC study of 1950 for the Jáchal and Niquivil-Tucunuco districts only (cited in Panocchia 1979).

Table 5.1: Distribution (%) of potential agricultural land in irrigation districts by agriculture capacity

District and Locality	Productive Land	Unproductive land due to		
		Salinity	Slope	Urban use
Jáchal (31,339 has)	40%	19%	41%	0.5%
Huaco (4,333 has)	41%	35%	23%	0.5%
Mogna (3,218 has)	35%	31%	34%	---
Niquivil/Tucunuco (1,588 has)	16%	74%	11%	---
Total (40,478 has)	39%	24%	37%	0.4%

Source: Own calculations based in data from Harza de Argentina (1971)

Salinization in the department was assumed to be the consequence of waterlogging, the lack of adequate drainage and the particular composition of the soils. This diagnosis combined issues related to certain peculiarities of the environment with the forms of management of the natural resources, particularly the irrigation system (Harza de Argentina 1971). The report affirmed that it was possible to recover at least part of these lands for agriculture by correcting some of these deficiencies through drainage and soil washing.

In sum, the seriousness of the salinization problems seems always to be associated with the amount of water available for both irrigation and washing. Panocchia (1979) cited two contrasting positions. The SANINDEC study of 1950 saw the amount of salt in the water as acceptable and not harmful for the crops, assuming that an adequate drainage for the irrigation water was in place. In contrast, the farmers complained about salinization when the amount of water was not enough to secure a good washing of the soils.

Another report (Centro Regional del Agua Subterránea San Juan 1972) affirmed that boron concentration in the waters of the Jáchal was extremely high: 4.5 mg/l when the maximum limit was set at 3.75 mg/l. The concentration of boron acted as a constraint for agriculture in two different ways: by limiting the available crops to those tolerant to boron (mainly onions, alfalfa, wheat, corn and olives) and by reducing the yields. Agriculture in the department was still possible because the excess of irrigation water during winter (the fallow season) was used to clean the salt from the soils.

The Cauquenes Dam: the extremes of the salinization problem

The Cauquenes Dam is a typical history of a human intervention in the environment gone wrong. The dam has affected mainly the population of Huaco, where there have been not so secret plans to blow the dam up to restore the original situation in the oasis, deemed as ideal by the population.

The Cauquenes dam was built in 1962 at the heads of the Huaco River, in a place known as La Boca de la Quebrada (see figure 5.7 above).[107] A number of temporary and occasional watercourses flowed to that place, and the springs that originated the Huaco River were nearby. In fact, the first two consequences of the dam were the disappearance of the springs, which were covered by sediments, and the waterlogging of the properties around La Boca de la Quebrada (Casas and Tejada 2001).

The bottom of the dam lake was not cleared from vegetation before the filling. This and the loss of the springs provoked water quality in Huaco to worsen

[107] Some documents indicate that this was not the original place, but a location in a small valley called La Ciénaga, at half distance between Jáchal and Huaco. It seems that farm owners in the area had enough political influence to move the construction site up the river in order to avoid the flooding of their properties.

almost immediately, first for drinking and then for irrigation. The Municipality of Jáchal (the local government for the department) had to provide and distribute fresh water for the Huaco population using trucks. However, there was no solution for the irrigation water, and the crops began to dry up due to the overall bad quality of the water and particularly due to an extremely high salt content. To make matters worse, a drought struck a few years later, from 1965 until 1971.[108] In the end, the traditionally diverse crop pattern of Huaco, which included fruit orchards, vineyards, cereals, vegetables and pastures, was replaced by a pattern of crops resistant to salt based on onions and quinces. The source for the drinking water changed from surface to ground water, through the drilling of a battery of wells. According to Casas and Tejada (2001:28), the increase of salt content in the water has been more than 150%, including chlorides and borates.[109] Out of the 1600 hectares under cultivation in 1965, only 768 hectares remained in 1978. A number of sources indicate that out- migration increased markedly during this period (Retamar 2001; Musso 1994; Casas and Tejada 2001).

Waterlogging

Waterlogging is another undesirable consequence of irrigation (Mainguet 1999). The process consists basically in arising the water table, sometimes as high as the surface. It has been linked to seepage from the unsealed irrigation ditches and to deficient drainage. In the case of Jáchal, it does not appear to be of the great concern in terms of the department, because none of the farmers declared waterlogging in

[108] It is possible that the drought increased salinization, since prevention of salinization seems to be closely related to the availability of water to wash the soils and eliminate the excess of salt. In the case of Huaco, a natural fluctuation of the ecosystem in combination with bad management greatly increased the desertification hazard.

[109] A. Estévez (director of the AER-INTA) measured an EC (electric conductivity) of 7000 micro ohms in the Huaco River down the dam. Irrigation water is considered useless when the EC is higher than 5,000 micro ohms.

his/her plot in the 1988 census of agriculture. There are some signs of waterlogging in the oasis of Jáchal, in San Roque and Niquivil south of San José, and it has been related to the consequences of the Cauquenes Dam in the fields near the lake.[110]

However, key informants mentioned waterlogging as a huge problem in Mogna, where the water table is near the surface in several places. The genesis of the problem is not clear yet, but it seems to include at least two elements: a) irrigation seepage through rise of the water table and lack of drainage, and b) some of the fields and the village are at a lower altitude than the riverbed. To make matters worse, all the Mogna area is salty (there are salinas surrounding the oases to the south and southwest) and the rise of the water table brings the salts to the surface, where they accumulate after water evaporates. This last cycle of waterlogging began 15 years ago. Land degradation has been marked and shows no signs of recovery yet.[111]

Natural Vegetation Cover and Deforestation

According to Morello and Matteuci (2000), native forests in arid and semi arid areas in Argentina have been exploited for firewood use in low-income rural and urban sectors, and also for wood for vineyards. In the case of Jáchal, all the respondents declared that they used firewood for heating and boilers in winter, and some of them also use it for cooking. According to my own observations and experience, the use of firewood for heating seems to be the rule for all the population not only the poor, even in San José (the urban area). The alternative to firewood is natural gas, which (1) is very expensive and (2) has to be paid in cash. On the other hand, firewood is free for most of the population, who just pick it up from their fields

[110] Interview with A. Estévez, 2001

[111] Interviews with A. Estévez (AER-INTA) and Liliana Ovalle (Delegación Municipal of Jáchal in Mogna), 2001

or where they can find it. This practice is not free of troubles, particularly near San José, where population density is higher and so is the demand for firewood, particularly during the winter months. This fact makes firewood gathering a profitable "harvest", especially for owners of fields without water rights. To protect ownership rights, firewood gathering or "harvest" requires a permit and is supervised or controlled by Gendarmería Nacional.[112] Those gathering firewood from a field other than their own and without permit risk punishment. However, this is more difficult to enforce in smaller villages and in more rural and isolated areas.

Other than firewood, natural vegetation has been traditionally used for the forage of goats. There were around 11,060 goats in the department in 1988, the year of the last census of agriculture. One of the key informants affirmed that there have been some signs of deforestation in the slopes of the mountains surrounding the oasis of Jáchal, one of the pasture areas, which may be connected to the reports of flooding in the area.[113] In the case of Jáchal, this is difficult to confirm since there are no records of past stocks, but there are some suggestive indications.

Soil Deterioration

Overall, soil deterioration is related to the onion monoculture for the last 50 years, combined with heavy tilling and agrochemicals, which have resulted in alterations of the soil chemical and physical structure despite high soil resilience.

A soil fungus, the "fusario", has persistently affected onion crops in the department of Jáchal. This fungus causes the onion to rot quicker, sometimes before it reaches the market, and compromises timely marketing. Farmers are aware of the

[112] Gendarmería Nacional, similar to the National Guard, is the corps in charge of border security in Argentina, although in occasions they may assume police functions. There is a permanent base in San José because the department of Jáchal is included within the frontier areas.
[113] Interview with Daniel Allende, PSA.

problem but not seriously worried about it. The main prevention is crop rotation. There also pesticides available, but they are expensive and increase the crop cost.[114]

ASSESSING ENVIRONMENTAL CHANGE AND DESERTIFICATION USING REMOTE SENSING DATA

Because of the lack of specific environmental studies and diagnosis for the department of Jáchal, I explored the evolution of environmental conditions and dynamics using remote sensing data for January of 1973, 1987 and 2001, using vegetation cover as the proxy for environmental conditions.[115]

The preprocessing of the remote sensing data included correction for differences in projection, rectification to the 1987 image and resampling of the rectified images. The vegetation index applied to the images was the Kauth –Thomas or Tasseled Cap Transformation. The processing of the images also included unsupervised classification and change detection through image differentiation and post-classification.[116]

A first indication of change over time can be observed in the histograms of the greenness index, derived from the Tasseled Cap transformation, for 1973, 1987 and 2001, which are displayed in figure 5.8. The curves for 1973 and 2001 are

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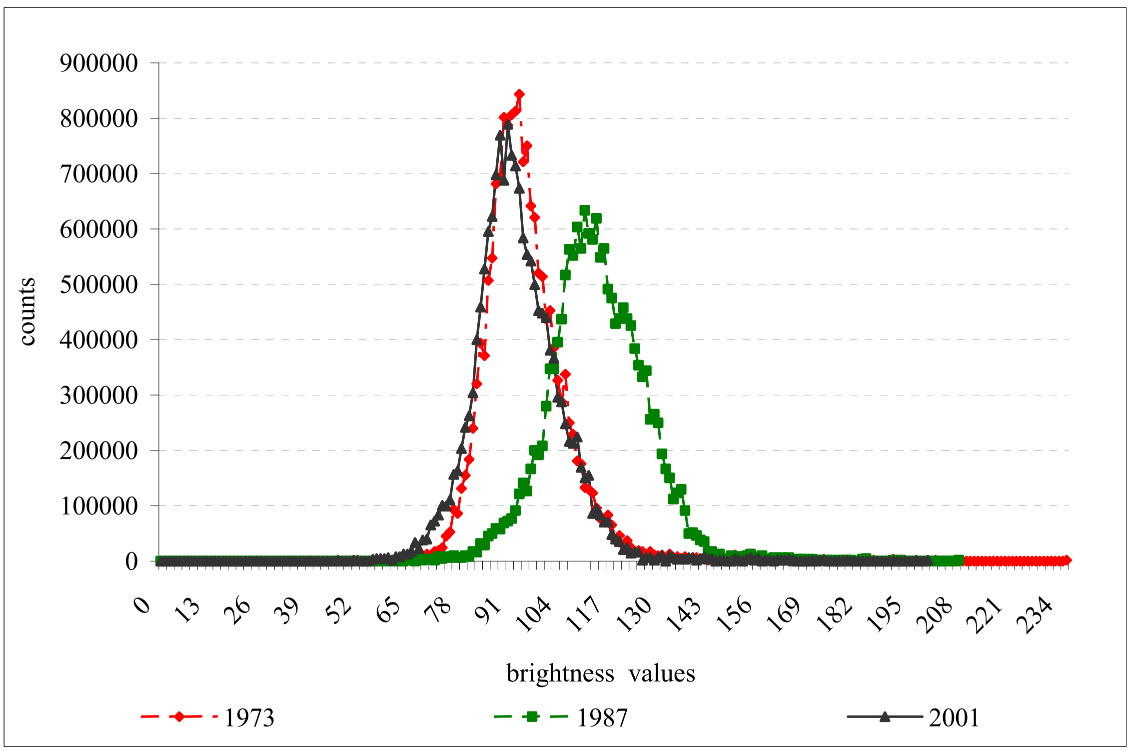
[114] Interview with A. Estévez, AER-INTA.

[115] The United Nations recommends the use of satellite derived vegetation indices as general indicators of the state of the environment in drylands. In theory, vegetation indices measure the evolution of vegetation activity as a consequence of meteorological and ecological conditions, and human activities in the drylands (United Nations Sustainable Development 1999: Chapter 12). The assumption behind this recommendation is that plant cover is the key issue in desertification. Plant cover could be an indicator of vulnerability to soil degradation, but also certain types of vegetation cover may indicate that soil degradation is taking place (Middleton and Thomas 1997:51). In practice, however, there are some caveats in the use of this type of index in arid land research since the relationships between desertification, land degradation and vegetation are complex and not completely understood as of today (Middleton and Thomas 1997:50).

[116] A detailed account of the methodology followed in the analysis of the remote sensing data is presented in Appendix A.

almost identical, while the one for 1987 shows a lower peak and a displacement toward higher brightness values. In the greenness index, brightness values are higher where the biomass or total amount of vegetation is higher or when the growing season is in its peak. Accordingly, these histograms suggest an overall increase in the amount of vegetation from 1973 to 1987, followed by an overall decrease between 1987 and 2001.

Figure 5.8: Greenness Index Histograms - January of 1973, 1987 and 2001



Source: Tasseled Cap Transformation of the 1973, 1987 and 2001 images.

The image differentiation results presented in table 5.2 qualified the type of change observed in figure 5.8 into five categories. All the increases and decreases refer to biomass. As can be seen, the category "some increase" dominates the 1973-

87 period, while the opposite category, “some decrease”, represents more than 90% of the pixels in the 1987-01 period. This is coincident with what the histograms in figure 5.8 show.

Table 5.2: Greenness Index Image Differentiation Results, by period

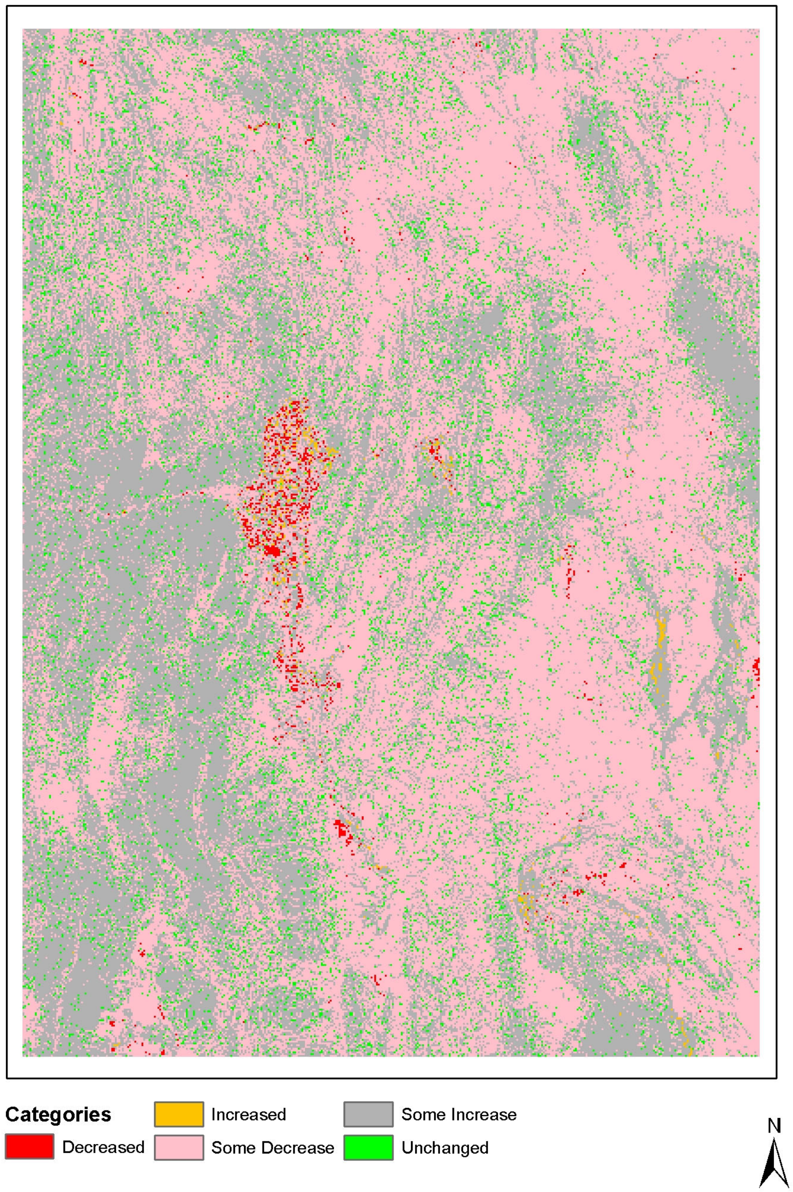
Change Category	1973-1987	1987-2001	1973-2001
Decreased (20% and more)	0.2	4.5	0.5
Some decrease (1 – 19%)	2.4	**93.7**	**56.1**
Unchanged	0.5	0.1	6.0
Some increase (1 – 19%)	**94.3**	1.1	**37.1**
Increased (20% and more)	2.7	0.1	0.3
Total	100.0	100.0	100.0

Source: Tasseled Cap Transformation of the 1973, 1987 and 2001 images.

The figures for the entire period, 1973-2001, indicate that more than 50% of the pixels are included in the first two categories, decrease, while about 37% are included in the last two, increase. On the whole, the total amount of vegetation appears to have decreased during the 28 years period, although the majority of both the increase and the decrease were low to moderate (between 1% and 19% of the original brightness values). This may be an indication that there is not a cyclical return to the initial state or conditions of January 1973, as figure 5.8 seems to indicate, but a net decrease in biomass.

Visual examination of the maps displaying the greenness index image differentiation results (figures 5.9 to 5.12) gives an idea of the spatial distribution of the areas of change. Figure 5.9 displayed the areas that changed between 1973 and 2001, following the categorization of table 5.2.

Figure 5.9: Greenness Index Image Differentiation Map, 1973-2001

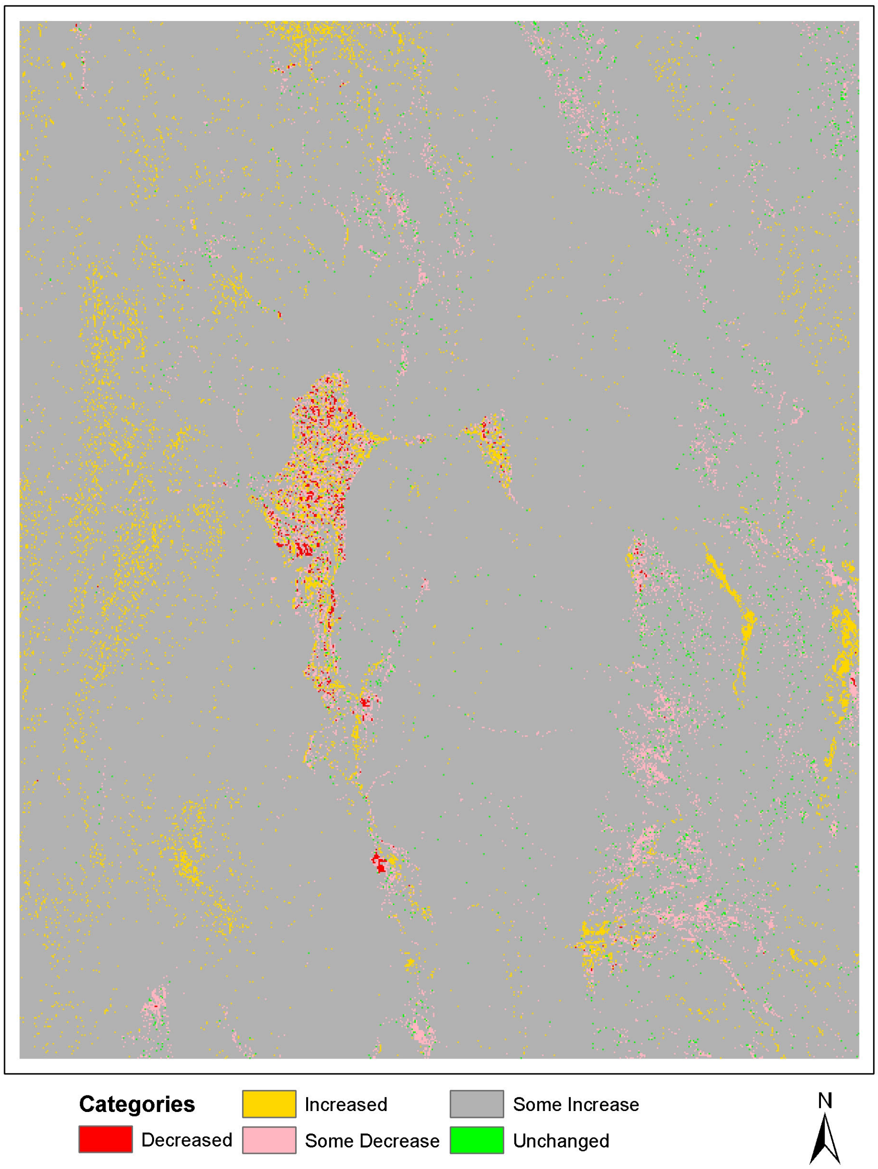


Source: Image differentiation of the greenness indexes from the Tasseled Cap transformation, 1973 and 2001 images

Small patches of increased (20% and more) vegetation areas are visible in the irrigation districts --Jáchal, Huaco, Tucunuco, Niquivil and Mogna-- as well as in small areas of the Travesía de Ampacama on the east. The areas where vegetation decreased 20% or more are mostly concentrated in the main irrigation areas, especially in the south of Jáchal, Tucunuco, Huaco, and to less extent Punta del Agua. The areas showing some increase or decrease in biomass are intertwined across the rest of the department, mainly in the areas out of the oases and on the east: the mountains, the sierras and the south and center sections of the travesía, all of these areas of natural vegetation cover. Finally, the areas of some increase correspond to the mountains and sierras, especially in the west. It is apparent that the total area of some decrease (areas in pink) is larger than the total area of some increase (areas in gray). These results indicate that those sections of the department where changes between 1973 and 2001 were larger coincide with the areas of settlement and agriculture.

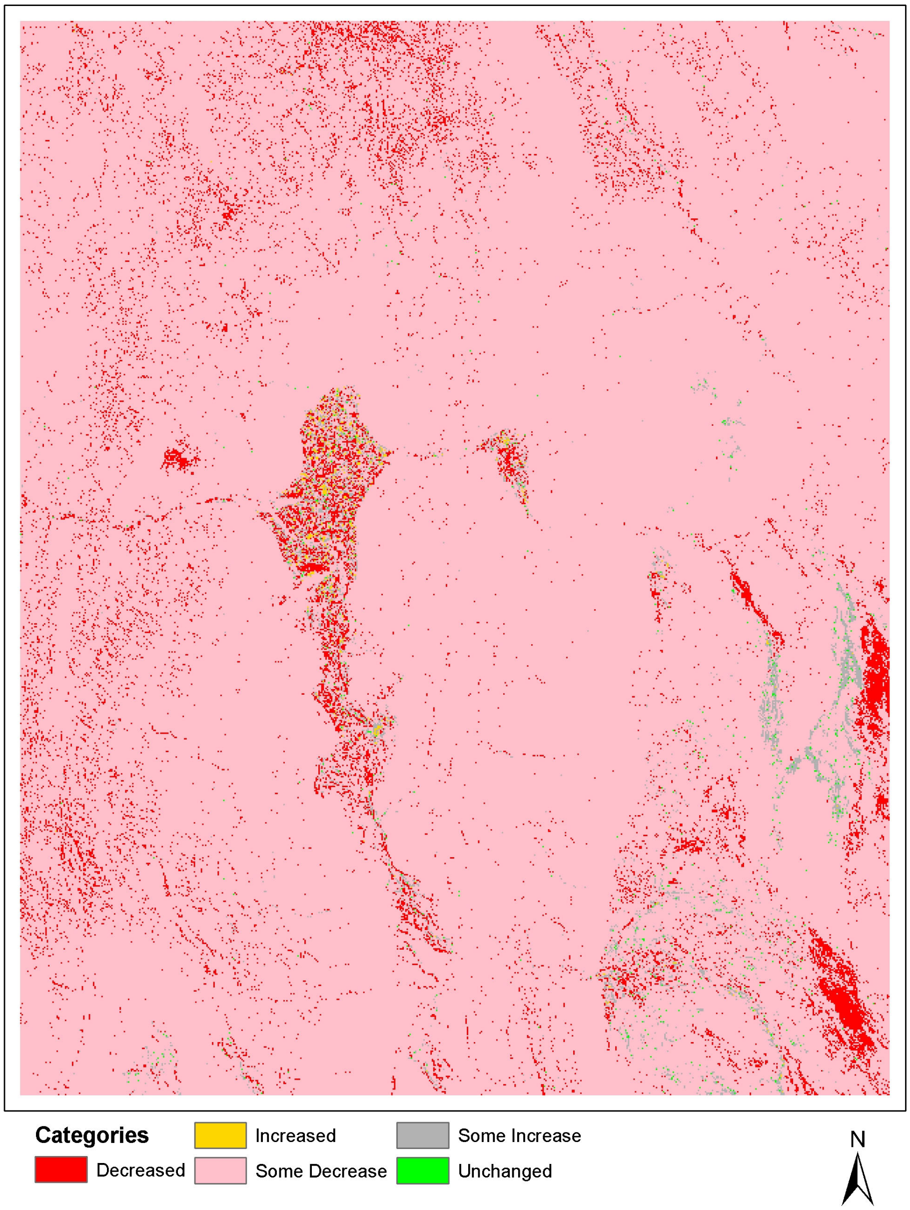
Figures 5.10 and 5.11 give a first approximation to the timing of the changes in the different areas.

Figure 5.10: Greenness Index Image Differentiation Map, 1973-1987



Source: Image differentiation of the greenness indexes from the Tasseled Cap transformation, 1973 and 1987 images

Figure 5.11: Greenness Index Image Differentiation Map, 1987-2001



Source: Image differentiation of the greenness indexes from the Tasseled Cap transformation, 1987 and 2001 images

For the 1973-87 period, displayed in figure 5.10 above, the areas of some biomass increase are outside of the irrigation districts and dominate the image. Places where vegetation presents a 20% or higher decrease were concentrated in the irrigation areas, with the exception of the oases of Mogna. They are particularly visible in the south of Jáchal, Niquivil and Tucunuco. The areas of 20% or more increase are scattered in non-irrigated areas –the natural grazing areas in the mountains to the west and north, and in some saline areas of the travesía-- and in the irrigation district of Mogna. The areas of some decrease were located in the travesía and in the irrigation districts.

The map for the 1987-2001 period, displayed in figure 5.11 above, shows a broad dominance of the areas of some biomass decrease (1 to 19%). The sections where vegetation increased 20% or more are visible in some of the oases –Jáchal, Niquivil and Huaco-- and in the travesía on the east. Large areas of biomass decrease can be observed on the southeast, close to areas of some increase that seem to follow stream courses. Other places of decrease are scattered in all the irrigation districts and in the mountains on the west and north, almost reverting to the 1973 state.

The distribution of the department area according to the unsupervised classification categories for 1973 and 2001 is displayed in table 5.3. As can be seen, there are some differences in the distribution of the classes between 1973 and 2001, but in both years bright vegetation represents the smallest proportion.[117] There was a decrease in the two vegetation categories, from 17.3% of the total area in 1973 to 10.5% in 2001, which agrees with the results in table 5.2. The next step is to look at the origin of these different figures.

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[117] This is consistent with the small proportion of the department area suited for agriculture and with the general low soil coverage of the natural vegetation cover.

Table 5.3: Distribution of the department area by class, 1973 and 2001

Classes	1973		2001	
	Area (Has)	**%**	**Area (Has)**	**%**
1. Residual (rocks, water, etc.) R	474,251.9	31.4	609,076.9	40.3
2. Bare soils BS	604,659.2	40.0	555,075.4	36.8
3. Bright bare soils (salt, sand, etc.) BBS	168,973.4	11.2	186,195.7	12.3
4. Bright vegetation BV	19,583.3	**1.3**	3,721.4	**0.2**
5. Other vegetation OV	242,413.1	**16.0**	155,811.4	**10.3**

Source: Unsupervised classification of the 1973 and 2001 images.

Table 5.4 below displays the change detection matrices 1973-2001, in terms of both percentages of pixels and area.[118] The numbers in the diagonals (shadowed in grey) indicate the percentage of pixels and their correspondent area that remain in the same category from 1973 to 2001. For example, "77.9" in the left up corner indicates that 77.9% of the pixels in the category 'residual (rock, water, etc.)' in 1973 were in the same category in 2001, while the rest (22.1%) was distributed in other categories, in other words, changed between 1973 and 2001.

Looking first at the vegetation categories (BV and OV), we can see that a little more than 50% of pixels included in "bright vegetation" in 1973 were classified as "other vegetation" in 2001, while just 13% remained in the same category, and the rest (32%) was included in non-vegetation categories. Regarding "other vegetation", 55% of the pixels passed to the residual category, and 30% remained in the same. In the case of the "bright bare soils", which includes the saline areas, almost 50% remained in the same category, and 55% changed to "bare soils". Conversely, 14%

[118] A pixel is a two-dimensional picture element that is the smallest nondivisible element of a digital image (Jense 1996:17). In this analysis, pixel dimensions are 30x30 meters.

of the bare soils changed to bright bare soils between 1973 and 2001. Finally, most of the residual category (78%) remained the same, but about 10% of it changed to “other vegetation”.

Table 5.4: Change detection matrices: 1973 to 2001

Percentages (%)

Classes	**2001**				
1973	1. R	2. BS	3. BBS	4. BV	5. OV
1. Residual (rocks, water, etc.) R	77.9	10.96	1.53	0.01	9.60
2. Bare soils BS	16.05	66.33	13.97	0.09	3.55
3. Bright bare soils (salt, sand, etc.) BBS	3.72	44.49	47.75	0.16	3.87
4. Bright vegetation BV	15.82	12.16	4.08	12.52	55.43
5. Other vegetation OV	54.94	10.09	5.34	0.16	29.46

Area (Has)

Classes	**2001**					
1973	1. R	2. BS	3. BBS	4. BV	5. OV	**Total 1973**
1. Residual (rocks, water, etc.) R	369,464.3	51,986.7	7,261.7	26.5	45,512.5	474,251.9
2. Bare soils BS	97,053.2	401,059.3	84,493.1	574.1	21,479.5	604,659.2
3. Bright bare soils (salt, sand, etc.) BBS	6,279.1	75,182.4	80,690.9	277.9	6,543.0	168,973.4
4. Bright vegetation BV	3,097.5	2,380.8	798.3	2,452.3	10,854.4	19,583.3
5. Other vegetation OV	133,182.7	24,466.2	12,951.6	390.5	71,422.0	242,413.1
Total 2001	609,076.9	555,075.4	186,195.7	3,731.4	155,811.4	1509,880.9

Source: Change detection of the unsupervised classification of the 1973 and 2001 images

The map in figure 5.12 displays the spatial distribution of the combined 25 "from-to" categories of the change detection matrix (one for each cell), recoded now to nine categories to make the map easier to read. This recodification was framed around the vegetation categories (BV bright vegetation and OV other vegetation), as can be seen in the map legend. Newly vegetated areas correspond to places that changed from non-vegetation categories (rock, bares soils, bright bare soils) to vegetation categories (bright or other vegetation). Areas where loss of vegetation may be presumed are those that changed from vegetation categories to non-vegetation categories.

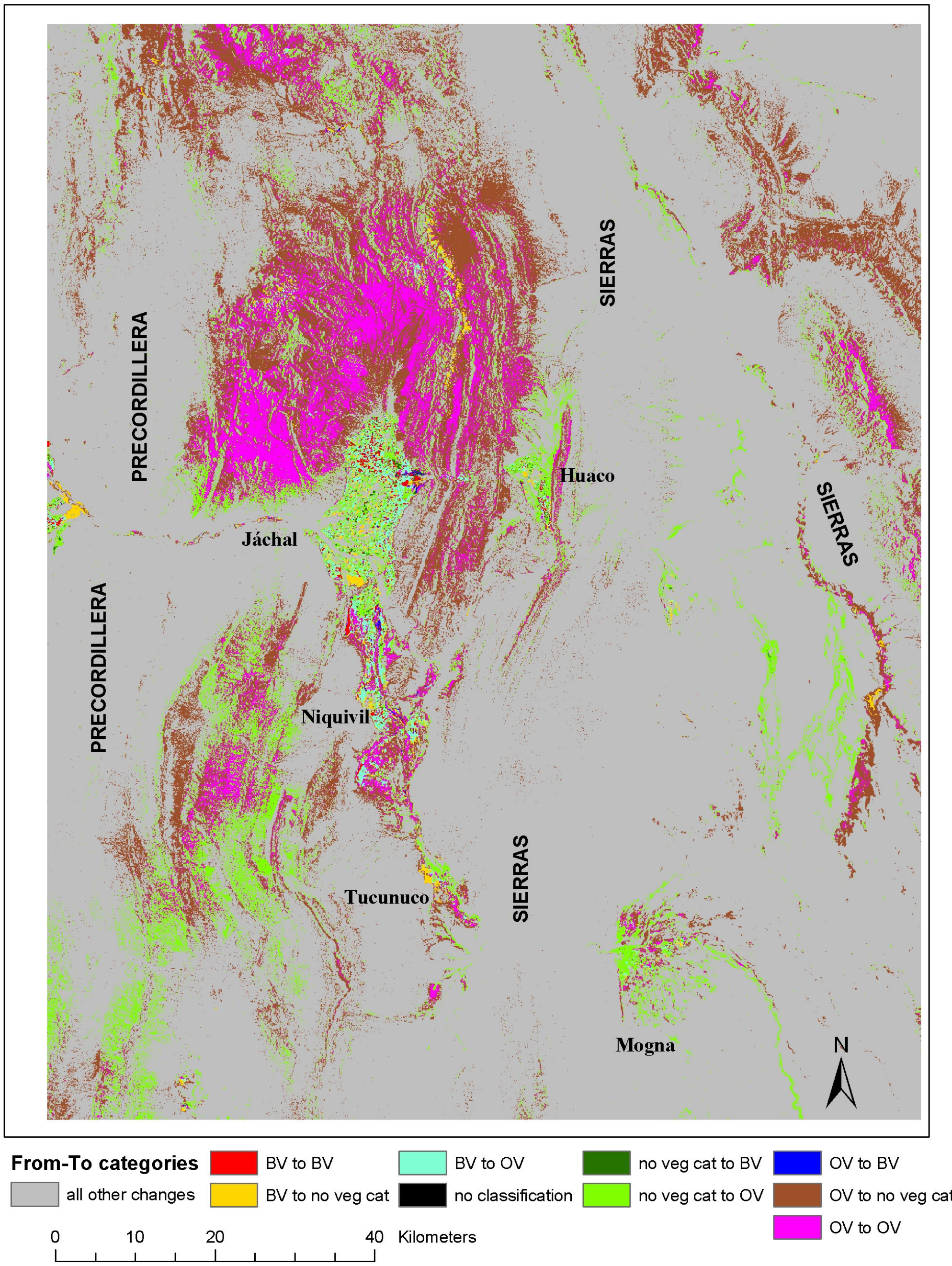
Two clear sectors are visible in the image: those where changes related to vegetation or biomass took place, and those where they did not. The places of changes related to vegetation --which corresponded mostly to irrigation districts, population centers and grazing areas-- seem to be grouped in two north-south bands between the places where changes were not related to vegetation. These last places (in grey in the map) follow the trace of mountains (the Precordillera) and sierras, and are the areas where no vegetation or biomass was detected in 1973 or in 2001, according to these results.

Sections that lost vegetation (in brown and yellow in the map) are concentrated in the north, west and southwest of the Jáchal oases, close or nearby the grazing zones where the "puestos" are located. There are also some visible patches in the irrigated areas, notably between Jáchal and Tucunuco.

However, the grazing and puestos areas themselves --surrounding Jáchal by the north, on the west of Niquivil-Tucunuco and in the upper north limit of the image (puesto Gualcamayo)— seem to be places of non-change between 1973 and 2001 in terms of vegetation. Other areas of no change are scattered in the irrigation districts, notably Niquivil.

Small areas that kept their dense bright vegetation (in red in the map) are visible in the Jáchal district (in the north and in the south), nearby areas that showed higher biomass density in 2001 than in 1973 (OV to BV) and others that displayed lower density (BV to OV). Areas that gained vegetation appear concentrated in the center and south of the department. They correspond to the irrigation districts, the areas surrounding the puestos zone west of Niquivil-Tucunuco, and some small patches in the travesía, following the stream courses.

Figure 5.12: Change detection map, 1973-2001

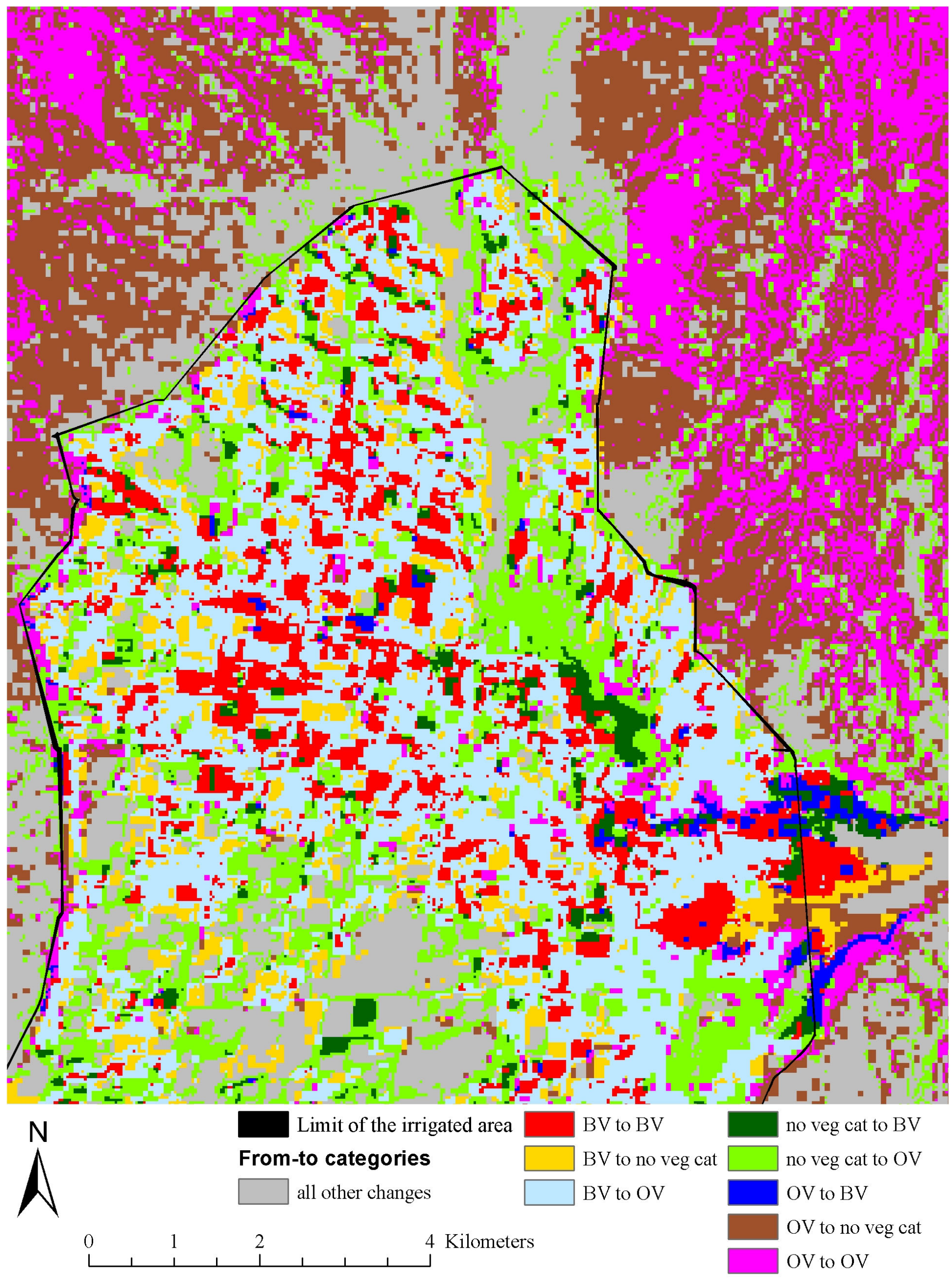


Source: Change detection matrix, 1973 to 2001

The next step takes a closer look at each of the interview sites, which are displayed in maps 5.13 to 5.15. In the case of Jáchal Central (figure 5.13), the areas outside of, but close to the irrigated districts show zones of vegetation loss combined with areas that kept their original characteristics. The areas of loss correspond to the piedmonts, sloped places where vegetation loss may eventually accelerate erosion due to runoff, increasing also the risk of flooding for people living nearby and of damages to the irrigation channels that follow the district limit. The areas that preserved the vegetation density are more distant from the oases.

A patched pattern appears in the irrigation district itself. Areas that lost vegetation density between 1973 and 2001 surround areas that preserved a higher density, while both areas that gained and lost vegetation enclose sectors without vegetation. The overall impression is that bright, dense vegetation may be disappearing in the irrigated area.

Figure 5.13: Change detection map, 1973-2001, Jáchal Central.

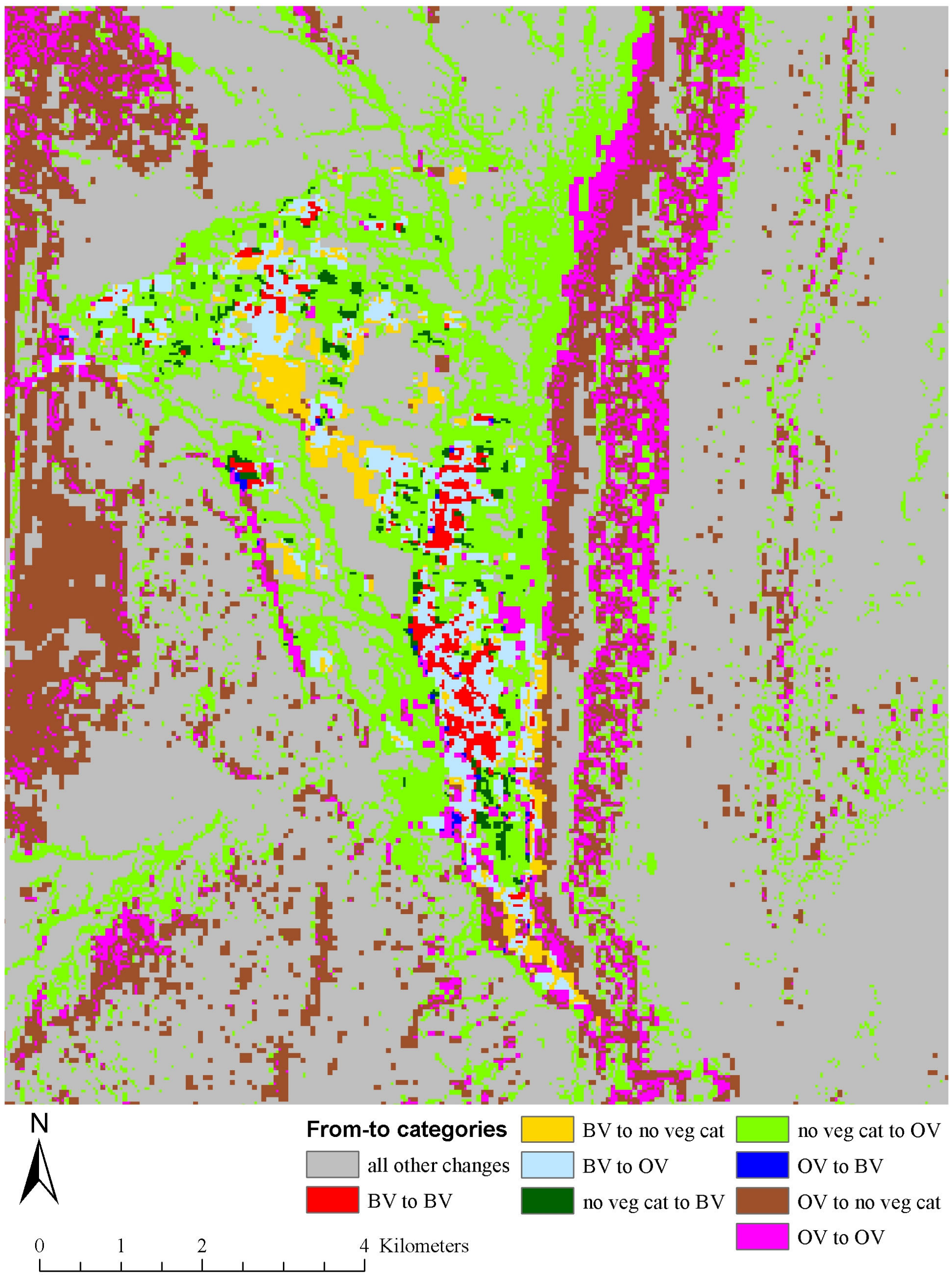


Source: Change detection matrix, 1973 to 2001

Figure 5.14 shows the classical triangle-like form of the Huaco oases. The area without detectable biomass in 1973 and 2001 (in gray) appears proportionally larger than in Jáchal Central, and is found even within the irrigated area. Two areas of vegetation loss are concentrated in the sierras to the west and east of the oases. As in the case of the piedmonts in Jáchal, the loss of vegetation in these sloped sectors increase the risk of hydrological erosion, flooding and damage to the irrigation channels.

The oases itself appear to be divided in two sectors, one on the north and the other on the east. Areas without vegetation and areas that went from bright vegetation to no vegetation (visible as quite large yellow patches) separate these two sectors. As in Jáchal Central, there is a pattern of bright vegetation areas encircled by areas that have lost density, particularly in the east sector (where most of the village population is concentrated). A significant amount of the oases area seems to have gained low-density vegetation.

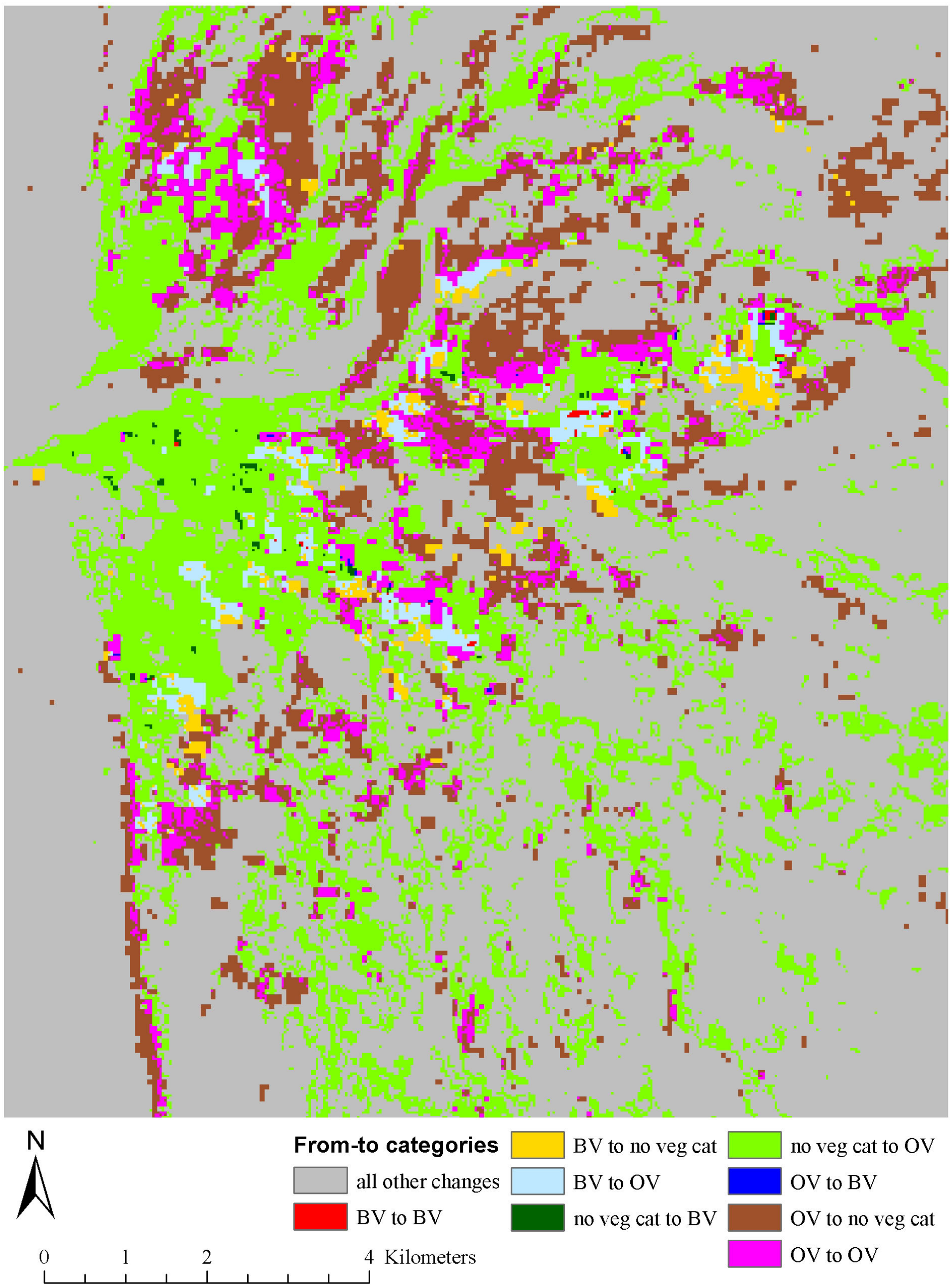
Figure 5.14: Change detection map, 1973-2001, Huaco



Source: Source: Change detection matrix, 1973 to 2001

Finally, the spatial distribution of the “from-to” categories for Mogna is displayed in figure 5.15. The dendrite pattern of the oasis is apparent , similar to a delta, where the two categories of areas that form the dominant features of the image –i.e. those without vegetation and those that have gained vegetation) are interlaced. The areas that gained low-density vegetation appear as the central element of the image. There are no areas of bright vegetation left, although there were in 1973. They changed to other vegetation (lower density) or appeared in 2001 as areas without vegetation. This is also the case of some areas that had lower density vegetation in 1973. The areas that lost density or vegetation (light blue, yellow and brown patches) seems to be arranged or concentrated in a ring around the main area where vegetation recovery. This “ring” could be the area of waterlogging.

Figure 5.15: Change detection map, 1973-2001, Mogna



Source: Source: Change detection matrix, 1973 to 2001

In sum, the results show cycles of decline and regeneration associated with moisture availability in the department, but also a net decline in biomass, as measured by the greenness index, between 1973 and 2001, despite the recuperation of 1987. There was also a slight increase of areas of saline and sandy soils, which may or may not be an indication of land degradation and eventually desertification.[119]

Where the changes took place, it means, their spatial distribution, may provide clues about the character of the main underlying process, especially since the character of the changes was different in the irrigation districts and in the rest of the department, as shown by the greenness and change detection maps. The areas where change in greenness was classified as 20% or more were consistently located in the oasis. Also, the irrigation districts and to a lesser extent the grazing areas displayed a fragmented or patched pattern in the distribution of the type of changes. These may indicated not only more changes but also more aggressive ones.

It is possible to hypothesize that the modifications in the irrigated and populated areas are more likely due to social processes, while changes in the rest of the department could respond to natural processes. An example could help to illustrate this point. Tax incentives for crop diversification increased olive plantations in large extensions of Jáchal and Huaco during the last part of the 1990s.[120] This tree needs between 5 and 8 years to grow, and in between the soil may

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[119] A bright soil is almost always an indication of salty land, not apt for agriculture. However, appearance of increasing biomass may not indicate better conditions. During fieldwork in Mogna, I observed that in areas under waterlogging plant cover seemed dense and green (although soil coverage was low). However, most of these plants were useless halophytes ("jumes" is their local name) not suitable to feed the goats. In the end, the extremely salty water ascending from the almost superficial water table would eventually kill them, and the area will appear as bare bright soils, due to the accumulation on salt on surface.

[120] It is said that almost 50% of Huaco agricultural area is under olives, and belongs to just one owner.

appear bare because of the very low coverage of the young trees. This could be an explanation of the large patches of areas that lost bright, dense vegetation in Huaco. The loss of vegetation around the oasis of Jáchal (for example, on the north and east) may be consequence of overgrazing and deforestation. Increases in salty and sandy areas could be due to a particularly dry summer if located in the travesía, or to inefficient irrigation management if located in the oases.

The evidence presented so far in this chapter does not allow concluding that a generalized process of desertification is happening in the department of Jáchal. It is difficult to decide if the changes assessed in the remote sensing analysis correspond to a land degradation process or if they are just part of the cyclical dynamics of this arid environment. The images, a fixed point in time, may be registering just a stage of an on-going process, whose evolution is unknown. However, it is likely that vegetation losses in the irrigated and pasture areas point to incipient and currently localized processes of land degradation that could eventually trigger desertification if they overcome the resilience of the agro-ecological system.

SUMMARY AND CONCLUSIONS

The analysis of the different information and data sources suggests a complex but interesting panorama with respect to environmental hazards in Jáchal, their evolution and nature. Overall, aridity represents at the same time the main characteristic, the main environmental constraint and the main hazard of the department of Jáchal. Aridity means that water shortages in general as well as seasonal and inter-annual variations in water availability are the norm. Climatic events as droughts, floods and hailstorms add to the hazard posed by the characteristics of the arid climate. The drainage is limited, with multitude of occasional and temporary courses and just two permanent rivers, the Jáchal and the Huaco, which have structured population settlement. Soil quality is not optimal and natural vegetation cover is low, although extremely modified in the irrigated areas.

However, aridity is not alone, and its effects are complicated by natural resources management issues as well as by other social problems related to agriculture and settlement in arid lands. In Jáchal, the main natural resources are water, land and to a less extent the natural vegetation cover, and irrigated farming and ranching have profoundly modified the natural landscape.

In chapter 2, land degradation was defined as

> [The] reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of […] irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical and biological or economic properties of soil; and (iii) long-term loss of natural vegetation. (United Nations 1994)

Most of these items were mentioned in the chapter. Seemingly, the forms of management has led to a number of environmental problems, among them salinization, waterlogging, deforestation and soil infestation, but the seriousness of these problems cannot be wholly addressed, and in addition the incidence of the problems present marked spatial variations. Nevertheless, the evidence presented in this chapter lets us conclude that land degradation should be included among the environmental hazards in Jáchal. However, it is not yet a rampant desertification process.

The relative influence of human and natural factors in land degradation in the department are hardly to assess, since environmental constraints have interplayed with forms of use and management of natural resources for a long time. For example, the irrigation system buffers some of the effects of aridity but the particular irrigation system (gravity) contributes to land degradation by increasing salinization. In turn, the typical problems of gravity irrigation systems are exacerbated by the salty quality of the waters of the Jáchal River.

Although will be addressed in alter chapters, lets just say here than the long-term population-environment relationship suggests that people in Jáchal are used to the type of hazards represented by the natural constraints and the environmental problems associated to forms of management. They have coped with and adapted to them, in different ways.

Chapter 6. Experiences of Environmental Hardship

> Usually therefore, any changes in both the natural and socio-economic environment are interpreted in terms of its effect upon the security of livelihoods. *(Blaikie 1994:75)*

In previous chapters, I presented the relevant physical characteristics and dynamics of Jáchal's environment, reviewed the available information about environmental problems and explored environmental change through the analysis of remote sensing data. In this chapter I will look at households' experience of environmental hardship, i.e. that part of their hardships that is related to physical dynamics, characteristics or conditions of their environment in its dual role of context and provider of production inputs (land and water).

As was mentioned in chapter 2, environmental factors may affect or influence households' migration in three ways (Bilsborrow 1992:3-4): a) by affecting income, b) by increasing risk, or c) by making the environment less pleasant or healthful.

Based on this typology, I am particularly interested in exploring two different but interconnected aspects of environmental hardship. One of them is the incidence of environmental problems in agriculture and other productive activities, especially on the availability and distribution of natural resources such as agriculture land, water and pastures. This aspect is related to Bilsborrow's paths (a) and (b). A second and concomitant aspect is the effect of environmental stress on the every-day life of people living in an arid environment and in a fairly poor and underdeveloped setting, which may be incorporated in path (c).

I consider that it is important to examine both aspects as they applied to livelihoods. While the effect of environmental hardship on agriculture may eventually compromise the production dimension of livelihoods, its effects in every-day life may compromise the reproduction dimension as well.

In both cases, mediations or intervening factors should be taken into account in the interpretation of environmental hardship, even though these mediations may be not present in the responses. Institutional arrangements, the characteristics of the dwelling, access to infrastructure and services, and poverty levels may have an effect on the exposure to and the effects of the impacts of natural phenomena.

Despite the existence of an irrigation system in the department that should protect against the effects of water shortages, water availability and distribution is expected to be *the* critical issue and the focal point for potential conflicts among actors. However, a number of other environmental concerns in addition to water scarcity became visible in the responses, among them salinization, drought, floods, hail, wild life, plagues and weeds, soil quality, and waterlogging. Some of these issues relate to the typical characteristics of an arid environment while others are linked to possible on-going processes of land degradation.

Although not structured in an independent module, the 2001 household interview questionnaire included questions that attempted to capture these experiences, enlightening the different ways in which people's lives are affected by their physical environment.

TEMPORAL AND SPATIAL DIMENSIONS OF ENVIRONMENTAL HARDSHIP

It is apparent from the interviews and particularly from the histories of the older respondents that environmental matters have temporal variations during the year and also from year to year. For example, summer seems to be a particularly critical time. It is the rainfall and snowmelt season when most of the scarce and sometimes violent rainfall occurs, and consequently it is also the stream flooding period. Obviously, summer is also the hottest season with the highest evapotranspiration figures and climate discomfort for the population. Finally, the end of the summer is the growing and harvest season for most of the crops and the time when they are most vulnerable to damage, for example hail. In addition to seasonal variations, certain problems show a clear starting date. An example of this is the acute salinization process in Huaco, which followed the construction of the Cauquenes Dam in 1962. Other environmental problems appear to be recurrent issues that repeat themselves in broad cycles of decades. The current waterlogging in Mogna, for example, started around 1985, but at least one of the respondents remembered another cycle during the 1940s. Because of these temporal variations, older and younger respondents may have experienced different forms of environmental hardship.

Given that settlement in the area began no later than the 18th century, population may be adapted to the "normal" variability of physical environmental conditions, but not to the emergence of processes of change like those typical of land degradation, like waterlogging and salinization.

The environmental context and the distribution of natural resources vary across space. This makes a difference in people's lives, and a clear example is the distribution of water sources in arid environments. Monimart (1989:17), in her research about the effects of desertification on Sahelian women's lives, found that the perception of such effects changed according to or was tied to the gradient of the agro-ecological zones of the Sahel.[121] She also found that the perception of the

[121] "…The impact of the ecological milieu [in the perception of desertification] seems to be more determinant that any ethnic or country identity…" (Monimart 1989:18). The Sahel's degree of aridity declines from north to south, and Monimart found that responses varied following this gradient. For

socioeconomic impacts of desertification –such as increasing domestic work, male out migration and increasing poverty-- was higher than the perception of any specific *ecological* impact per se.

Although the geographic scope of this research is narrower that Monimart's and the overall environmental conditions are more uniform across the department than they are across the entire Sahel, nevertheless I think that it is worthwhile considering the potential influence that each particular interview site exerts on the perception of hardship because of its specific combination of environmental conditions and locality. According to this rationale, the responses about environmental hardship are presented separately for each interview site. This might seem excessive given the limited number of interviews, but I think that would add clarity to the analysis by linking more closely the respondents' experiences to the physical characteristics and processes of particular environments. Tables 6.2 to 6.4 display the list of environmental problems for each interview site, as well as the effects on every-day life and on agricultural activity. I began with a brief reference to the quality of houses and their access to services.

DWELLING QUALITY

Poverty and vulnerability are measured in Argentina using two different approaches. One of them is the poverty line, which takes into account the household's income. The other measure is structural poverty, a household level index composed of a number of indicators: household head's sex and educational level, household members' schooling, overcrowding (the relationship between the number

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example, 57% of the responses mentioned lack of water as a problem associated to on-going desertification in the northern zone against 95% in the southern one. The author attributed this to the fact that water scarcity is a usual circumstance in the northern region.

of rooms in the house and the number of members of the household) and the characteristics of the dwelling (INDEC 1984; CEPA 1994a). The index is known as unfulfilled basic needs or NBI (for its acronym in Spanish). A household is considered to have NBI if any of the following characteristics applies: household heads without schooling, overcrowding (more than three persons per room), or substandard dwellings, including here inadequate water services or an inadequate lavatory (generally outside of the house) (Forni and Neiman 1994).

Of interest in this chapter are the characteristics of the dwellings of the households in the sample.[122] The quality of the house, in the terms outlined above -- by acting as filter, mediator or intermediate variable-- makes a difference in how people visualize and endure different types of environmental hardship in every-day life.

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[122] According to NBI, houses are classified as A or B. B houses are those considered as precarious because: a) they do not have access to water inside the house, b) they do not have a bathroom inside the house, or c) they have dirt floors.

Table 6.1: Characteristics of the houses

#	Couple's names	Place	Built in	Floors	Roofs	Bathroom	Water	Precariousness
1	Aníbal and Rosa	Huaco	Adobe	Cement	Cane	In	Tape water	N
9	Alejandro and Maria	Huaco	Brick	Tile	Cane	In	Tape water	N
12	Pablo and Lorena	Huaco	Adobe	Tile	Cane	In	Tape water	N
13	Matías and Paula	Huaco	Adobe	Cement	Cane	In	Tape water	N
20	Enrique and Rosalía	Huaco	Adobe	Tile	Cane	In	Tape water	N
3	Manuel and Francisca	Jáchal C	Brick	Cement	Cane	In	Tape water	N
16	Nora	Jáchal C	Adobe	Dirt	Cane	In	Ditch (treated)	Y
19	José and Andrea	Jáchal C	Adobe	Dirt	Cane	In	Tape water	Y
8	Nicolas and Ana	Huaco	Adobe	Cement/dirt	Cane/plaster	Out	Tape water	Y
18	Mario and Catalina	Huaco	Adobe	Cement	Cane	Out	Tape water	Y
2	Leoncio and Pura	Jáchal C	Adobe	Dirt	Cane	Out	Ditch (treated)	Y
7	Domingo and Clara	Jáchal C	Adobe	Dirt	Cane	Out	Municipality	Y
17	Alberto and Beatriz	Jáchal C	Adobe/revoque	Dirt/cement	Cane	Out	Ditch (treated)	Y
21	Pedro and Claudia	Jáchal C	Adobe	Cement	Cane	Out	Ditch (treated)	Y
4	Guillermo and Elena	Mogna	Adobe	Dirt	Cane	Out	Tape water	Y
5	Eduardo and Catalina	Mogna	Adobe	Dirt	Cane	Out	Tape water	Y
6	Agustin and Irma	Mogna	Adobe	Dirt	Cane	Out	Ditch (treated)	Y
10	Martin and Patricia	Mogna	Adobe	Dirt	Cane	Out	Ditch (treated)	Y
11	Javier and Mariana	Mogna	Adobe	Dirt	Cane	Out	Tape water	Y
14	Omar	Mogna	Adobe	Dirt	Cane	Out	Ditch (treated)	Y
15	Alfredo and Cristina	Mogna	Adobe	Dirt	Cane	Out	Ditch (treated)	Y

Source: Compiled from the Interviews in the Department of Jáchal.

Note: Couple's names are fictitious.

Table 6.1 displays the housing characteristics of each household, sorted by condition of precariousness. As common characteristics, all the houses but two were made of adobe and all of them had cane roofs. Also, 15 out of 21 households in the sample may be classified as precarious (low quality). Most of these precarious houses shared two characteristics: bathrooms (latrines would be a more accurate word) outside the house and dirt floors. The relation ‘precarious houses to all houses’ was 2/7 in Huaco, 6/7 in Jáchal Central, and 7/7 in Mogna, which suggest differences in living conditions among the three locations in terms of quality of lodgings.

Important in arid environments is water availability. The table shows that 12 households had access to tap water through pipe distribution systems. This included all the non-precarious houses and six of the precarious ones. The other eight houses used water from the irrigation ditches treated with chlorine. Finally, the Municipality of Jáchal provided water for the last household by truck.

MOGNA

Table 6.2 displays the environmental problems mentioned by Mogna’s respondents, as well as their perceived consequences for agricultural activity and for every-day life. The list includes waterlogging, drought and water scarcity due to reasons other than drought, as well as other problems like weed proliferation and wild cats.

Waterlogging dominated the testimonies of environmental hardship, and it is assumed to be responsible for the decadence of the village. It appears as the main environmental problem in terms of the diversity of effects on every-day life and on agricultural activity.[123] In the case of Mogna, it is a desertification process because it involves land degradation in arid lands. As mentioned in chapter seven, it basically consists in the rise of the water table, sometimes to the surface where it forms saline swamps. Waterlogging in Mogna also implies acute salinization because of the salty character of the soil composition.[124]

Waterlogging appears to be a recurrent problem in Mogna. Older respondents remembered that there was another cycle around the 1940s, although it may not have been as bad as the current one, which has now persisted for 15 years.

> There was [waterlogging] before, water rose, it was as dangerous as the current one, but it lasted only for a few years […] and land recovered […] And then came this one, and it is not ending. *(Omar, Mogna)*

According to the responses, waterlogging affected every-day life in several ways. One of them was the threat of destroying the adobe houses, which are almost all the houses in the village. It makes houses uncomfortable to live in because of the dampness inside, which was visible on the walls and on the dirt floors as well.

> Many houses, for example my parents' house… They had built a new house a short time ago… They had to demolish it because the waterlogging reached it… It "devoured" the house inside and outside… The floors were always wet. *(Mariana, Mogna)*

> Today, even the houses are affected, there are houses badly affected by the waterlogging. Look, here, in this ground, we are now, the water [table] may be just 40 cm from the surface… If there were now an earthquake as the one in 1977, I do not know if the houses could resist as they did then… Too much dampness. *(Eduardo, Mogna)*

123 Although amply known in the department, waterlogging in Mogna has not been documented before and does not appear in the literature about Jáchal. I became aware of it during a telephone interview with the Director of the AER INTA in Jáchal, A. Estévez, prior to fieldwork.

124 One of my first impressions of Mogna was the crunchy sound of my boots crushing the salt crust that covered the ground every place we went in the village, except in those farms located at a slighter higher altitude, relatively speaking.

Because the water table is so close to the surface, there were increasing problems with wastewater disposal and particularly with sewage, since it is not possible to dig adequate latrines. Due to the risk for public health that this situation represented, the provincial government recently began to draw plans for building a sewage and wastewater disposal system in the village.

Waterlogging has also affected households in their every-day lives because it increased households' expenditures by reducing or eliminating (depending on the gravity of the problem at the farm or plot level) subsistence crops like corn and vegetables, which are grown for household consumption. As will be shown in Chapter 7, these subsistence crops are an important part of livelihood strategies to make ends meet.

> Because of waterlogging, few people farm, because there are is no land to do so… If you plant where there is waterlogging, the plants are not going to grow. *(Patricia, Mogna)*
>
> Now, there is nothing, you can harvest a little of corn… Now, everything has to be bought outside, corn for the hens, all. Hogs, before [the waterlogging] almost everyone had hogs, raised hogs, but now, nobody can afford to raise hogs. *(Catalina, Mogna)*
>
> Maybe, people plant a little of "chacra" because they do not have land where to crop, you see? The rest of their land is under waterlogging. [125] *(Guillermo, Mogna)*

According to the respondents, the effects of waterlogging on commercial agriculture activity have been devastating. There has been a marked reduction in productive land, in crop yields and in the availability of resistant crops. This last effect has led to a change in the crop pattern. For some households, waterlogging also initiated or accelerated the shift from agriculture to livestock (goats).

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[125] Chacra is the collective name of the crops grown for the household consumption, including also those for poultry feeding (generally corn).

> [In the farm] there are parts that are under waterlogging and parts that are not. Where there is not waterlogging, they farm, and where there is, they have the farm animals, there grows chepica [a weed], a rough pasture. *(Patricia, Mogna)*

> Waterlogging is what is ruining Mogna… We had pasto (alfalfa) before, a lot. We bought none of those things, pasto, corn, wheat, oats, all grew here. Now with the waterlogging there is not land to grow pasto, we have corn and oats. *(Martín, Mogna)*

> I: How many hectares does the farm have? R: It has 21 hectares. I: Do you cultivate all of them? R: No, they should be like three at the most, because down there everything is "revenido" [affected by waterlogging]. If you look there and I tell you "I have had alfalfa here", you are not going to believe me, because the jumes are as tall as a house, and [the land is] under waterlogging. And before not, I worked there as well. And there was pure pasto (alfalfa). *(Agustín, Mogna)*[126]

As this last quotation makes clear, one of the worst effects of waterlogging has been the loss of most of the alfalfa fields, in terms of both the crop and the land. Alfalfa, especially for seeds, used to be one of the most important economic resources of the area.[127]

> Look, over there on the south, [fields] were all alfalfares (alfalfa fields), there were alfalfares everywhere. Today, they are all vegas (meadows), they are marshes now […] I lost everything, everything. *(Omar, Mogna)*

Regarding wheat, another traditional crop in the area, histories are mixed. Some respondents attributed the decadence of the crop to the waterlogging process, while others believed it was due to the closing of the local mill. Wheat seems to play the double role of subsistence and commercial crop.[128]

> Wheat? No, also because of what I was telling you about the waterlogging, you see? Before, people made a living of that, they went to Jáchal with the

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[126] I: interviewer, R: respondent. "Jumes" or salt-cedars are halophytes, plants adapted to grow in saline conditions.
[127] Interview with Liliana Ovalle, municipal employee at Mogna.
[128] Wheat also seems to symbolize the 'old good times' of the department (Adamo 2003; Díaz and Luna 1991).

> wheat. But now that is rare, may be just one family is still growing wheat, the rest are not. *(Mariana, Mogna)*

Farmers that were still farming at the moment of the interview complained about the reduction in yields due to the salinization and general soil degradation associated with waterlogging. This reduction has to a great extent diminished profits. Even those crops that are more resistant to salt and soil dampness were affected.

> You know what happens? You cannot work, you cannot farm. Before, a hectare of wheat yielded 25,000 kilos (sic), 22, 23, but always from 20 up. And last year I tried, I grew wheat again, a hectare more or less… I harvested 8 bags, maybe 40 kilos each [320 kilos]. It was not worth the effort. *(Eduardo, Mogna)*

Most of the old good alfalfa and wheat fields that are already lost for agriculture, after 15 years in the process, can be used only for grazing, with limitations. When the salty water in on the surface not even that land use is possible. The situation may be qualified as serious, because alternatives to agriculture and ranching and off-farms jobs are practically nonexistent in Mogna.

Water scarcity is the next environmental problem in Mogna, for several reasons, among them problems or conflicts in the distribution of water, drought or the Jáchal River flooding season. In the first case, water is available up the river, but it does not reach the village. In the second, there is not enough water in the river basin. In the third, there is plenty of water in the river, but it cannot reach and enter the ditches, the water simply by passes them.

Conflicts with other irrigation districts over irrigation rights were common in earlier days, but they seem to be over now. However, they are a valuable antecedent for understanding the relative position of Mogna in the department, and the institutional mediations in water scarcity. At this respect, Díaz and Luna (1991:89-91) quote a report of 1887 that described Mogna as follow:

> On one side, an irrigation ditch filled with yellow and dirty water, and on the other, fields that were probably farmed on a distant day, but that today lay completely abandoned […] The reason for such accidental and miserable crops is in the water, the land is excellent […] Irrigated farming uses the scarce discharge of the Jáchal River, which arrives in the worst possible conditions, since for both domestic use and irrigated farming it is derived from two salty drainages at Tucunuco […] The reason of such accidental irrigation and such awful water is that all the leftovers of water from the Jáchal and Agua Negra were used in Tucunuco, but there was an agreement that every eights days all water would be for Mogna. This agreement is not honored […] This is the cause of the gradual death of the district, this is the origin of its depopulation and abandonment.

This paragraph demonstrates the particularities of Mogna's location at the very end of the Jáchal River and of the irrigation system.[129]

Regardless of the irrigation system or possibly because of its inefficiencies, drought still pose a very real threat for Mogna's people. At times of drought, it is harder for the water to reach the village and its quality worsens, very similar to the problems mentioned in the 1887 report quoted above.

Drought affects households in two ways. In every-day life, the respondents mentioned the lack of drinkable water, since its availability depends almost entirely on the river, even for tap water. Regarding the effect on commercial agricultural activity, the consequences of drought included loss, damage or stress of crops and livestock, but also increases in ranching labor because of the need of moving the livestock to whatever water source they could find.

> About droughts... there were some years, before… When my father went to Albardón, there was a drought then, there was not water for irrigation […] The water did not come down the river… We had to take the animals… That was the time when we had a lot of livestock, sheep, goats. We had to go to

[129] However, the 1869 Census of Population (pp375) described Mogna as follow: "… To the east, the desert of Mogna lays in a beautiful valley irrigated by the Móquina River. There many water mills, and agriculture is the dominant industry…" It seems that problems began with the creation of the Tucunuco, one of the largest irrigated farms in the department, located up the river from Mogna. There are not records of that farm in 1850, but it appeared in 1895.

> the Quebrada, we went there to get water, the scarce water that was coming down the river, a very, very bad water. *(Agustín, Mogna)*

> In the 1960s, let me see, before the 1970s, they went with the herds there, five kilometers up the rivers, where the water arrived… if it arrived [...] A lot of animals died, yes, because of thirst. *(Guillermo, Mogna)*

The third reason relates to the flooding season and its consequences. To some extent, the problem of floods is slightly different in Mogna than in other places. The flood raises the level of water in the river and increases water speed, destroying the unstable dam and making impossible the entrance of water into the irrigation ditches. "Se va el agua por el río" (the water runs down the river) is the local expression for this recurrent problem. This is basically a problem of irrigation infrastructure that has not been solved since Mogna was established.[130] The respondents' words are also eloquent:

> We do not have water problems, except when there is a drought, it means when the water runs down the river. It is in summer when the water runs down the river, because of the floods. We do not have a permanent dam, if we had one, there in the Boca de la Quebrada, the water would not run down the river. But not, all the summer, every summer we have to rush to put branches in the dam to get the water in the ditches, when the flood is coming. *(Cristina, Mogna)*

> The thing is that there is not a good dam here in Mogna, you see? And because of that the water runs down the river, and then you have… two, three weeks of struggling and struggling until the water is in the ditches again. *(Mariana, Mogna)*

The effects in every-day life include the lack or scarcity of drinkable water and increasing domestic labor, since household members musk look for water and transport it to the house. In terms of commercial agricultural activity, the consequences are similar to those of drought, i.e. damage to and loss crops. However, livestock can be moved to the river, so livestock losses are not so severe.

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130 For illustration purposes, figure 6.1 at the end of the chapter displays the differences in irrigation infrastructure between Huaco and Mogna.

> When there is not water, yes you have to go to the south to carry water […] for everything, in buckets, in bottles, on foot, by horse […] And then is when the crops are lost […] we carry water just for the house [not for the crops]. *(Mariana, Mogna)*

However, floods also present their conventional effects. According to one of the respondents, Mogna was established in what used to be the old riverbed, so when the river reaches peak discharge, during the summer and after heavy rains, it attempts to come back to the old course. Some of the histories of the consequences of these sudden and violent events were quite dramatic.

> The delivery… they were twins, you see? I was caught by the flood on my way to the hospital… I couldn't go through, the babies couldn't be born. *(Mariana, Mogna)*

> The water comes and covers everything… There were years when we were in danger here in Mogna… One year we were in danger because of the heavy rains and the river was coming this side and all the people praying for the water not to get nearer the village… Because it is told that the river entered Mogna once. *(Patricia, Mogna)*

Table 6.2: Summary of perceived environmental problems and their effects, Mogna, 2001

Environmental Problem/Concern	Effect on every-day life and society in general	Effect on agriculture activity
Water logging	Damage in houses' basements	"Killing" of the agriculture activity (mainly alfalfa fields)
	Destruction of adobe	Lost of productive land
	Dampness inside the houses	Reduction of crop productivity
	Increase in household expenditures due to the impossibility of growing subsistence crops	Reduction of available productive land
		Lost of crops and reduction of diversity of crops
		Invasion of halophytes like jume (salt-cedar)
Water scarcity due to peak river discharge	Lack of drinkable water	Lost or damage of crops due to lack of water for irrigation
	Increasing domestic labor: looking for and transporting water from more distant sources	Livestock stress
Weed ("chimpica")		Replace other pastures like alfalfa
		Increase in farm laboring
Wild Cats ("pumas")	Threat to people's safety	Lost of livestock
Drought	Lack of drinkable water: no water in the river	Lost or damage of crops due to lack of water for irrigation
		Increase in ranch labor: looking for water for the livestock, move it also
		Loss of livestock / Livestock stress
Flooding	Flooding of the village Destruction and damages to houses and roads	Flooding of fields

Source: Compiled from Interviews in the Department of Jáchal, 2001

HUACO

A serious salinization problem has affected Huaco since the building of the Cauquenes Dam on the Huaco River in the 1960s. Coincident with the inauguration of the dam was the beginning of a drought that affected the region from around 1965 until the early 1970s, which exacerbated the salinization problem. Acreage declined considerably, and many families emigrated from Huaco.

The overall impression I got from the respondents in Huaco --corroborated by the literature (Casas and Tejada 2001; Retamar 2001; Musso 1994) and key informants in the area-- is that the building of the ill-famed dam signaled a profound negative change in their quality of life. In fact, each of them talked of the times before the dam as "the good times". The respondents stated that, although the situation seems better now, the acute salinization of the irrigation water changed land use in the village from a combination of orchards, alfalfa, vineyards and wheat to a virtual monopoly of onions, quince and alfalfa. Even in those crops that are resistant to salt, the yields are not as good as they should be.

> R: The water is the problem, is too salty. I: Has this happened all the time you have been a farmer? R: No, it is said that not until 1962 […] But my experience is with this water… With this water, nowadays… it is not so much problem for onions, that's OK. Now, for example, the problem is for the fruit trees, peaches, apricots, grapes, all that with this water cannot be grown. *(Matías, Huaco)*

> Salt […] does not affect alfalfa, now if we had fruit trees, then yes, in those trees the effect of salt is very clear… Also, for example, if I harvested the barley, the effect is also clear there, yields are not what they are supposed to be. What I mean is that instead of 1000 kilograms per hectare you obtain 700 kilograms. *(Alejandro, Huaco)*

The main effect on every-day life, which has lasted until now, has been the impossibility of using irrigation water as drinkable water and the consequent urgent necessity of finding other sources. Due to this, a water distribution system was built, which pumps underground water from a number of wells.

> Now it is a little better, but when the dam was filled, the water became very bad, not even the animals could drink it. It was a green water […] there was a waterfall and there was a brown foam there. The water was heavy, thick, with bad taste […] We did not have pipe water before, we drank the water from the river. *(Nicolás, Huaco)*

> When the dam was built… we did not have water. The water had to be brought in cisterns by truck… It was a desperate situation… It was then when people began to leave. *(Nicolás, Huaco)*

As in Mogna, current water scarcity may be caused by drought or by problems with the distribution system due to the system's own limitations or to flood damage to the irrigation ditches. The limitations of the system refer to the impossibility of delivering enough water in time to keep the crops from perishing or deteriorating. When water is not enough because of higher demand in summer, turns are established according to the acreage with water rights and water availability. When a drought strikes, the situation becomes worse in terms of water restrictions, and turns could be longer. Small farmers may have as few as three hours of water eight days apart, and this could be fatal in the summer heat.

> I only cultivated a part of the plot because water is scarce… May be in winter there is a lot of water, because there is little work on the land. But then in summer, when we farm a lot more… for example, here I have 2.5 hectares, almost 3, and we only have two hours of water […] In summer, we begin to be careful with the water, because if we do not water the crops they dry out because of the sun. Although the turn is at two a.m. or at 5 a.m., you have to be there to take care of the water, because if not… especially with the onions. *(Enrique, Huaco)*

Damage to the irrigation ditches because of the flooding runoff carried severe consequences in terms of water supply, since it could be weeks until the service is restored. It is possible to distribute drinkable water and water for domestic uses by truck, but this is not an option for the crops.

The immediate effects on every-day life are the lack or shortage of drinkable water and of water for domestic uses (cleaning, laundry, cooking). A further effect in drought times is the discomfort caused by the extreme heat and very low atmospheric humidity associated with drought. The effects on agriculture and ranching are similar to those in Mogna: loss of crops and decrease of yields.

Soil infestation is an environmental problem that affects exclusively onion farmers. This is caused by a fungus, the "fusario", which rots the plant while still in the ground. It represents a clear situation of land degradation, the result of current and past agricultural practices. The respondents were well aware of the problem and its consequences, but in general they did not consider it extremely serious, at least not to the extreme of discontinuing onions as their main commercial crop. One of the known solutions to this problem is crop rotation, e.g. do not crop the same plot two years in a row. This could be one of the reasons why onions are often cultivated in rented fields, even when the farmers are owners.

Consequences of soil infestation include crop losses, increasing production costs due to the intensification of the uses of pesticides, and changes in the timing of marketing. Due to the effects of the fungus on the onions (putrefaction), these cannot be stored waiting for better prices.

> That [fusario] has existed for ever. Because, what happens is that sometimes the soils have problems, they are infected, you see? For example, there is the case of a farm on the river over there, on that coast, that if you do not sell the onions right away when you harvest them, everything gets rotten, it does not last two months in the ground. *(Matías, Huaco)*

> Yes, there are always problems with the soils … for example, with onions… many times they rot, it is a problem of the soils, it should have a fungus or something… There are poisons [pesticides] for that, but sometimes you do not buy it because you do not have money. *(Aníbal, Huaco)*

Weed and other plagues may also affect farmers, resulting in increasing production costs because of the use of agrochemicals, and increasing farm labor.

> [Because of weed] you can lose the crops, soils are compacted […] Because of the chepica [a weed] you cannot plow with the horse, you have to rent a tractor because it is too hard. *(Pablo, Huaco)*

Table 6.3: Summary of perceived environmental problems and their effects, Huaco, 2001

Environmental Problem	Effect on every-day life and society in general	Effect on agriculture activity
Salinization	Water from irrigation ditches and watercourses is not longer drinkable	Declining productivity, salinity reduces productivity
	Change in flora	Replacement of traditional crops (orchards, grapes, tomato, pimiento) for salt-resistant crops (onion, quince, alfalfa)
		Limitation in the availability of productive land
		Loss of crops
Onion fungus (fusario)		Changes in the timing of marketing
		Rotten onions
		Increase in the use of pesticides: rise in production costs
		Crop rotation
Flooding (heavy rain)		Damage to the irrigation ditches
Water scarcity	(Dam) Lack of drinkable water	Limitations in the crop acreage
		Potential crop loss due to the irrigation turns in summer
		Loss of crops (agricultural drought?)
Other plagues and weeds		Increase in production costs
		Increase in farm laboring
Drought	Discomfort due to the extreme heat	Climatic drought: loss or damage to crops due to lack of irrigation
	Lack of drinkable water	

Source: Compiled from Jáchal Interviews, 2001

JÁCHAL CENTRAL

Table 6.3 displays the list of environmental problems in Jáchal Central according to the respondents. Different from the prevalence of waterlogging in Mogna or salinization in Huaco, these problems seem more diverse than in the other two sites, and less intense. The list includes salinization, floods, water scarcity and droughts, diverse plagues, hail storms and soil infestation.

The literature review and key informants mentioned salinization of the soils due to the salty waters of the Jáchal River as one of the more serious environmental problems in Jáchal (Allub and Guzmán 2000; Davire and Malberti 1999). However, the respondents did not seem concerned about this particular issue, and in fact it was hardly mentioned. The only response about it refers to the particular situation of salinization due to waterlogging associated with the Cauquenes Dam. The effects were similar to those mentioned in Mogna but at a smaller scale.[131]

> R's Brother: Here, because of the dam it is impossible to grow nothing… the salt. R: We make a living with the [domestic] animals […] The salt started like five years after the dam was inaugurated […] Now, we buy all the vegetables, all…" *(Nora and her brother, Jáchal Central)*

Because some of the households interviewed in Jáchal Central were close to the sloped areas of piedmonts and alluvial fans, the issue of flooding due to torrential rains was different from the other two sites.[132] The run off damages the irrigation ditches, the crops, the houses and the roads.

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[131] The household head and her brother stated in the interview that the water table was so near the surface that farming was impossible on that land, so they had to rent land in order to grow commercial crops. However, when I visited this particular farm, I did not see any evidence of waterlogging or salinization. In addition to this, the farm did not have water rights (it was located almost out of the irrigation area) so they have to rent land in other farms no matter what.

[132] An alluvial fan, a very common desert landform, is a low cone of alluvial sands and gravels resembling in outline an open Japanese fan. "Alluvial" applies to any stream-laid sediment deposit. (Strahler and Strahler1992:349,588)

> During the summer, when it begins to rain… Depending on the year, if it is raining a lot in the sierra, for sure you are going to have problems in the farm […] This summer we had tomatoes and the flood entered right there […] We lost that crop. *(Domingo, Jáchal Central)*

> Two years ago the flood entered the house… We built this small wall afterwards, we did not have it before… That time, the water reached the bedrooms…" *(Alberto, Jáchal Central)*

> There, where they lived before in La Legua, the flood entered into the house, that's why the move here…" *(Pura, Jáchal Central)*

As in Mogna and Huaco, water scarcity may be due not to drought but to floods. Summer floods break the irrigation ditches, leaving the farmers without water for days or weeks. As in Huaco, this could mean the loss of the crop. In addition to this, as a substantial of the households in the area use the irrigation ditches to get water for drinking and for domestic use, the breaking of the ditches also disrupts these aspects of their daily lives.

> [What happened was that] It rained, the run off went down and the ditches collapsed. There were months when the water never got here […] Maybe they [Hidraúlica] fixed the ditch today and in the night it rained again, and again the ditch broke down […] There are times here when it rains for weeks […] in February, March. *(Leoncio, Jáchal Central)*

Droughts were not frequently mentioned. The last one happened in 1995, according to one of the respondents.

> There were some years of drought, there was no rain, around two or three years ago there was a big drought here, around 1995. Here, we have drought and extreme hot weather […] And, yes, sometimes we lose the crops because the plant does not resist the dryness more than two or three days, and if you do not have water on time [because it is not your irrigation turn], the plants die…" *(Leoncio, Jáchal Central)*

Hail is the other climatic event that produces damage to crops and against which very few farmers have insurance, because of the cost.[133] Curiously, it was

[133] Hail insurance can amount to 25% of the crop value at market nominal prices.

mentioned only in Jáchal Central. Depending on the type of crop and the moment of the year, the consequences for agriculture are serious. Onions are generally quite resilient to hail damage (this could be another reason why it is the main commercial crop). Other crops, however, like tomato or garden vegetables are much more sensitive to that type of damage.

> There was a very strong hail storm in March […] We had tomatoes, onions, but everything ended up bare, damaged, after the hailstones… The stones remained in the ground for two days. *(Leoncio, Jáchal Central)*
>
> And right after a hailstorm, one of the respondents commented,
>
> We cultivate sugar beets for the seeds, yes. But I do not think that they are going to yield the same [this year], because the damaged plants were ready for harvesting, and that is gone [after the hail]. *(Claudia, Jáchal Central)*

Onion farmers in Jáchal shared one problem with those in Huaco, the persistent fungus (fusario) that infests the soils seems to be widely spread in the department wherever onions are grown. It was considered the result of years of the same crop in the same plot, although two of the respondents (who used to work together) suggested that the cause is not in the soil but in the water. The technicians from INTA, however, consider that the fungus is a soil problem.

The respondents mentioned as consequences for agriculture the reduction of yields, the increase in costs and the modification in the timing of marketing because of the impossibility of storing the infected onions and waiting for better prices.

> This land is rented […] It is different each year, one year in one plot, next year in another one. Because if you cultivated a plot once, and then you try to cultivate it again the next year, the land grows weaker, it is not that good anymore… You would need a lot of fertilizer, and sometimes you do not have money for that… You need to rest the land for a year, grow corn or barley. If I grow onions two years in a row in the same field, the yield is not going to be the same, the onions would rot […] Look, this year all of us that had onions had to sell them in February, March…" *(José, Jáchal Central)*

Table 6.4: Summary of perceived environmental problems and their effects, Jáchal Central, 2001

Environmental Concern	Effect on every-day life and society in general	Effect on agriculture activity
Hail Storms	Damage to roofs	Crop damage or lost, particularly vegetables
Flooding (heavy rain)	Damage to the houses	Problems to take the harvest to the market (roads)
	Damage to roads and isolation	Loss of crops or damage
Strong Winds (Zonda)	Damage to the roofs	
Water scarcity	Lack of drinkable water	Loss of crop for lack of irrigation
Wild life	Invasion of domestic flies in late spring and summer	
	Wild cats are a threat to personal safety	
Other plague and weed		Use of pesticides
		Increase in farm laboring
		Crop rotation
		Increase in production costs
		Damage to crops
Salinization (water logging due to The Cauquenes Dam)	Stopping subsistence production (chacra), buying in the market	Change from farming to ranching
Onion Fungus		Increasing use of pesticides rises the crop production costs
		Crop rotation
		Unfavorable changes in the timing of marketing
Drought	Lack of drinkable water	Loss of crop
	Discomfort due to the extreme heat	

Source: Compiled from Jáchal Interviews, 2001

SUMMARY AND CONCLUSIONS

The interviews illustrate that environmental hardship in Jáchal includes a number of issues that affects every-day life and agriculture in different ways and to a different extent: climatic events (floods, hail, violent summer storms, strong winds), wild life (from domestic flies to pumas), crop plagues and weeds, and soil and water deterioration (salinization, water logging, soil infestation).

Overall, households in Mogna, Huaco and Jáchal Central differ in their locations along the water sources, which influence availability of water resources, and in the technical conditions of irrigation infrastructure. However, they share similar climatic conditions. This combination may result in different exposure and hardship when facing the same type of problems. It also demonstrates the role of institutional interventions or mediations such as the water distribution systems and irrigation, under the management of the local branch of the Provincial Directorate of Hydraulics (DPH).

There are differences between the three sites in terms of what hazards are considered problems. Waterlogging and salinization are acute problems in Mogna and Huaco respectively, while concerns in Jáchal Central vary. The quality of the houses is better in Huaco than in the other two places. And apparently, respondents in Jáchal seem to endure less environmental hardship judging from the lack of any acute environmental problem in the responses.

There are also marked similarities, for example in the causes and effects of water scarcity, the essential characteristic of an arid environment. It may be associated with disruptions in the availability of water (for domestic uses, human consumption and irrigation) due to natural climatic events (drought) or to institutional issues (problems in the distribution system).

Some questions remain unanswered, among them:

- When facing cyclical problems like the one in Mogna, what will the situation be like in two, five or ten years from today, taking into account that the village has survived at least one other waterlogging process in the past?
- How accurate are the histories about the actual, real effect of environmental hardship on agriculture if most of the households do not depend exclusively on commercial farming/ranching to make a living?
- How important is the effect on subsistence farming and ranching?

This chapter has shown how environmental hazards become events that affect every-day life and agricultural activity of small farmers' households living in different places in the department of Jáchal.

This consideration of household hardships attempts to serve as an introduction to the population's subjective view or perception of environmental hazard. These perceptions, the way different persons visualize and live the hazards, are shaped by personal experience and by present and past individual, household and community characteristics. However, they are also informed by the broad socio-economic, political and historical context in which individuals, households and communities are embedded (Day 1995; Izazola 1997; Hogan 1995; Heathcote 1980).[134]

[134] "…Perceptions, then, include the full spectrum of values, beliefs, attitudes, and ideologies that people use in defining the context of their lives…" (Day 1995:270)

In the next chapter, I will attempts to link these effects to the households' structure and composition, the importance of farm and ranch activity and income, and alternative off-farm income sources.

Figure 6.1: Differences in infrastructure: capture of water in Huaco (left panel) and Mogna (right panel)

Photos: Susana Adamo, 2001

Chapter 7. Making a Living in a Difficult Place: the Livelihoods of Small Farmer Households

> Livelihood better express the idea of individuals and groups striving to make a living, attempting to meet their various consumption and economic necessities, coping with uncertainties, responding to new opportunities, and choosing between different value positions. (Long 2001:54)

While the most common connotation of "livelihood" refers to means of living, maintenance or sustenance, Long's quotation is referring to other connotations, those of course of life, kind or manner of life, or conduct (Simpson and Weiner 1989). In this sense, the meaning of livelihood is broadened to include not only what an individual, household or community has but also the decisions they make and what they actually do with the means they have. Chambers and Conway (1991:6) probably had this broader connotation in mind when they defined rural livelihood as "…the capabilities, assets (stores, resources, claims and access) and activities required for a means of living…"

From this point of view, an analysis of the small farm households' livelihoods may consist of two parts: the ownership and control of assets or resources, and the strategies to mobilize these assets and convert them into income, food and other basic necessities.[135] However, as rural livelihoods do not occur in a vacuum, it is necessary to keep in mind that these processes take place in specific contexts (social, economic, political and environmental), which shape the structure

[135] Although some authors do not consider them to be strictly the same, in this chapter I will follow Bebbington (1998:2039) in using the terms 'asset' and 'resource' interchangeably.

of opportunities or access (Moser 1998; González de la Rocha 2000; Chambers and Conway 1991).[136]

At this point, I am interested in livelihoods because they are intrinsically linked to vulnerability, in two ways. On one hand, degree of social vulnerability and ownership and control of assets are inversely related: the larger the number of assets, the lower the degree of vulnerability. On the other hand, higher diversification in strategies is associated with a lower degree of vulnerability or higher resilience of the households confronting stressful situations (Ellis 1998; Adger 2001; Moser 1998).

The objective of this chapter, then, is to explore the farm households' livelihoods in order to better understand households' vulnerability to environmental risk and hardship, and population mobility as a response to those risks and hardships.

To achieve that goal, I will describe the socio-demographic characteristics of the households in the sample, inventory their assets or resources, and review their livelihood strategies. I will use the responses included in the modules C (household's income, assets and general socio-economic situation) and D (the farm/ranch as productive unit)[137]. As before, the interpretative framework for these answers combines the conceptual framework, the contextual background of the department, and the interviews with key informants.

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[136] Chambers and Conway (1991:8) define 'access' as "…the opportunity in practice to use a resource, store or service or to obtain information, material, technology, employment, food or income…" This is similar to the concept advanced by González de la Rocha (2000:6) that "…household resources do not exit in a vacuum. What matters is people's ability to convert their resources into assets that can be used to lessen vulnerability and improve well-being. Resources become assets only when people can take advantage of opportunities in the market, society and their relationship with the state. This implies that household resources cannot be analyzed independently from the opportunity structure that either enables or constraints their ability to transform their resources into actual assets…"

[137] The Interview Guide is presented in Appendix B.

HOUSEHOLDS' SOCIO-DEMOGRAPHIC CHARACTERISTICS

In considering households as an interface between population and environment, Morvaridi (1998) suggests that certain households' characteristics are critical to understand environmental degradation and its effect on livelihoods' securities. He mentions household size and structure (age and sex), its internal dynamics (in terms of the relationships among the members, their rights and duties, and negotiated decisions), and the household's access to external resources (natural resources, off-farm income sources, etc.) The first two may be considered as socio-demographic characteristics, while the third one refers to the interaction between the households and their socio-economic and natural environments.

Households' characteristics are relevant for at least three interlinked reasons. First, socio-demographic characteristics play a role in increasing or preventing vulnerability to different events, including environmental risk, because to some extent they control the acquisition and management of resources (Rodríguez Vignoli 2000). These characteristics have an effect on the diversity of strategies, and through them the ability of the household for coping with the different types of stress associated with agriculture.

Second, the household's internal life-cycle factors (births, marriages, deaths) determine responses to changes in the external environment or context –for example migration. Those factors affect its age-sex structure and composition, which shape the household's available labor force for farming or ranching and for off-farm and non-farm employment, including labor migration. This is particularly important for understanding agricultural families' strategies.

Third, there are asymmetries in rights and obligations within the household according to its gender and age composition. These asymmetries will affect the ability to cope with economic and other difficulties (Moser 1998).

In this section, household socio-demographic characteristics have been grouped into two dimensions: a) structure and life cycle stage, and b) basic demographic conditions, which include size, dependency, and composition by sex and age (Rodriguez Vignoli 2000; Oliveira and Salles 1989). This working definition of household combines common features of several classical definitions in the literature. A household, domestic group or domestic unit may be a person living alone, or a group of persons, related or unrelated, that share the same physical space and a set of activities oriented to the day-to-day reproduction of the unit. Some of these activities are common provision for food and other basic necessities, consumption of goods, and sexual reproduction and childrearing (INDEC 1997a:49; Shryock and Siegel 1973:299; Hammel and Laslett 1974:76; Yanagisako 1979:165; Oliveira and Salles 1989:14).

a) Structure and life cycle phase

The basic element in the definition of the household structure is the relationship of the members with the household head. I have followed the criterion that the household head is the person acknowledged as such by the rest of the members (Shryock and Siegel 1973; INDEC 1997a). However, the field experience indicated that, although husbands were regarded as the household heads in almost all the responses, it was possible to observe during the interviews that sometimes the wife was the actual head, as the decision-maker and main provider for the household.

The classification of the household structure follows the categories of the National Institute of Statistics and Census of Argentina (INDEC), which in turn is based on international recommendations (INDEC 1997a). These categories or types of household structure are: a) single person; b) nuclear complete (the conjugal couple and its children); c) nuclear incomplete (one parent and the children); d) nuclear extended (the couple and relatives); e) composed (related and unrelated persons); f) unrelated multi-person households. Nuclear extended households may be further sub-divided by taking in account with which relatives the conjugal couple is living. The possible subdivisions are: upward (parents), downward (married children) or lateral (siblings) (Hammel and Laslett 1974)

Table 7.1 displays the socio-demographic characteristics of the households in the sample.

Table 7.1: Households' socio-demographic characteristics: structure and life cycle

Int #	Site	Fictitious names of the couples	Type of household	Child 1 [1]	Child 2 [2]	Age (a) [3]	Age (b) [4]	Head's age group	Spouse's age group
1	Huaco	Aníbal and Rosa	Nuclear Complete	3	3	6	11	40-44	35-39
2	Jáchal	Leoncio and Pura	Nuclear Extended Downward	6	1	--	--	50-54	60-64
3	Jáchal	Manuel and Francisca	Nuclear Extended Downward	8	2	40	40	60-64	55-59
4	Mogna	Guillermo and Elena	Nuclear Complete	11	2	18	25	70-75	60-64
5	Mogna	Eduardo and Catalina	Nuclear Complete	5	3	16	32	55-59	50-54
6	Mogna	Agustin	Single person	2	0	--	--	75-79	N/A
7	Jáchal	Domingo and Clara	Nuclear Extended Lateral	7	7	6	23	45-49	40-44
8	Huaco	Nicolas and Ana	Nuclear Extended Downward	8	2	25	27	65-69	60-64
9	Huaco	Alejandro and Maria	Nuclear Complete	2	2	5	9	30-34	35-39
10	Mogna	Martin and Patricia	Nuclear Extended Upward	5	5	9	16	40-44	35-39
11	Mogna	Javier and Mariana	Nuclear Complete	5	5	0	9	35-39	35-39
12	Huaco	Pablo and Lorena	Nuclear Complete	2	2	13	14	45-49	35-39
13	Huaco	Matías and Paula	Nuclear Complete	5	4	11	20	40-44	40-44
14	Mogna	Omar	Nuclear Incomplete	6	1	30	30	80-84	N/A
15	Mogna	Alfredo and Cristina	Nuclear Extended Downward	8	2	21	24	60-64	60-64
16	Jáchal	Nora	Nuclear Extended Lateral	0	0	--	--	55-59	N/A
17	Jáchal	Alberto and Beatriz	Nuclear Extended Lateral and Upward	6	6	2	12	45-49	30-34
18	Huaco	Mario and Catalina	Nuclear Complete	4	4	9	19	40-44	45-49
19	Jáchal	José and Andrea	Nuclear Extended Upward	3	3	0	3	40-44	20-24
20	Huaco	Enrique and Rosalía	Nuclear Composed	3	3	9	15	45-49	45-49
21	Jáchal	Pedro and Claudia	Nuclear Composed	7	6	19	27	65-69	55-59

Note: [1] Child 1: # of children of the couple, [2] Child 2: # of children still in the household, [3] Age (a): age of the youngest unmarried child in the household, [4] Age (b): age of the oldest unmarried child in the household

Source: Compiled from the interviews in the Department of Jáchal, 2001.

The households were basically distributed into two structural types, nuclear complete (8 households) and nuclear extended (10 households).[138] Other types were nuclear composed (one household in Huaco with a maid among its members, and another case in Jáchal Central of a nuclear household plus a nephew), nuclear incomplete (one case in Mogna of a father living with a son), and single person (also a case in Mogna of an old household head living alone). There were no cases of unrelated multi-person households. It is important to keep this distribution in mind, particularly the prevalence of extended households, when looking at labor resources and local social networks

It is interesting to note that there is a certain differentiation by place. For example, all but one of the households in Jáchal Central presented a nuclear extended structure, while 5 out of seven households in Huaco had a nuclear structure. Mogna showed a mixed distribution between nuclear and extended households. Differences in migration patterns among the sites, discussed in chapter 6, may be one factor in this. For example, adult married and unmarried siblings living together is common in Jáchal Central, where out-migration was less prevalent.

Household structure and the age of the household head are correlated, and this may be another factor. Median age of household heads varies by site: it is 43 years old in Huaco, 54 in Jáchal Central and 64 in Mogna (seven cases in each site). Household heads in nuclear complete and nuclear extended (lateral and upward) were overall younger than those in nuclear extended downward.

In addition to this, downward and lateral extended households differ in terms of the internal relations among the members -parent to children vs sibling to sibling.

[138] Household structure for the census fractions where the interview sites were located showed a somewhat different picture, with a higher proportion of nuclear households and a lower proportion of extended ones (INDEC. Unpublished data. 1991 Census of Population)

This could be important to understand differences in the availability and selection of strategies.

The household structure that was just described is an informative but static cross-sectional picture of the households. But households are dynamic in nature and their structure, composition and size change over time. These changes have been arranged in a life cycle whose stages are marked by vital events such as marriage, birth of the first and last children, marriage or departure of the last child, and death of one spouse (Shyrock and Siegel 1973:310; Forni et al.1991; Fortes 1971).[139] These categories take into account age of the head, age of the mother or wife and age of the children, particularly of the youngest child in the household.

As can be observe in table 7.1, household heads' ages extend from age group 30-34 to age group 80-84, while that of spouses ranges from age groups 20-24 to 60-64 years old. These numbers alone suggest that the households in the sample were at different stages of the life cycle. Regarding the wife's age, some couples had finished their reproductive life (those where the wife was age 50 and older, 7 households), while others were still potentially able to have more children (those were the wife was less that 50 years old, 11 households), and consequently 'rejuvenate' the household. Finally, the age of the youngest unmarried children in the house, ranging from 0 to 40 years old, also indicates different phases.

[139] Following Forni et al.'s classification (1991:91), the households in the sample may be in one of the following phases: a) *Formation:* nuclear couple recently formed, without children, age of the mother is less than 50 years old; b) *Expansion:* both parents are present, mother is less than 50 years old, children are not potentially apt for migration or marriage (sons are less than 16 years old and daughter and less than 14 years old); c) *Fission:* begins when the first child marries or migrates, or when the first child is potentially apt for that (sons older that 16, daughter older than 14); d) *Replacement:* complete couple, mother is more than 50 years old, all children have migrated or are married, A variant of this type is replacement with childrearing, similar to replacement but have grandchildren without their parents.

b) Basic demographic conditions

Basic demographic conditions include household size, dependency, and age and sex structure. There is, of course, a correspondence between household size and structure, because extended households tend to have more members. Lateral and downward extended households in the sample were likely to have more able adults in the labor force, and a better dependency ratio. They are potentially wealthier than other types of households in terms of labor resources.

While household size is a first approach to the households' labor force endowments, the same household size may hide different resources. The composition by age and sex indicate how many members may effectively be placed in the labor market, and what kind of jobs they may likely obtain. Farm and non-farm jobs and tasks are differentiated by gender, and in general women and men have access different labor markets. In addition to this, sex and age composition influence the dynamic of intra-household relationships, and it is related to household structure and life cycle. Finally, the dependency ratio -- defined as the number of consumers divided by the number of workers (Yanagisako 1979)-- is also influenced by household composition, particularly by the presence of children.

Table 7.2 displays these basic conditions. Household size varied between 1 and 12 members, but households sharing the same size showed differences in terms of composition, particularly in terms of the number of children age 14 or younger. These differences are reflected in the dependency ratio, which is higher in those households where the number of members is higher but also where the number of children age 14 and younger is higher.[140] Regarding women age 15 and older, its

[140] The minimal legal work age in Argentina is 14. This does not mean that there are not younger children working, but that they are not reported because it is illegal. Also, school attendance is mandatory until that age.

number is related to household size and structure: it is higher in larger households, which also tend to be extended households.

Table 7.2: Households' basic demographic conditions

Int #	Site	Household Size	# of Children 14 and younger	# of Women 15 and older	Dependency ratio
1	Huaco	5	3	1	2.5
2	Jáchal	9	N/A	5	4.5
3	Jáchal	8	3	2	2.0
4	Mogna	4	0	2	1.3
5	Mogna	5	0	2	1.2
6	Mogna	1	N/A	N/A	1.0
7	Jáchal	11	3	4	2.2
8	Huaco	10	4	3	1.7
9	Huaco	4	2	1	2.0
10	Mogna	8	3	3	2.0
11	Mogna	7	5	1	3.5
12	Huaco	4	2	1	2.0
13	Huaco	7	2	4	2.3
14	Mogna	2	0	0	1.0
15	Mogna	5	1	1	1.2
16	Jáchal	3	0	2	1.0
17	Jáchal	12	6	3	2.4
18	Huaco	6	2	1	2.0
19	Jáchal	6	3	1	2.0
20	Huaco	6	2	2	2.0
21	Jáchal	9	0	6	1.3
All	Average	6.3	2	2.1	2.1

Source: Compiled from the interviews in the Department of Jáchal, 2001.

INVENTORYING HOUSEHOLDS' ASSETS

In this section, I will review households' asset portfolio as an input for the analysis of the strategies. There is a certain agreement in the literature about what qualified as a household asset (Moser 1998; Scoones 1998; Bebbington 1999;

Reardon and Vosti 1995).[141] Pooling together several classifications, the categories of assets or resources are: a) labor force and human capital (education, skills and health status), b) productive and financial assets (land, water, livestock, natural vegetation cover, implements, savings, credit, and housing), and c) social capital (household relations, social networks and associations).

a) Labor Force and Human Capital

Labor is generally considered the most important asset in small farm households (Chayanov 1986:53). Table 7.3 displays the number of "contributors" or workers, family and seasonal workers, and the dependency ratio for the households in the sample. I have included in the denominator of the dependency ratio all the "contributors" to the household's production and reproduction, including retired people with pensions, housewives and seasonal and family workers.

I specified the number of family workers without compensation (salary or profit) in a different column. These family members, generally but not always the wives, work in the family farm, taking care of the farm animals, livestock and subsistence crops, contributing to the household maintenance and reproduction with their non-wage labor. Seasonal workers represented a special case in terms of their

[141] Scoones (1998) identifies five categories of asset categories related to rural livelihoods: natural capital (land, water and natural vegetation cover), physical capital (irrigation canals, implements, roads), human capital (education, skills and health), financial capital or its substitutes (credit, savings, jewellery, goats and cattle), and social capital (networks, associations). Bebbington (1999:2022) mentions five types of capital asset, namely produced, human, natural, social and cultural. Reardon and Vosti (1995:1495) specify four types of assets, which are linked to specific types of poverty and from which different flows of income are derived. They are: a) natural resources assets (land, water, wildlife, biodiversity and vegetation cover), b) human resources assets (education, health, nutritional status, and skills), c) on-farm physical and financial assets (livestock, farmland, pastures, reservoirs, buildings and equipments), and d) off-farm physical and financial assets. Moser (1998) distinguishes between tangible and intangible assets. The first category includes labor, human capital (health status, skills and education) and productive assets (housing), while the second one comprises household relations and social capital. Because we are dealing here with small farm households, it is necessary to include land and water among the productive assets, since Moser developed her categories for the urban poor.

contribution to the household livelihood. They were mostly unemployed at the interview time (late winter and early spring) but they had already contributed to the household budget by working during summer and fall.

Table 7.3: Households' labor force resources

Int #	Site	HH size	Contributors (workers)	Family workers	Seasonal workers	Dependency ratio
1	Huaco	5	2	0	0	2.5
2	Jáchal	9	4	2	0	4.5
3	Jáchal	8	4	2	0	2.0
4	Mogna	4	3	0	1	1.3
5	Mogna	5	3	0	2	1.7
6	Mogna	1	1	0	0	1.0
7	Jáchal	11	5	3	0	2.2
8	Huaco	10	5	3	0	2.0
9	Huaco	4	2	0	0	2.0
10	Mogna	8	4	0	3	2.0
11	Mogna	7	2	0	0	3.5
12	Huaco	4	2	0	0	2.0
13	Huaco	7	2	0	0	3.5
14	Mogna	2	2	0	0	1.0
15	Mogna	5	4	0	2	1.2
16	Jáchal	3	3	2	0	1.0
17	Jáchal	12	6	0	0	2.0
18	Huaco	6	3	2	0	2.0
19	Jáchal	6	2	0	0	3.0
20	Huaco	6	3	0	0	2.0
21	Jáchal	9	7	3	0	1.3
All	Average	6.2	3.3	0.8	0.4	2.1

Source: Compiled from the Interviews in the Department of Jáchal, 2001.

Built in this way, the dependency ratio maximizes the household's labor force and optimizes the relationship between consumers and producers. Consequently, as can be observed in the table, dependency ratios are not very high. However, they are potentially unstable over time and particularly along the year, depending on the proportion of contributors in the household who are seasonal workers or family workers. It is interesting to note that the three households (#11, 13 and 19) where the dependency ratio is higher (3.0 or more) share a similar phase in the life cycle: nuclear families in the expansion stage, with small children, and without seasonal or family workers. They were distributed among the three sites.

Human capital, measured through the highest level of education achieved by the household head and the spouse, was generally low, as can be seen in table 8.3. None of the household heads went to high school and a substantial number of them did not finish primary school. Regarding the spouses, only two of them finished high school and were working as teachers in local schools, while the rest showed the same low level of education as household heads.

While low educational levels are usually regarded as a limitation to employment opportunities, particularly in non-farm jobs, this did not seem to be the case in Jáchal, given the type of jobs available in 2001. They were mostly restricted to farming occupations, domestic service, construction and the low and middle ranks of public employment. But household heads and spouses with very low education levels (which could be deemed functional illiterates) faced serious constraints even in the same department.

However, low educational levels seriously restrict job opportunities outside the department, particularly in urban areas. In fact, the occupations of the migratory relatives showed that the employment at the destination was typically in the same type of jobs: domestic services, construction and farming occupations.

Table 7.4: Human Capital: education of the couple

Int #	Site	Head's education	Spouse's education
1	Huaco	Primary School	Primary School
2	Jáchal	2nd year primary	No school
3	Jáchal	4th year primary	4th year primary
4	Mogna	3rd year primary	1st year primary
5	Mogna	5th year primary	3rd year primary
6	Mogna	3rd year primary	N/A
7	Jáchal	6th year primary	6th year primary
8	Huaco	4th year primary	4th year primary
9	Huaco	Primary School	High School
10	Mogna	Primary School	Primary School
11	Mogna	Primary School	Primary School
12	Huaco	Primary School	Primary School
13	Huaco	4th year primary	Primary School
14	Mogna	4th year primary	N/A
15	Mogna	3rd year primary	5th year primary
16	Jáchal	Primary School	N/A
17	Jáchal	3rd year primary	6th year primary
18	Huaco	5th year primary	Primary School
19	Jáchal	Primary School	Primary School
20	Huaco	Primary School	High School
21	Jáchal	Primary School	Primary School

Source: Compiled from the Interviews in the Department of Jáchal, 2001

In sum, these households did not seem to be suffering a shortage of workers, judging by the dependency ratio. However, it is uncertain what the returns to these labor resources were and how they contributed to reduce household vulnerability, taking into account the number of seasonal and family workers, levels of unemployment and underemployment, and generally low educational levels.

b) Productive and Financial Assets

Key issues when considering such productive assets as dwelling, as well as land and water, are ‘access’ and ‘control’, which are represented by the type of tenure and water rights. In this particular case, I am including the dwelling among these assets for two main reasons. First, a number of the households in the sample had small grocery stores installed in their houses. Second, some of the respondents identified a permanent dwelling as a stability factor in their lives.

Table 8.4 shows tenure for land and dwelling and access to water. Regarding dwellings and land, there were four different types of tenure: ownership, rent, family property and legal occupancy. Ten out of the 21 households were living in family property. This category refers to a property that originally belonged to the parents or grandparents of one of the members of the couple, so he or she was actually one of the heirs (has rights over the property), but not the owner. This is an important distinction, since according to Argentine law each of the siblings has an equal right to the inheritance, which cannot be cancelled by the parents’ will. Also, because titles were not in the name of the heir, these properties could not be used as collateral for debts, for example.

In general, households obtained this type of tenure because either the household head or the spouse was the only sibling still living in the department. In most of the cases this type of tenure also included the family land. In the cases in what additional land was rented it was due to the small size of the family land.

Table 7.5: Households' productive assets: dwelling, land and water

Int #	Site	Dwelling Tenure	Land Tenure	Land acreage (Has)	Water rights in owned land	Water turn spacing	# of water hours
1	Huaco	Family	Family	9	Yes		3 hours
2	Jáchal	Owned	Rented	11	---	7 days	3 hs/ha
3	Jáchal	Owned	Rent/work share	9	---	No	Permanent
4	Mogna	Legal occupancy	Legal occupancy	10	Yes		
5	Mogna	Legal occupancy	Legal occupancy		Yes		
6	Mogna	Family	Family	21 (3)	Yes		
7	Jáchal	Legal occupancy	Legal occupancy	15 (3)	Yes	4 days	22 hours
8	Huaco	Family	Family / rented	8 / 15	Yes		
9	Huaco	Rented	Owned	75	Yes	7 days	35 hours
10	Mogna	Owned	Rented	5			
11	Mogna	Family	Family		Yes		
12	Huaco	Owned	Owned / rented	76	Yes		
13	Huaco	Legal occupancy	Legal occupancy	5	Yes	7 days	0.5 hs/ha
14	Mogna	Family	Family	42	Yes		
15	Mogna	Legal occupancy	Legal occupancy		Yes	No	Permanent
16	Jáchal	Owned	Family	18	No	8 days	3 hours (domestic needs)
17	Jáchal	Family	Rented	15		6 days	54 hours
18	Huaco	Family	Family / rented	5 / 8	Yes	7 days / 6 days	32 hours / 62 hours
19	Jáchal	Family	Rented	2.5		6 days	10 hours
20	Huaco	Family	Family	25 (5)	Yes	7 days	1 h/ha
21	Jáchal	Family	Family	6	Yes	5 days	6 hours

Source: Compiled from Interviews in the Department of Jáchal, 2001.

Legal occupancy (5 out of 21 cases), instead, was the result of some kind of agreement (the terms varied) between the owner/s –in general, living outside of the department-- and the actual occupants of the dwelling or their parents. This type of occupancy also entailed the legal occupancy of the land, without paying rent or sharing work in most of the cases.

Ownership of the dwelling was reported in five households, three of them in Jáchal Central, but only in one case in Huaco the household also owned the land. A possible interpretation is that the house was more important than the land in terms of the physical assets of the family and inheritance for the children. An alternative interpretation could be that good land with good water rights was beyond the reach of most of the respondents. In addition to this, inadequate land titles rendered most of the properties in the market unsuitable for selling.

In addition to family property and legal occupancy, rent appeared as a prevalent category in the case of land tenure: eight out of the 21 households rented land. However, there were no cases of legal occupants renting land, although there were several cases of households residing in family property and renting.

The type of land and dwelling tenure is closely related to access to credit for financing farming and ranching, and other financial needs. Banks and other financial institutions customarily request property titles as collateral. Most of the respondents and a number of key informants identified the lack of credit as one of the constraints for agriculture.

Land acreage varied from 2.5 to 75 hectares, but these differences should be adjusted by the acreage actually used. In the case of ranching, most of the farm acreage is in use. On the other hand, cropping acreage may be substantially less than farm acreage, as can be observed in the table. The numbers between brackets indicate these hectares, when the information was available. As can be observed, the proportion of the holding in cropping could be very small, suggesting the underutilization of land.[142]

[142] This seemed to be common situation in the department. According to the last census of agriculture (1988), the proportion of irrigated cropland that was not in use averaged 50%. This proportion varied

While some restrictions in cropping acreage were related to marketing and prices, others were related to water limitations. In fact, water and not land was the key resource for most of the respondents: none of them complained about land scarcity but many complained about water scarcity. Water availability also constrained the selections of crops.

> You do not crop all the land although you do rent it all […] In a property of 20 hectares, you can farm maybe 6, because of the water, here we have 3 hours of water per hectare every 7 days. *(Leoncio, Jáchal Central)*

> Well, here we do corn, barley, we have a quince orchard. Water is hardly enough for that. *(Nicolás, Huaco)*

In Jáchal, access to irrigation water is mediated by water rights, which in turn were assigned according to the number of hectares. A farm may have 45 hectares, but the water rights cover only 20 of them, and this will be the maximum extension of its cropping area, because agriculture is not possible without irrigation due to aridity. As can be seen in table 8.4, all but one of the households had water rights in their land but there were broad differences in terms of the quantity of water, turns and numbers of hours.

While the numbers of hours is determined by the acreage with rights, the turns and the quantity of water entering the farm by unit of time were determined by the overall availability of water in the irrigation system. Irrigation turns were a serious concern for most of the respondents, as was already mentioned in chapter 8. The further apart the turns were spaced, the highest was the risk of losing the crop, particularly during the summer. Regarding quantity, farms with the same number of hours could receive different amount of water depending on the average discharge in the irrigation ditches.

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within the department. Fraction 1 (where Jáchal Central was located) was similar to the department mean, while in Fraction 7 (Huaco) the mean proportion increased to 64%.

Information about financial assets is limited in the interviews. Because financial institutions offered restricted services in the department, most of the households relied on their own savings in times of necessity. One of the spouses (Claudia from Jáchal Central) explained to me how all the household savings had run out when one of the daughters first and her husband later had fallen gravely ill.

Livestock, particularly cattle, is another common form of savings among these farm households, because it can be rapidly converted into cash. That could be the reason why almost all the households had some kind of livestock even though ranching was not a consistent activity in many of them. In talking about how their entire onion harvest had been stolen, one of the household heads told me:

> He [the fraudster] left us with nothing, we had nothing to eat, I had to sell my mother's dairy cattle to pay the rent of the land. *(Alberto, Jáchal Central)*

c) Social Capital

Defined as "…the ability of actors to secure benefits by virtue of membership in social networks or other social structures…" (Portes 1998:6), social capital includes household relations, social networks (of relatives and neighbors) and the different associations where the households and their members participate.

Classified as intangible assets (Moser 1998), household relationships are influenced by the household's structure and composition and varied over time according to the phases of the family life cycle. While the household's socio-demographic characteristics have been already addressed, it is important to emphasize here the effects of household structure on the household's labor force.

As a rule, extended farm households, which were the majority of the sample households, have advantages compared with nuclear households because of the pooling of labor for production and reproduction (Reyes Suárez 1992; Forni et al.

1991). However, the case of nuclear households with grown and single children could be similar. Among the households in the sample, there were cases of fathers working with sons, mothers working with daughters, and siblings working together in the same farm enterprise. They not only worked together, also shared housing, land and water, the key productive assets.

In addition to the household's internal relations, family or kin networks – consisting of relatives living inside and outside the department-- appeared as an important component of social capital among the households in the sample[143]. Their relevance was evident in three respects. First, some of the households relied on the help of non-resident relatives for seasonal increases in labor at the farm. Second, the viability of migration as a strategy sometimes depended on the availability of kin to look after the farm and the animals while the household was gone. This is, for example, the case of Martin and Patricia (Mogna). Every year, from January to May, they left Patricias's brother in charge of their small farm and the animals while they migrated to work in the vineyards. Third, as was already mentioned in chapter 6, these kin networks have been key elements in shaping out-migration flows. Paradoxically, kin networks in the department have been depleted by the constant out-migration. I think that this is one of the reasons why neighbor networks were the other component of social capital.

Tradition and local culture are important in Jáchal (Davire and Malberti 1999). Among these traditions may be mentioned a type of labor interchange known as "vuelta de mano" --literally, return of hand-- which refers to reciprocity of duties among households. This was still one of the basic social capital resources. Although

[143] For example, all the PSA (Social Agrarian Program) groups I met in Jáchal were formed by relatives (brothers, parents and children) and/or close neighbors.

other products or goods could be traded, work is the common element in the interchange. Sometimes this tradition is practiced among relatives, other times among neighbors, but in both cases *physical distance* is important (Díaz and Luna 1991).

> We used to go… for example, if a family was living there [in the vicinity] and had to harvest the wheat and so on, we went and helped, you see? And then, afterwards, they helped us in return, vueltas de mano, nothing else. *(Cristina, Mogna)*

Wheat and "vuelta de mano" were closely related in respondents' histories, as this quote illustrates[144]. However, this type of reciprocal work was also used for onions, generally when it was not possible to hire workers because of cost constrains.

> I: Do you hire some external help? A: Well, no, because we do not have enough money. When the onion price is right, then yes, you can hire some help, but when it is not, no, nothing happen. Sister: Or also you can work in "vuelta de mano". We look for some people to come and help us, and afterwards we help then. Because it is not possible other way. *(Alberto and his sister, Jáchal Central)*

MOBILIZING THE ASSETS: LIVELIHOOD STRATEGIES

Household livelihood strategies were defined in Chapter 2 as the household's ways of securing its material and biological reproduction. For this, strategies mobilize the assets or resources, itemized in the previous section, to satisfy different necessities or to make ends meet.

[144] Farming has shaped social relationships in different ways. To some extent, onions and wheat not only represent two different periods in Jáchal's economic activity, but also symbolize different social relationships within the community. While wheat is associated with non-market and non-monetary obligations, onions are linked to market relationships mediated by money exchange. Díaz and Luna (1991:166) have suggested that "…1947 marks the breakdown of the pastoral social structure […] The passage from a pastoral society to a society whose economy is based in commercial agriculture impacted the traditional social values, thus from values based in solidarity we pass to the prevalence of individualism, distrust and speculation…" It is interesting to note that by no means was wheat just a subsistence crop destined to domestic consumption. It was part of the regular commercial interchange between Jáchal and other regions.

The interviews showed that the households in the sample displayed a number of different strategies. This diversity is a common feature of rural settings in developing countries (Ellis 1998; Stark 1991). Overall, diversity is considered a positive trend, but it is necessary to consider what kind of strategies are used.

Strategies may be grouped into two main categories: farm and non-farm.[145] Farm strategies may be further subdivided into on-farm and off-farm. On-farm strategies refer to those activities related to the household's own farm, while off-farm strategies farming or ranching activities developed by household's members in other farms. Non-farm strategies includes all those activities outside agriculture (Reardon et al. 2001). I have left the domestic or reproductive tasks --from childrearing to cooking, cleaning and laundry—out of this classification. Largely women's responsibility, these tasks are generally considered as non-productive work, although still they are essential for the household survival. A summary of these strategies is presented in table 7.6.

145 Rural livelihood strategies have been grouped or divided in different ways (e.g., Reardon and Vosti 1995:1500; Scoones 1998:9). I am following here Reardon et al. (2001).

Table 7.6: Summary of Livelihoods Strategies

Farm		Non-Farm
On-Farm	Off-Farm	
Farming	Farm worker in Jáchal	Public employee (general)
Ranching	Seasonal farm worker	Teacher
Subsistence Farming		Sale clerk in retail
Subsistence Ranching		Small Retail (owner)
		Retirement
		Construction worker
		Domestic service
		Weaving
		Other temporary and casual work
Reproduction: Domestic tasks/Domestic work		

Source: Compiled from the Interviews in the Department of Jáchal, 2001

The strategies in the table were not mutually exclusive. Table 7.7 shows their combination for each household. Various points may be highlighted. First, all of the households had farming or ranching or both as part of their livelihoods, but not all of them farmed in the same way, as indicated by the different crops and types of livestock. Farming was more frequent among households in Jáchal Central (6 cases) and Huaco (5 cases) than in Mogna (3 cases). Furthermore, no Mogna farms planted onions or tomatoes, the typical commercial crops, although forage crops (barley, oats and alfalfa) were common. These crops were also present in the other two sites, generally in ranching operations or in those units that combined farming and ranching.

In Huaco and Mogna, the association of pasture and ranching was regarded as a way of overriding the decrease in crop yields resulting from salinization. The use of barley, oats, alfalfa and even wheat as standing green forage was more profitable than harvesting them. Only one old household head in Mogna, Don Agustín (whose livestock had been almost exterminated by puma attacks) mentioned selling "a little" barley to neighbors.

Table 7.7: Combination of Livelihood Strategies

Int #	Site	Hired labor	Non Farm	Farm	
				On-Farm	**Off-Farm**
1	Huaco	No	Small grocery store	Farming (onions, alfalfa, quince), ranching (cattle), chacra	
8	Huaco	No	Public employment, domestic service	Farming (onions, barley, oats), chacra (corn, vegetables, quince, chickens, hogs)	Farm workers
9	Huaco	Yes	Grocery store, public employment	Ranching (cattle), pastures	
12	Huaco	Yes	Grocery store	Ranching (cattle), farming (onions, alfalfa, oats, corn)	
13	Huaco	Yes	Public employment, paid family aide	Farming, chacra (corn, hogs, chickens)	
18	Huaco	No	Public employment	Farming (onions, cumin), ranching (sheep), chacra (corn)	Farm worker
20	Huaco	Yes	Public employment	Farming (onion, barley), ranching (horses), chacra (corn, vegetables)	
2	Jáchal	Yes	Casual construction jobs	Farming (onions), chacra	Farm workers
3	Jáchal	No		Farming (onions, tomato, wheat), chacra (corn, chickens, eggs, hogs)	Farm workers
7	Jáchal	No		Farming (onion, tomato), chacra (corn), ranching (cattle, goats)	Farm workers
16	Jáchal	No	Retirement, weaving	Ranching (sheep, goats), goat manure	Farm workers
17	Jáchal	No	Retirement, construction jobs	Farming (onions, tomato. alfalfa), ranching, chacra (corn, vegetables)	Farm workers
19	Jáchal	No	Small grocery store	Farming (onion, alfalfa, quince), chacra (corn, vegetables)	Farm worker
21	Jáchal	No	Domestic service, construction jobs	Farming (alfalfa, barley, onion), chacra	Farming
4	Mogna	No	Retirement, construction jobs, weaving	Farming (barley, alfalfa), ranching (cattle) chacra (corn)	Seasonal farm workers (San Juan)

5	Mogna	No		Farming (barley), goat manure, livestock (goats)	Administrator, seasonal farm workers (San Juan)
6	Mogna	Yes	Retirement	Ranching (cattle, goats), farming (oats, barley)	
10	Mogna	No		Ranching (cattle, goats), goat manure, farming (oats, corn)	Seasonal farm workers (San Juan)
11	Mogna	No	Medical insurance payments	Ranching (goats, sheep, cattle), chacra (barley, oats, corn)	
14	Mogna	No	Housekeeper, casual jobs	Ranching (goats), goat manure	
15	Mogna	No	Weaving, construction jobs	Farming (pastures), chacra (corn, chickens), ranching (goats, cattle), goat manure	Seasonal farm workers (San Juan)

Source: Compiled from Interviews in the Department of Jáchal, 2001

Goats were the basis for a source of income collateral to ranching, that of manure. This was reported almost exclusively for Mogna farmers and informants – only one household head mentioned it in Jáchal Central and none in Huaco. Goat manure was collected and stored during the year and then sold to vineyards in San Juan. In 2001, profits from this business were disappointing. One of the respondents, Cristina, whose farm produced about three trucks of manure, told us that the price had been very low, around $50 the truck when the regular price used to be between $100 and $150.[146] A number of ranchers had chosen not to sell the manure at that price.[147] The alleged cause for such low prices was the low prices of the grapes in the previous season.

Regarding onions, all the respondents agreed that the widespread problems associated with the crop, despite its prevalence as part of the crop patterns, as can be seen in the table. Low prices were the focal point of the complaints, associated with the marginal situation of these farmers because of the small production volume and distance to main consumer centers. Summarizing the different versions, onions were sold at $1.50 or even at $1.20 the sack of 20 kilos in 2001, when the price should have been between $2 and $3 to cover the costs and get some profit. The last time onions were profitable was around 1995, when the price averaged about $6 the pack, peaking at $10. And still farmers persisted with the crop, probably because when the price was right profits were high.

> One year the buyer did not pay us correctly, and then he came back the next year and paid his debt, and then we built this house and bought a small truck. *(Manuel, Jáchal Central)*

[146] When I was in fieldwork in 2001, the exchange currency between peso and dollar was 1 to 1.
[147] Goat manure seems to be measured according to the amount necessary to fill a regular truck, or "camionada". None of the respondents could specify the dimensions of a regular truck.

A second related point to highlight is that subsistence farming or the "chacra" as it is called, was also present in all the households. Chacra was clearly differentiated from commercial farming (namely onions, tomato and forage crops like alfalfa and barley), involving different crops and farm animals. As one of the respondents explained to me, "…Onions are all the opposite of chacra, chacra is corn…" (*Clara, Jáchal Central)*

Chacra usually consisted of corn, vegetables like green collards and squash, and farm animals such as chickens and hogs. It was not cropped on rented land, used whatever water was available for domestic consumption or leftovers of irrigation after the main crop had been watered, and the produce was consumed within the household. Some respondents praised this practice as a key element in protecting and even securing the household's reproduction.

> I help to make ends meet[148] with my little vegetable garden. I have lima beans, carrots, green collards, some chicken… And, well, in that way we are going through. *(Claudia, Jáchal Central)*

A third point is that *all* the households combined farming or ranching with off-farm (3 households) or non-farm (8 households) occupations, or with both (9 households). There is a certain pattern of combination by site. Public employment was very characteristic of Huaco, while seasonal farm jobs appeared only among Mogna households.

Off-farm strategies consisted basically in working as farm laborers, temporary ("changes") or seasonally. These strategies could or could not involve migration out of the department or mobility to another part of the department.

[148] This is a very approximate translation. The local expression for "to make ends meet" is "darse vuelta", literally to turn around.

Seasonal work presented different cycles in the year, depending on the specific crops (grapes, raisins, onions, apricots, other fruits, etc.).

For example, in the case of Martin and Patricia, all the family migrated to the vineyards, while in the other two Mogna cases only the sons were seasonal migrants. These three households in Mogna rely greatly on this seasonal work to obtain enough income to buy "mercadería" (all that is not produce in the household, like clothes, shoes, sugar, tea, yerba mate, species, etc.) for the entire year. However, the last grape season was not good, according to different respondents, and they were paid less than expected.

In Jáchal Central, where the largest onions farms (more than 10 hectares) were located, there seemed to be more opportunities for on-site off-farm jobs: six out of seven households included them among their strategies.

Non-farm strategies included public sector employment, small retail, retirement, and weaving. Public sector employment was the most important. It included national, provincial and municipal positions in the areas of health, education, agriculture extension services, irrigation management, roads maintenance and security, in different job categories.

Different from farming and off-farm jobs, non-farm strategies were regarded as more stable and secure. Public employment salaries and retirement payments, even small ones, were highly praised.

> Over there, there are a lot of people that have a salary […] there are a lot of people that are luckier than us because they have their little salary, they have their help. *(Claudia, Jáchal Central)*

> What is really sad for me is that I am getting old, I get nothing, I do not have a pension, or retirement fund, or nothing. And there is nobody to go to ask for. *(Manuel, Jáchal Central)*

Small grocery and retail stores were another common option, and a number of households counted it among their strategies. In general, wives were in charge or helped to run the store while the husbands were occupied in something else.

Three of the Huaco households mixed cattle ranching with a grocery store where they put their meat up for sale. This may be considered as a kind of local vertical integration of the farming enterprise, from the pasture to the consumer, which allowed these households a certain independence from buyers. However, they were also more dependent on local conditions.

For households with access to non-farm incomes, farming could be a subsistence activity, whose objective is to provide for domestic needs, or a commercial activity to complement other income. That was the case of Matías in Huaco, who worked as an ambulance driver for the local hospital (public employment) and kept a small chacra for domestic needs. He used to grow onions, but stopped this activity some years ago because of the very low prices. However, he did not dismiss farming totally, but was just waiting for better times.

Also, households where at least one member had a non-farm salary job, especially if it was in the public sector, or that received retirement payments, seemed to be better off than those households depending on farming and eventual off-farm jobs and seasonal work. However, this changed in the last couple of years, as the public sector ceased to provide employment and stopped paying salaries on time.

Labor migration to off-farm and non-farm jobs was complementary to other household strategies. Depending on the moment of the year and the type of social networks. When migration and cropping times coincide, there are several alternatives: external help (generally a relative is in charge of the crop), short trips to the origin area to look after the crop, or the termination of cropping if migration appears as a better alternative in terms of increasing income or reducing risk.

Table 7.8 shows how different household's members contributed to the household's livelihoods. As can be observed, all but one of the household head was a farmer or a rancher, the exception being a disabled household head, Pedro, who had formerly worked as a construction worker. A clear gender division of labor appears: wives (and also daughters) were typically occupied in domestic chores, although they had also productive obligations within the household, like helping with the small grocery store, taking care of the farm animals, helping in the farm, that helped to balance the household budget.

Table 7.8: Occupations of the household's members

Int #	Site	Head's occupation	Spouse's occupation	Other members' occupations
1	Huaco	Farmer, rancher, retail	Housewife, retail	N/A
2	Jáchal	Farmer, construction worker	Housewife	Farmer, housewife, construction worker
3	Jáchal	Farmer, farm worker	Housewife	Farmer, housewife, farm worker
4	Mogna	Farmer, retired, casual construction worker	Housewife, weaver	Off Farm worker
5	Mogna	Farm worker, farmer	Housewife	Off Farm worker
6	Mogna	Farmer, rancher	N/A	N/A
7	Jáchal	Farmer, livestock	Housewife, farm worker	Farmer, livestock, housewife
8	Huaco	Public employee, farmer	Housewife	Farmer, domestic service, farm worker
9	Huaco	Retail, farmer, rancher	Teacher, housewife	N/A
10	Mogna	Farmer, off farm worker (seasonal), rancher	Housewife, off farm worker (seasonal)	Off farm workers (seasonal)
11	Mogna	Rancher, farm worker	Housewife	N/A
12	Huaco	Rancher, farmer, retail	Housewife, retail	Farm helpers
13	Huaco	Public employee, farmer	Housewife	Paid family aide
14	Mogna	Farmer, housekeeper	N/A	Casual work
15	Mogna	Farmer	Housewife, weaver	Off farm and construction workers
16	Jáchal	Housewife, livestock, weaver, retiree	N/A	Off farm worker, livestock
17	Jáchal	Farmer, off farm worker	Housewife, farm worker	Farmers, off farm and construction workers, retiree
18	Huaco	Public employee, farmer	Housewife	Farm worker
19	Jáchal	Farmer, off farm worker	Housewife	Construction worker
20	Huaco	Public employee, farmer	Teacher	N/A
21	Jáchal	Disable (formerly construction worker)	Farmer, housewife	Domestic service, off-farm farmer, construction, casual work

Source: Compiled from the Interviews in the Department of Jáchal, 2001.

In the list, three non-farm occupations for wives appeared: teaching, domestic services and weaving. While the first two are classical female occupations, I would like to comment further about the third one, which I was not expecting to find because Jáchal is not a tourism area with a market for traditional crafts.

Two wives in Mogna (Elena and Cristina) and the only female household head (Nora in Jáchal Central) declared weaving as part of the household income sources, although they did not specify how much the household depended on it. These women were about 60 years old and had learned the trade from their mothers. The typical products were blankets. In turn, one of the household heads, Mario from Huaco, talked about selling part of their wool to weavers in the area. These comments, anecdotal as they are, are suggesting the possibility of a different local market for sheep products.

SUMMARY AND CONCLUSIONS

> I have done whatever I have to do, I have never neglected my family.
> *(Guillermo, Mogna)*

This chapter presented an overview of the livelihoods of small farmers' households through a review of their household's socio-demographic characteristics, their asset or resource portfolios, and the livelihood strategies they used for mobilizing or realizing those resources in order to achieve and maintain a certain standard of living.

The analysis and interpretation of the interviews show that the households of Jáchal display a multiplicity of livelihood strategies to make ends meet in a difficult environment. However, the success of these strategies in keeping or improving standards of living, diversifying sources of income and minimizing risk seem relative, since they are tied to an uncertain agricultural activity, public employment and small retail, in the middle of a generalized national, provincial and departmental economic crisis.

Because these are farm households, it was reasonable to expect that land and water, on one side, and the household's labor force, on the other, would be the most valuable assets. However, due to the production and market problems of the crops, mainly onions, it appears that labor is more valuable than land, at least for some of the respondents. For small farmers, agriculture may be the main activity, but in terms of income it is not the most dependable, rather it is frequently not profitable, while off-farm employment was or used to be more reliable.

The number of persons the household could place in the labor market used to make a difference in terms of well-being, depending on their qualifications. However, the realization of this advantage, the capacity to mobilize this labor force if and when needed, depends on the household's life cycle stage and the individual human capital of each member as well as on the local opportunity structure. Given the high unemployment rate in Argentina in general (about 20% in October 2001) and in the department in particular (about 30% for rural areas), in some of the households the extra adult members were a burden and not an advantage.[149] This situation particularly affected young adult children. However, in other cases, older parents without retirement income became dependent on their children's help.

According to the respondents, key informants and the unemployment figures, getting a job outside the farm or to make the farm profitable was a difficult task in Jáchal. The "opportunity" structure of the department, the demand for workers, does not match the labor force supply because the labor market in the area is very small and its diversification is low. Underemployment and unemployment were constantly

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[149] For the detailed analysis of the labor market situation in the department see Chapter 3.

present in the interviews, a constant threat undermining the efficacy of those strategies heavily based on off-farm and non-farm employment or jobs.

> Now it is uncommon… it is not like before… Now, maybe you work a week and the next you don't, you work a day or two, finish the loading of the truck, and you are done. [Things] have changed a lot, now is not like in the old days, when you entered [to work on] an onion field and you worked 15, 20 days, steady. Now no, the cebolleros [larger onion buyers]… maybe they come, and buy, and pack and stack on one Saturday one thousand sacks, and then they come back next week. And you have to have 15 or 20 chinos [farm workers] to do the job in two days, and the rest of the week there is nothing to do! There are not jobs, at least in the farms… And those [construction] jobs in the neighborhoods… over there in San Isidro… they are laying off almost everyone, and the municipal jobs also […] There is no job for anyone… And the sad thing is… you might maybe hire someone… but the products have no value whatsoever, so you need to do all by yourself.
> *(Leoncio, Jáchal Central)*

Another consideration is the precariousness of these strategies in the long term, particularly in relation to retirement funds. Only those households and spouses in formal non-farm employment, which is to say the public sector, would probably have access to retirement, which raise the question of elderly small farmers' well-being in the department. Older respondents worried about this. In the absence of substantial savings, one of the few available solutions was children taking care of their parents, sometimes also of their uncles and aunts (their parents' siblings), which may imply migration at older ages.

It is necessary to emphasize that the financial situation of most of the households seemed quite precarious in 2001. I got the impression that in some cases they had reached the limits of their ability to cope with and adapt to the very bad times of the Argentine economy. This may have affected, for example, the rationale of spatial mobility as a household strategy. An indication of this is the number of grown unemployed children who would have migrated to look for employment elsewhere in other times, but who were at home in 2001 probably because of the lack of opportunities in the typical destinations. It is necessary to consider this national economic context, particularly in terms of rising unemployment and economic stagnation, when interpreting the interviews and the role of migration among household strategies. While the classical setting for migration is apparent in terms of the push-factors, the pull-factors seem to be absent. As one of the household heads (with two daughters living in San Juan) explained to me:

> Last year [2000] we were thinking, talking to the boys and to her [his wife], we were thinking of leaving Mogna. There were better perspectives. But today, I think that the city is suffering as much as we are, so it is not worthwhile to move. We have to remain here, struggling, to wait to see what happens… Because if we move, for example to Albardón, we are going to have to sell everything or to abandon all the livestock […] And if we do not do well there, there are no jobs […] I think that life would be worse. *(Farmer, Mogna)*

The diversity of strategies, the reliance of the households on non-farm jobs, the underutilization of land and the chronic problems associated with farming may also indicate that the relevance or influence of land degradation and incipient desertification on livelihood decisions would be relatively low. In this sense, those households that depend more on a combination of farming or ranching and local off-farm jobs would be the most exposed.

Chapter 8. Conclusions

> Simply, there may be other more pressing perceived causes and diagnoses to a decline in living standards than environmental degradation. (Blaikie 1994:75)

SUMMARY OF FINDINGS

Blaikie's phrase seems appropriate for understanding the picture that emerges from the synthesis of the results. In effect, the findings of this research indicate that, once again, the implications of desertification for human populations are difficult to disentangle. While the links between migration and desertification remain elusive, land degradation seems to play a limited role in population mobility.

The elements were there. In the case of small farm households struggling to make a living in arid lands --which were assumed to be more at risk that other population groups-- permanent and temporary labor migration has consistently been part of their livelihood strategies, and they have repeatedly been exposed to different types of environmental hardship. However, this hardship seems to have had a modest influence in households' decisions to resort to migration.

From the findings in Chapter 4, it is clear that population mobility in the department is an old and well-established process. It has been in place at least since the end of the 19th century and probably started when people settled in the department in the mid 18th century. The family migration histories indicated that the migration experience was present, to some extent, in all the interviewed households.

Permanent migration has had important consequences for the evolution of population growth in Jáchal. Migration has probably offset what could have been a high population growth (given fertility figures), removing the “excess” population as people had to leave the department in order to make a living, in or out of agriculture. Jáchal has never shown high population growth. On the contrary, its rates of population growth have generally been negative. This slow population growth and the relatively small population of the department diverge from the traditional picture of land degradation in rural areas, where population growth is assumed to be the leading force behind land degradation and the consequent out-migration.

At the same time, internal population mobility in the department changed the spatial distribution of the population, and settlement is now more concentrated than it was in the past. Areas close to San José de Jáchal have increased their population density, while land use is changing from agriculture or ranching to residential. This local version of “urban encroachment” may be a source of future degradation problems.

When reasons for moving were analyzed, environmental hardship was hardly mentioned except in situations of drought or flooding. This may suggest that the relationship may appear more transparent if the intensity of environmental problems increases, or if they streak violently and suddenly. But even in some of these (few) cases, environmental reasons were generally intertwined with economic ones, and in this sense environmental migrants were also economic migrants.

The outline of the environmental characteristics of Jáchal, presented in Chapter 5, showed that its dynamics are defined by aridity, which represents at the same time the main characteristic, the main environmental constraint and the main hazard of the department of Jáchal. The effects of aridity are exacerbated by the particular forms of access, use and management of natural resources. Irrigated farming and ranching have profoundly modified the natural landscape. Seemingly, these forms of management, and particularly irrigation, have led to a number of environmental problems, among them salinization, waterlogging, deforestation and soil infestation, whose incidence present marked spatial and temporal variations in their occurrence. These variations became evident in the differences across interview sites. It is necessary to highlight the mediating role of the irrigation system and the provincial Department of Water Resources as mediators in the access to and distribution of water.

The duration of the population-environment relationship in Jáchal introduces further considerations. The department has a long history of settlement that goes back to the mid 18th century, which makes it very difficult to know what the original state of the environment was, and to compare it with current conditions. However, it is possible to assume that the livestock trade cycle, the railroad, population growth and the expansion of intensive agriculture modified whatever original environmental processes were in place. It is possible that the starting point for the evaluation of environmental change and land degradation was already a degraded landscape.

The environmental hardships outlined in Chapter 6 that were mentioned by the respondents were diverse and clearly linked to the specific location. Respondents differentiated between those incidents and processes affecting farming and ranching, and those affecting everyday life. To this respect, it is necessary to remember that the perception, evaluation and response to environmental hardships are related to livelihood security. If land degradation is not considered as a serious threat to established livelihoods, responses to it –no matter what type of response they were--will probably be weak or even absent.

The fact that only the oldest group of respondents mentioned environment-related motivations for migrating suggest that something has change in the perception of environmental hardship over time. This change may be due to technological development or other factors that provide protection from the effects of natural events. Also, it is possible that people were now less engaged in farming and consequently less exposed to climatic events, or that living conditions had improved and as a consequence people were less exposed to environmental hardship, for example because they live in better dwellings and have better access to public services. Jáchal has endured a number of changes along its history, and along them its economy became more diversified (if not more successful). With a twist toward services, commerce and public employment, the population as a whole distanced themselves from the dependence on natural resources, and became less vulnerable to their inherent variability and more resilient to extraordinary events.

The analysis of livelihoods carried out in Chapter 7 helps to clarify the picture. The diversification of livelihood strategies, the reliance of the households on non-farm jobs, the underutilization of land and the chronic problems associated with farming lead to the conclusion that the relevance or influence of land degradation and incipient desertification in livelihood decisions appeared relatively low, even though both processes have co-existed in the department for a long time.

However, some groups within the community could be in a different situation. Those households that are more dependent on farming/ranching, local off-farm jobs or a combination of both may be also more vulnerable to land degradation and other environmental factors. In this case, those factors could trigger population movements in two dfferent but not mutually exclusive ways: a) by lowering labor demand in agriculture in a scenario of scarcity of local non-farm jobs, and b) by interfering with the normal development of agricultural enterprises, making it non profitable for the families involved. The structure and composition of the local labor market act as intervening factors.

The households of Jáchal display a multiplicity of livelihood strategies to make ends meet in a difficult environment, among them labor-related migration. However, the success of these strategies in keeping or improving standards of living, diversifying sources of income and minimizing risk is relative, since they are tied to an uncertain agricultural activity, public employment and small retail, in the middle of a generalized national, provincial and department economic crisis. In this context, the slow processes of land degradation and incipient desertification are just something more to deal with, not particularly relevant if the household's main source of income is elsewhere.

The evaluation of land deterioration may be influenced by the relative values of the assets. Because these were farm households, it was reasonable to expect that land and water, on the one side, and the household's labor force, on the other, would be the most valuable assets. Yet, due to the persistent production and market problems of agriculture in general and of onions in particular, the labor force appears to be more valuable than land. For small farmers, agriculture may be the main activity, but in terms of income it is not the most dependable. On the contrary, it is frequently unprofitable, while off-farm employment is or was more reliable. The renewed importance of subsistence farming (chacra) as a result of the profound economic crisis in Argentina may give new significance to degradation processes. However, given that chacra typically occupies marginal lands and very small plots, this is not very likely until the severity of the problems substantially increases.

Paradoxically, new initiatives based on a more sophisticated agriculture could lead to new opportunities but also to a new awareness of environmental problems, to the extent that they require increased water consumption and greater acreage. In that scenario, the safeguard or buffer that is land underutilization will be gone.

The crisis, however, is also devaluing households' labor assets. Given the high unemployment rate in Argentina in general (about 20% in October 2001) and in the department in particular (about 30% for rural areas), in some of the households the extra adult members were a burden and not an advantage. According to the respondents, key informants and unemployment figures, getting a job outside the farm or to make the farm profitable was a difficult task in Jáchal. The "opportunity" structure of the department, the demand for workers, does not match the labor supply because the labor market in the area is very small and its diversification is low. Underemployment and unemployment were constantly present in the interviews, a constant threat undermining the efficacy of those strategies heavily based in off-farm and non-farm employment or jobs. Although this situation particularly affected young adults, there were also cases of older parents without retirement income who became dependent on their children's help, which introduces the issue of the precariousness of these strategies in the long term, particularly in relation to retirement funds.

Overall, the financial situation of most of the households seemed quite precarious in 2001. It is necessary to consider this national economic context, particularly in terms of rising unemployment and economic stagnation, when interpreting the interviews and the role of migration among household strategies. This deteriorating context may have affected the rationale of spatial mobility, particularly permanent migration, as a household strategy, as living conditions and opportunities in traditional destinations were not substantially better that those in

Jáchal. While the classical setting for migration is apparent in terms of the push-factors, the pull-factors seem to be absent. More research is required about this point.

POLICY IMPLICATIONS

One of the purposes of this research has been that its findings may lead to a better understanding of the interactions between population and environment dynamics works in desertification processes. This understanding could eventually contribute to the formulation of public policies oriented toward long-term social sustainability (including in this term the demographic, economic and environmental sides) in the drylands of Argentina.

Social sustainability addresses social structures and living conditions of human populations as the central issues in achieving the goal of sustainable development. Concomitantly, it also acknowledges the key role of social actors, capital, organizations and institutions in that process. In my opinion, the results of this research indicate that policies addressing issues of social sustainability in Jáchal should concentrate in at least three basic items: access to assets or resources, expansion of opportunities, and empowerment of the actors.

Improvement of access to resources includes not only natural resources (land but specially water, since this is the most conflictive natural resource because of its scarcity), but also to improve access to information about markets that could lead to better decisions about marketing, to credits for agriculture or other economic activities, and to infrastructure in irrigation and communications.

The expansion of opportunities refers to policies that support effective diversity in livelihoods, particularly at a time when a drastic reduction of public employment in the provinces is likely in a near future.

Finally, empowerment refers to those policies that point to increase small farmers' control of the situations in which they are inserted. Within this broad field, I am including education and training (human capital), and farmer's organizations (social capital).

PATHS FOR FUTURE RESEARCH

The agenda for future research includes two main broad topics. One of them has to do with changing the scale of analysis, going from the local to the regional level (the entire West Central Region), using departments as the unit of information and analysis. The main challenge of this line will be to incorporate regional longitudinal environmental data, particularly that related to land degradation. I am also interested in exploring more thoroughly other possible social implications of desertification in addition to migration, for example the living conditions of the people who do not migrate.

I also plan to continue the investigation at the local level. To pursue this line of research, I would like to return to the field, extending the local area to include not only Jáchal but also locations in other provinces of the AWCR. One of the objectives is to follow up the exploration of motivations and reasons for leaving and staying in a particular place, specifically those where environmental hardship may be high and social sustainability may be lower.

My intentions are to keep the remote sensing and interview modules, but to add other components. On the qualitative side, I am considering adding focus groups to the in-depth interviews. The limited interaction I had with two groups during fieldwork proved enlightening about community thinking and attitudes about, for example, exposure to environmental hazards or out-migration.

On the quantitative side, I intend to design a systematic internal migration survey, based on the results of the interviews. In relation with this, changes in migration trends and population distribution patterns at the local level may be related to variations in land use, particularly the shift from rural to urban type of uses. In arid areas, not only could these changes trigger new degradation processes or accelerate the existing ones, but the urban growth of arid areas --although modest if compared with other areas-- could quickly exceed the carrying capacity, particularly in terms of competing water uses (domestic, industrial, irrigation), or wood consumption for heating and cooking.

Appendix A. Remote Sensing Data and Techniques

I explored the evolution of environmental conditions and dynamics in the department of Jáchal, Argentina, using cross-sectional remote sensing data for 1973, 1987 and 2001, specifically three LANDSAT summer (January) images that agree approximately with the area of the department of Jáchal. Summer was selected because it is the growing season --for natural vegetation and crops-- the rainy season, and also the time of the year when the Jáchal River carries more water. Because of the extreme aridity of the region, cloudiness was not an issue.

The first image is a MSS LANDSAT 1 image from January 27th 1973 (path 249, row 081). The other two are TM LANDSAT 5 images from January 8th 1987, and January 30th 2001 (path 232, row 081). The images were acquired from the USGS (US Geological Survey) and from the CONAE (Argentina National Commission for Spatial Activities), and included systematic correction in origin.[150] The temporal distance among images (14 years) was determined by the purpose of going back in time as far as possible, and, after that first time was chosen, by the availability of images of the area of interest.

In addition to remote sensing images, ancillary data –aerial photographs, topographic maps, photographs and other documentation—was used in the attribution of categories, and in the analysis and interpretation of the results.[151]

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[150] Part of the preprocessing that is necessary before actually analyzing the image, systematic correction fixes radiometric and geometric errors, two of the most common errors in remote sensing imaginary (Jensen 1996:107)

[151] The aerial photos were acquired from the CEFOCCA (Center for Photogrametry, Cartography and Cadastre, National University of San Juan), and they correspond to two series --1980 and 1988-- of the area of Mogna, in scale 1:10,000 and 1:50,000. The topographic maps of the Department of Jáchal were acquired from the IGM (Military Geographic Institute), and they include seven charts at scale 1:100,000 for 1983 and 1991, and two charts scale 1:250,000 for 1991.

PREPROCESSING

The three images were first corrected to match the same projection, UTM Zone 19 South. Then, an image-to-image rectification was performed in the MSS1973 and the TM2001, using the TM1987 image as the reference.[152] The number of ground control points was 12 in each case, using a first order polynomial model and bilinear interpolation.[153] The RMSE (root mean square error) was 0.6472 of pixel for the MSS1973 image, and 0.5661 of pixel for the TM2001 one. After this, a subset of the image, which matches more closely the political limits of the department, was extracted from each image. Finally, the three images were resampled to a 30 meters pixel size, the standard pixel size of TM images (MSS images standard pixel size is 80 meters).

PROCESSING

Vegetation Indices and the Tasseled Cap Transformation

Vegetation indices have been defined as "…dimensionless, radiometric measures that function as indicators of the relative abundance and activity of green vegetation…" (Jensen 2000:361). Considered as a particular class of image or spectral enhancement, they are used to highlight vegetation characteristics in the image, based on the differences in reflectance that vegetation shows in visible and near infrared portions of the spectrum. Most of them employ some kind of band ratioing. According to Jensesn (2000:361), vegetations indices should have the following characteristics: 1) maximization of sensitivity to the plant biophysical

[152] ERDAS Image version 8.5 was used for all computing tasks.
[153] There are three methods for resampling the pixels in image-to-image rectification: nearest neighbor, bilinear interpolation and cubic convolution. Bilinear interpolation is more accurate than nearest neighbor and does not alter data values as cubic convolution (ERDAS 1997:335-44)

parameters; 2) normalization of external effects, making spatial and temporal comparisons possible; 3) normalization of internal effects, and 4) linkage to some measurable biophysical parameter for validation and quality control purposes. (Jensen 2000:361). However, few of the more than 20 vegetation indices meet these criteria.

In studies of desertification, the United Nations (1996) recommends the use of satellite derived vegetation indices, specifically NDVI (normalized difference vegetation index), as general indicators of the state of the environment in drylands. This rationale is based on considering plant cover as the key element in addressing desertification. Plant cover could be an indicator of vulnerability to soil degradation, but also certain types of vegetation cover may indicate that soil degradation is taking place (Middleton and Thomas 1997:51). Vegetation indices are used to measure the evolution of vegetation activity as consequence of meteorological and ecological conditions, and human activities in the drylands (United Nations Sustainable Development 1999: Chapter 12).[154]

For this study, the selection of the tasseled cap among other vegetation indices was determined by two reasons. First, the data were not atmospheric corrected, which prevented for the use most of the vegetation indices. Second, the images are from different sensors, MSS and TM, which have different bandwidths for the red and infrared parts of the spectrum, and different resolution (Jensen 2000).

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[154] Despite United Nations' recommendations, there are some caveats in its use of vegetation cover as indicator of desertification. The relationships between desertification, land degradation and vegetation are complex, and far to be completely understood (Middleton and Thomas 1997:50). Vegetation communities in drylands are not naturally stable, and it is difficult to differentiate between changes due to droughts that are part of natural cycles, and changes due to degrading human activities. Regarding vegetation indices, there are some precautions to take in account, among them the requirement for data calibration, the need for ground data to refine the correlation between NDVI and biomass, and problems associate to very low vegetation cover and soil background (Ray and Murray 1996; Bannari et al. 1995).

It has been argued that the use of data from different sensors that have different bandwidth and spatial resolution is problematic (Teillet et al. 1997), and NDVI in particular has been said to be sensitive to these characteristics.

The Kauth-Thomas or Tasseled Cap transformation was developed in 1976 for MSS data. It is an orthogonal transformation of the MSS data space into a new feature space defined by four axes: soil brightness index (B), greenness index (G), yellow stuff index (Y) and non-such (sic) index (N). The transformation is achieved by multiplying each band by a set of coefficients, which are sensor-specific. As a whole, the two first indices, brightness and greenness, include most of the information in the image (95% to 98%). A new set of coefficients of the Tasseled Cap was developed for the LANDSAT TM data. In addition to brightness and greenness, a new index was included, wetness, derived from the TM middle infrared bands 5 and 7, which was found to be sensitive to plant and soil moisture (Jensen 1996, 2000; Crist and Cicone 1984; Kauth and Thomas 1976). It could be considered as a variation of the perpendicular vegetation index, which uses the perpendicular distance to the soil line as indicator of plant development (Ray 1994).

In theory, the TC transformation may be use anywhere in the world to disaggregate the amount of soil brightness, vegetation and moisture content in MSS or TM pixels, although in practice it would be more adequate to compute the coefficients according to local conditions. This transformation has been extensively tested and used for agricultural research (Jensen 1996, 2000; Crist and Cicone 1984; Tso and Mather 2001). Its main advantages are that it reduces the feature space, making classification less complicated, and that the new axes are related to specific concepts. It is essentially comparable between MSS and TM images, particularly in the first two indices, soil brightness and greenness (Crist and Cicone 1984). The main disadvantages are related to the specification of the coefficients to be site-specific, and the omission of potentially important information due to the reduction of the six TM bands to the three tasseled cap axes (Tso and Mather 2001).

Classification and Change Detection

The next step was to run an unsupervised classification of the tasseled cap transformation images, using the ISODATA (iterative self organizing data analysis technique) algorithm (ERDAS 1997; Jensen 1996; Tso and Mather 2001). This procedure is essentially a clustering of the data in the number of clusters specified by the user. The original 20 cluster or classes were then recoded in five classes, according to the relevant elements: bright vegetation (BV), other vegetation (OV), bare soils (BS), bright bare soils (BBS), and residual, R.

It has not been possible to make the accuracy assessment for the unsupervised classification, for several reasons. One of them is the lack of timely ground data. Other, the ancillary sources do not match the images date of acquisition. However, ancillary data were used as the general reference for the attribution of the classes, coupled with the author's knowledge of the area.

In order to detect changes over time, two procedures were performed. The first one was image algebra change detection through image differentiation (Jensen 1996). The greenness index images were subtracted in pairs, 1987 from 1973, 1987 from 2001, and 1973 from 2001. Two new change images for each date resulted from this procedure, one of them continuous, and the other thematic. This last grouped changes in five classes (decreased, some decrease, unchanged, some increase, and decreased). Pixels where the difference in the greenness index between dates was equal to or higher than 20% were classified within the increased or decreased or decreased categories.

The second procedure was a post-classification comparison change detection, to obtain from-to class information (Jensen 1996). The recoded classified images for 1973 and 2001 were contrasted pixel by pixel using a 5 x 5 change detection matrix. The result was a change image map with 25 classes, one for each combination of classes.

The 25 classes or categories of the change detection matrix were recoded to nine categories to make the map easier to read. This recodification was framed around the vegetation categories (BV bright vegetation and OV other vegetation). Newly vegetated areas correspond to places that changed from non-vegetation categories (rock, bares soils, bright bare soils) to vegetation categories (bright or other vegetation). Areas where loss of vegetation may be presumed are those that changed from vegetation categories to non-vegetation categories.

Appendix B: The Fieldwork Experience in Jáchal

My fieldwork in Argentina extended from July to November of 2001, and was divided in three parts. The first and second ones included extended bibliographic research in the cities of Buenos Aires and San Juan. The third one corresponded to the interviews in Jáchal. This was my first 'real' fieldwork experience, in the sense that I planned and conduct it.

I arrived to Jáchal in August of 2001. My husband and I rented a house and lived there until the end of October. I decided to live there all the time, instead of commuting from San Juan (a 2.5 hours drive) every week, to have the opportunity of knowing haw life was in a small rural city, beyond what the respondents told me, but also for people to get use to see me around. Taken in account that Jáchal is quite a traditional place, including the assumptions about women's roles, my husband presence was an asset during out stay in the department (in addition of doing all the driving and giving me lots of support). It is worthwhile to mention that our presence was quickly noticed. I still remember my amazement when one of the key informants asked me if we were driving a gray car, which of course we were. Someone else had told him that.

Since I am Argentine, I had no problems in terms of language. However, as a "porteña" –someone born in the City of Buenos Aires— there was the typical distrust that results from the opposition between the Capital and the rest of the country. However, Jachalleros (people born in Jáchal) are in general more suspicious of Sanjuaninos (people born in San Juan, capital of the province). Also, Jachalleros have a reputation of not being very friendly with strangers in the beginning. This was obvious to me the first days, but after that we were "accepted". A key element in this was the work of my main facilitator, Claudia, a high school teacher in Jáchal, who showed me around and introduced me to a number of people.

Households were approached differently in each site (Jáchal Central, Huaco, and Mogna). In Jáchal Central, I contacted technicians working in the PSA (Social Agricultural Program), which in turn, they put me in contact with households belonging to the PSA groups. In certain occasions, I also worked together with another researcher in fieldwork, who has previous experience in the area and with the PSA program.

In Huaco, the approach was different. Through one of my facilitators in Jáchal, I contacted the principal of one of the high schools in the Village, whose teachers and students had previous experience in local surveys. After visiting the school, one of the teachers agreed to supervised three senior students in contacting households for my interviews. The teacher fell ill before the end of the fieldwork, so I was left in charge of the supervision and the interviews. Fortunately, everything worked out fine in the end.

Finally, in Mogna, the facilitator was one of the municipality's employees, which I contacted by chance visiting the village (she is also the owner of the only general store there), when I was in fact looking for the principal of the primary school. I visited Mogna once a week during September and October. Since it was a long drive from Jáchal (around 200 km), we spent the day there. Mogna was the most fascinating experience of fieldwork.

I tried harder to make appointments before the interviews, not to show up unannounced, and I was successful in almost all the cases. In general, all the households gave me a warm welcome. Sometimes the interview was inside the house, especially during the cold days of winter, and other times it was outside, in the 'galería' that even the poorest houses had. Occasionally, we could share 'mate' and homemade bread.

One of the things that worried me after the first interviews was the possibility that people may think that I had some relationship with government offices. To avoid this, I tried to be very clear, at the beginning of the interview, about my objectives and the type of work I was doing in Jáchal, and gave each head of household a copy of the cover letter or letter of introduction.

Although I was not always able to control what the facilitators was telling to future respondents, problems or misunderstandings were minimal. For example, it was common for people in Mogna to ask me for help to get some job for their grown children. In each case, I had to explain to the family that it was impossible for me to do that, since I have no contacts whatsoever with possible employers or public employment sources.

I have to say that, overall and in my opinion, I had a better rapport with female respondents. While in some of the interviews I was alone, in others one of the male key informants or facilitators, or my husband, were present. In these cases, it was common for them to talk with the husband while the wife and I listened or commented other topics. It was not possible to interview each of the members of the couple separately in most of the interviews. I think that in some cases it was due to control issues, as the husband wanted to know what the wives were saying, and vice versa. In other cases, wives were not willing to talk alone.

COVER LETTER

Proyecto de Doctorado: Población vulnerable en tierras frágiles: migración y desertificación en zonas áridas de Argentina. El caso de los pequeños productores de Jáchal (San Juan)

Ud. esta cordialmente invitado a participar en este estudio sobre las relaciones entre migración y degradación del suelo en Jáchal (San Juan, Argentina). Mi nombre es Susana Adamo, y soy estudiante del doctorado en sociología (especialidad demografía) en la Universidad de Texas en Austin (EE.UU). Yo utilizare estas entrevistas en mi proyecto de tesis de doctorado. A través de este proyecto, yo espero conocer mas sobre los problemas ambientales en el área, y sobre los mecanismos que ligan condiciones de vida en deterioro de las poblaciones humanas con degradación de la tierra, en procesos de desertificación. Además, estoy interesada en el rol que juegan diferentes tipos de movilidad poblacional – emigración, migración estacional, migración temporal, migración de retorno- en esta relación.

Mis planes son entrevistar alrededor de 30 familias de productores. Al ser un pequeño productor de Jáchal, Ud. fue seleccionado en forma aleatoria para contestar esta serie de preguntas sobre las estrategias familiares para enfrentar condiciones de vida en deterioro, incluyendo degradación del suelo o del ambiente en general. Si Ud. y su esposa/o deciden participar, les preguntare sobre historias migratorias, composición familiar, condiciones de vida, economía del hogar, manejo de la finca, ubicación de la finca, y condiciones ambientales. Esta entrevista no debería ocupar mas de dos horas de su tiempo.

Durante la entrevista, no preguntare ni grabare los nombres de ningún miembro de su familia. Ud. no esta expuesto a riesgo alguno al contestar a estas preguntas. Estas entrevistas son confidenciales. Si Ud. y su esposa/o deciden participar, contestaran las misma preguntas, pero en la medida de lo posible serán entrevistados separadamente, de modo que las respuestas de uno no influencien las respuestas del otro. Todas las respuestas serán confidenciales, estarán guardadas en un lugar seguro, donde el acceso a las mismas estará limitado a mi persona.

Sus respuestas son importantes porque pueden ayudar a entender como las familias de productores se enfrentan a la degradación ambiental, y el rol de la migración en las estrategias que elaboran. Por supuesto, Ud. no tiene obligación alguna de participar. Incluso si Ud. decide participar, puede retirarse en cualquier momento, o rehusar contestar cualquier pregunta. Si Ud. desea participar pero prefiere realizar la entrevista en otro momento, o en dos sesiones, yo regresaría para continuar la entrevista en el momento que le resulte mas conveniente.

Por favor, no dude en preguntar sobre cualquier punto que no este claro. Si Ud. tiene otras preguntas más adelante, puede contactarme en el (1)(512) 471-8347. Mis directores de tesis de doctorado son los Profesores Bryan Roberts, Ph.D., y Myron Gutmann, Ph.D. Pueden ser contactados en el (1)(512)471-4886.

Si Ud. lo desea, le puedo entregar una copia de esta carta.

INTERVIEW GUIDE AND ANNEXES

A) Caracteristicas demograficas de la familia u hogar

1- *Quiénes viven en esta casa?* Las preguntas en esta sección se harán al jefe/a de familia. La hoja de la encuesta demográfica se usará como guía para recabar el resto de la información demográfica.

2- *Algunas de las personas que Ud. acaba de mencionar se encuentra ausente en este momento?* La hoja de la encuesta demográfica se usará como guía para el resto de las preguntas sobre migración.

3- *Hay algún miembro del hogar que esté ausente en este momento y que no haya sido mencionado?* La hoja de la encuesta demográfica se usará como guía para el resto de las preguntas.

B) Historia migratoria de la familia

1- *Ahora me gustaría preguntarle sobre su historia migratoria y la de sus padres y hermanos y hermanas. Me refiero a lugar de nacimiento, lugares donde vivieron antes de aquí, etc., además de ausencias temporales, por cualquier razón.* Esta pregunta se hará a ambos miembros de la pareja jefa del hogar. Además de grabar la respuesta, se usará una planilla para ir siguiendo la respuesta y estar seguro que no se pierde información relevante, en particular sobre el calendario de eventos migratorios. Es importante preguntar específicamente porqué razón/motivo la persona/familia se mudó.

2- *Dónde viven sus hijos ahora?* Se usará el mismo procedimiento que en la pregunta anterior.

C) Ingresos / activos / situación socioeconómica de la familia

1- Cómo mantiene esta casa? Me gustaría saber sobre las fuentes de ingreso de la familia. Objetivo: conocer las fuentes de ingreso de la familia, la participación relativa de los ingresos provenientes de la finca, el aporte de los diferentes miembros, así como posibles problemas. Sería conveniente preguntarle a cada miembro de la pareja jefa del hogar por separado.

2- Características de la vivienda, incluyendo tenencia, y elementos de confort.

D) Información relativa a la finca o unidad productiva

1- *Me gustaría saber un poco más sobre la historia de esta finca. Hace mucho que Ud. y su familia la trabajan?* Objetivo: conocer elementos de la estructura agraria, como tenencia, duración de la ocupación, tamaño de la unidad, uso de la tierra, productos, destino de la producción, fuerza de trabajo empleada, así como la evolución de estos elementos en el tiempo. Poner atención al marco temporal. Esta sección debe ser contestada por la persona a cargo de la explotación, dejando constancia de su relación con el jefe del hogar.

2- *Ha tenido problemas con la finca? Me podría comentar sobre ellos?* Objetivo: esta es una pregunta amplia que busca recabar información sobre aspectos productivos, de calidad del suelo, de disponibilidad de mano de obra, de comercialización, etc. Otra vez, poner atención al marco temporal.

3- *Ha tenido problemas con el agua? Me podría comentar sobre ellos?* Objetivo: esta es una pregunta amplia, que busca recabar información sobre temas relacionados con el agua como recurso natural y productivo, por ejemplo calidad y cantidad, acceso, derechos, administración, etc. de nuevo, poner atención al marco temporal.

E) Localización de la unidad productiva

1- *Me gustaría conocer la ubicación de la finca. Podríamos ir hasta allá?*

2- *Si no le importa, voy a marcar la ubicación de la finca en el mapa con el uso de este instrumento, GPS, sistema de posicionamiento georreferenciado.* Objetivo: Localización de la finca o unidad productiva. Esta pregunta puede ser contestada por cualquiera de los dos miembros de la pareja, preferentemente aquel que esté más involucrado con la finca o unidad productiva, explicándole al respondente como se usa un GPS. La idea es tomar cuatro mediciones, en lo posible en los cuatro extremos de la unidad. Si esto no es posible, se tomaría una sola medición, en la puerta de la residencia, si la hubiera, o en la entrada al predio. Este módulo puede ser parcialmente reemplazado con el uso de mapas catastrales donde el respondente localice su propiedad.

3- *Cuál es el tamaño de esta finca o propiedad? Desde dónde hasta dónde se extiende?* Además de obtener (otra vez) el número de hectáreas, la idea es preguntar por elementos del paisaje que sean relevantes para el respondente (ríos, canales, arboles, edificios, etc.)

ENCUESTA DEMOGRÁFICA – JÁCHAL 2001 (Demographic Survey)

Cuestionario No.: Fecha:	Nombre del entrevistado:
Relación con el jefe del hogar:	Localidad:
Dirección:	

Resumen:	Total	Hombres	Mujeres
Numero de miembros actualmente en el hogar			
Numero de miembros temporalmente ausentes del hogar			

A. Información demográfica de las personas actualmente en el hogar

Nombre y Apellido de la persona	Relación con el jefe del hogar	Sexo	Edad	Educación	Ocupación		Estado Civil	# hijos
					Principal	Secundaria		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Comentarios: ………
………
………

ENCUESTA DEMOGRÁFICA – JÁCHAL 2001 (CONT.) (Demographic Survey)

Cuestionario No.: Fecha:	Nombre del entrevistado:
Relación con el jefe del hogar:	Localidad:
Dirección:	

B. Información demográfica de las personas temporalmente ausentes del hogar

Nombre	Relación con el jefe del hogar	Sexo	Edad	Educación	Ocupación		Estado Civil	Razones para migrar (1)	Residencia actual	Piensa Ud. que esta persona va a volver?	Ha enviado dinero alguna vez?
					Principal	Secundaria					
1											
2											
3											
4											
5											
6											
7											

Lista de razones para migrar:

Trabajo	Enfermedad
Educación	Muerte de un familiar
Casamiento	Conflictos familiares o de otro tipo
Desastre natural (inundación, plagas, fuego)	Tierras improductivas
Sequía	Otros:

Comentarios: ………
……...

HISTORIA MIGRATORIA DE LA FAMILIA – JÁCHAL 2001 (Family Migration History)

Lugar de nacimiento y residencia actual de los padres, hermanos y hermanas del esposo/a

Relación de parentesco / Nombre	Lugar de nacimiento	Lugar de residencia actual	Fecha de la migración	Edad a la migración	Lugar de destino	Ocupación actual	Estado civil	Razón para migrar
Padre								
Madre								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								
Hermano/a								

Comentarios/Observaciones: ....
....
....
....
....

Appendix C. Code Book Family Tree

- **Migration**
  - Permanent
    - Motivations
    - Mechanisms and Characteristics
  - Temporary
    - Seasonal
      - Motivations
      - Mechanisms and Characteristics
    - No seasonal
      - Motivations
      - Mechanisms and Characteristics
- **Livelihood Strategies**
  - Assets or resources
    - Labor
    - Water and Land
  - Farm related
    - On farm
    - Off farm
  - Non farm related
- **Environmental Hardship**
  - Drought
  - Water scarcity
  - Salinization
  - Waterlogging
  - Soil infestation
  - Other

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